COLLEGE OF PHYSICIANS & SURGEONS OF ALBERTA

Council Meeting Synopsis

CPSA Council Chambers
2700-10020-100 Street, Edmonton

Attendees:

Council Members - Voting:

- Stacey Strilchuk, BA, Chair
- Jaelene Mannerfeldt, MD MSc FRCSC, Vice Chair
- Nicole Cardinal, MD, CCFP, Executive Committee Member-at-Large
- Richard Buckley, MD, FRCS
- Patrick Etokudo, M.Sc, FSCMP
- Daisy Fung, BMSc, MD, CCFP
- Maryana Kravtsenyuk
- Levonne Louie, BSc., BComm, MBA, ICD.D.
- Lyle Oberg, ECA, MD
- Laurie Steinbach, BSW, BEd
- Ian Walker, MD, MA
- Tyler White (May 25)

Council Members – Non-Voting:

- Todd Anderson, MD, FRCP(C), FCAHS, Dean Cumming School of Medicine
- Brenda Hemmelgarn, MD, PhD, Dean FoMD (May 26)
- Gareth Jones
- Michael Taylor MD MSc MBA

Additional Attendees:

- Scott McLeod, MD, CCFP, FCFP, Registrar
- Michael Neth, PEng, Chief of Staff
- Gail Jones, BComm, Senior Executive Assistant
- Sue Welke, MSc, Program Manager, Governance
- Nazrina Umarji, B.Ed, JD, Hearings Director and In-house Legal Counsel
- Jeremy Beach, MBBS, MD, FRCPC, Assistant Registrar
- Michael Caffaro, MD, Assistant Registrar
- Dawn Hartfield, Assistant Registrar, Professional Conduct
- Charl Els, MBChB, FCPsych[SA], MMedPsych(cum laude), Dip.ABAM, MROCC, DESS, ACBOM, FIAIME, Assistant Registrar
- Gordon Giddings, MD MBA FCFP, Assistant Registrar
- Ed Jess, BA, Chief Innovation Officer
- Tracy Simons, CPA, CA, Chief Financial Officer

Guests (Internal):

- Dean Blue, Director, Accreditation
- Melissa Campbell, Senior Advisor, Communications
- Chantelle Dick, BA, Standards of Practice Advisor
- Patrick Litwin, Program Manager, PFT and Sleep Medicine
- Keely McBride, BA, MPH, Manager, Policy
- Tanya Northfield, Program Manager, Physician Practice Improvement Program
- Kennedy Schultz, Coordinator, Communications

Guests (External)

- Pierre Chue MBBCh, FRCPsych, LMCC, FRCPC, DABPN, MSc, CCST, Professor, Faculty of Medicine and Dentistry, Adjunct Academic Colleague, Faculty of Pharmacy & Pharmaceutical Science, University of Alberta (attended virtually)

Regrets:

- Oluseyi Oladele, MD, CCFP, FCFP

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

Council Meeting Synopsis

CPSA Council Chambers
2700-10020-100 Street, Edmonton

Thursday, May 25, 2023, starting at 0800

Note: items in blue font contain links to additional information.

1.0 Call to Order, Introductions, and Check-in for In-Camera Session (Council and Executive Team and others by invitation)

An in-camera session of Council provides an opportunity for Councillors to discuss sensitive matters in confidence. Any decisions made in-camera are shared in the public session.

1.1 Approval of In-Camera agenda and items on In-Camera consent agenda:

- **Minutes-in-camera, February 23 and 24, 2023**

1.2 Chair's opening remarks

- Review of Council Feedback

1.3 CPSA Healthier Albertan Grant

2.0 Call to Order and Introductions – public session

2.1 Traditional Territorial Acknowledgement

At each Council meeting, individuals are invited to share a personalized message to recognize and respect Indigenous Peoples who lived and continue to live on this territory, and for the land to which we are all connected. This type of acknowledgement is part of CPSA's ongoing efforts to develop healthy and reciprocal relations with Alberta's Indigenous communities—a key element of reconciliation, a process we are committed to.

Maryana Kravtsenyuk, elected member of Council, provided the land acknowledgement and noted that doing so is just one step towards reconciliation. She noted her personal responsibility to acknowledge and make visible the plight of Indigenous peoples, particularly regarding healthcare. She recognizes that words are not enough and committed to working towards equity and justice for Indigenous people.

2.2 Conflict of Interest Declaration (Real, Potential or Perceived)

No conflicts related to the matters being discussed on the agenda were declared.

2.3 Approval of agenda and consent agenda items

Consent Agenda matters are proposed for unanimous consent and without debate, however Council members may seek clarification or ask questions. Any Council member may also request that a *consent agenda item be moved to the regular agenda by notifying the Chair **prior** to the meeting. By approving the consent agenda, any individual approvals such as those noted below are considered approved.*

- Minutes, February 23 and 24, 2023, confirmation of approval re: electronic vote, December 30, 2022 , confirmation of approval re: electronic vote, May 10, 2023 (**for approval**)
- Executive Committee Meeting Summary Report (**for information**)
  - Registrar Performance Evaluation 2023 Process (**for approval)**
  - Council Effectiveness Evaluation Policy (**for approval**)
- Finance and Audit Committee Meeting Summary Report (**for information**)
- Governance Committee Meeting Summary Report (**for information**)
  - Council Retreat 2024 (**for approval**)
  - Appointment to Anti-Racism Anti-Discrimination Action Advisory Committee (**for approval**)
- Medical Facility Accreditation Committee Meeting Summary Report (**for information**)
  - Standards for Non-Hospital Surgical Facility Accreditation: General (**for approval**)
- Registration:
  - Currency of Practice (**for information**)
  - Policy – Non-clinical register for limited practice members (**for approval**)
  - Non-accredited approvals (**for information**)

Council approved or received as information the items on the Consent agenda.

3.0 Reports

3.1 Chair's Report

The Chair's report highlighting the Chair's activities since the February Council meeting was received as information.

3.2 Registrar's Report

The Registrar's report was received as information.

4.0 Committee Reports

4.1 Finance and Audit Committee

- Approval of Audited Financial Statements

Council approved the following:

- ***College of Physicians & Surgeons of Alberta financial statements for the***

year ended December 31, 2022

- ***Summary financial statements for College of Physicians & Surgeons for the year ended December 31, 2022***
- ***Pension Fund for Employees of College of Physicians & Surgeons of Alberta financial statements for the year ended December 31, 2022***

4.2 Governance Committee

- Governance Structure and Committees Policy (**for approval**)
- Development of a Competency Matrix and an alternative process to populate Council – next steps (**for approval**)
- Outcome of Executive Election Nomination Process for Council Chair (**for approval**)
- Request to provide Alberta Health and Alberta Health Services with a position on Council.

Council approved the CPSA Committees Policy with an amendment such that the Medical Facility Accreditation Committee as well as the Competence Committee include 2 members of the public.

Council approved the development of a process to consult with the general membership regarding changes to the way in which Council is populated.

And Jaelene Mannerfeldt was confirmed as the unopposed candidate for the position of Chair for a term of one year commencing Jan. 1, 2024.

Council also discussed the request to provide Alberta Health and Alberta Health Services with a position on Council and determined that this would not be required at this time.

4.3 Medical Facility Accreditation Committee

- Psychedelic Assisted Psychotherapy (PAPT) Accreditation Standards

Council approved the new Psychedelic-Assisted Psychotherapy Accreditation Standards.

4.4 Building Fund Initiatives Working Group

- CPSA Healthier Albertan Grant

The decision regarding the CPSA Healthier Albertan Grant was deferred.

4.5 Anti-Racism Anti-Discrimination Action Advisory Committee

The Report from the Anti-Racism Anti-Discrimination Action Advisory Committee was received as information.

4.6 Indigenous Advisory Circle

The Report from the Indigenous Advisory Circle was received as information.

5.0 Registration

5.1 Update - Alberta Sponsorship Model for Practice Readiness Assessments

Council received updated information regarding plans to expand the Alberta Sponsorship Model for Practice Readiness Assessments.

6.0 Annual Report

As required by legislation, CPSA develops an annual report which is presented to government before the end of June. Hard copy versions of the report as well as an enhanced digital version will be shared before the end of June. Keep an eye on the CPSA website for further information.

7.0 Standards

7.1 Approving Standards for Consultation

Council approved a modification to the CPSA Standard of Practice Consultation Process. The new process enables the Registrar to approve standards for consultation resulting in a more nimble process to update or create standards.

The following standards were approved for formal consultation:

- ***Establishing the Physician-Patient Relationship***
- ***Responsibility for a Medical Practice***
- ***Terminating the Physician-Patient Relationship***
- ***Restricted Activities***

Further details about the Consultation will be available on the CPSA website.

8.0 In-Camera (Council and Executive Team Members, others by invitation)

An in-camera session of Council provides an opportunity for Councillors to discuss sensitive matters in confidence. Any decisions made in-camera are shared in the public session.

8.1 Council Education

- **Presentation from Federation of State Medical Boards – Diversity, Equity and Inclusion**

9.0 Adjournment

Friday, May 26, 2023 starting at 0800

9.0 Call to Order and Introductions – Public Session

9.1 Traditional Territorial Acknowledgement

At each Council meeting, individuals are invited to share a personalized message to recognize and respect Indigenous Peoples who lived and continue to live on this territory, and for the land to which we are all connected. This type of acknowledgement is part of CPSA's ongoing efforts to develop healthy and reciprocal relations with Alberta's Indigenous communities—a key element of reconciliation, a process we are committed to.

Gail Jones, Senior Executive Assistant and Council support team member provided the Acknowledgement on the second day of meetings. In addition to acknowledging that CPSA offices are on Treaty Six Territory, she also reflected on her learnings around Truth and Reconciliation over the past five years and spoke of her commitment to continue to listen and learn as she moves into retirement.

10.0 Strategic Plan – follow up from February meeting.

Council approved the approach as presented that will be used for reporting on the 2024 Key Performance Indicators (KPI) and targets.

11.0 Department Presentation – Continuing Competence

- Physician Practice Improvement Program

The presentation with further details about the Physician Practice Improvement Program was deferred until September.

12.0 In-Camera (Council and other by invitation of the Chair)

An in-camera session of Council provides an opportunity for Councillors to discuss sensitive matters in confidence. Any decisions made in-camera are shared in the public session.

- Government Relations Presentation by CPSA Government Relations Consultant

13.0 In-Camera (Council and others by invitation)

13.1 Council Roles and Responsibilities - Appeal and Review Panels

13.2 Council and Registrar:

- Registrar Update
- Registrar and CEO Evaluation – Goals and Objectives for 2023

13.3 Council Only

14.0 Adjournment

COLLEGE OF PHYSICIANS & SURGEONS OF ALBERTA

Council Meeting Minutes - Public

CPSA Council Chambers
2700-10020-100 Street, Edmonton

Attendees:

Council Members - Voting:

- Stacey Strilchuk, BA, Chair
- Jaelene Mannerfeldt, MD MSc FRCSC, Vice Chair
- Nicole Cardinal, MD, CCFP, Executive Committee Member-at-Large (attended virtually)
- Richard Buckley, MD, FRCS (attended virtually as able)
- Patrick Etokudo, M.Sc, FSCMP
- Daisy Fung, BMSc, MD, CCFP Levonne Louie, BSc., BComm, MBA, ICD.D. (attended Feb. 23 only)
- Lyle Oberg, ECA, MD
- Oluseyi Oladele, MD, CCFP, FCFP
- Laurie Steinbach, BSW, BEd
- Ian Walker, MD, MA (attended virtually)
- Tyler White (attended virtually on Feb. 23)

Council Members – Non-Voting:

- Todd Anderson
- Gareth Jones
- Michael Taylor MD MSc MBA (attending Feb. 23 only)

Additional Attendees:

- Scott McLeod, MD, CCFP, FCFP, Registrar
- Michael Neth, PEng, Chief of Staff
- Gail Jones, BComm, Senior Executive Assistant (Recording Secretary - Feb. 23)
- Kimberley Murphy, ACEA, Executive Assistant (Recording Secretary – Feb. 24)
- Sue Welke, MSc, Program Manager, Governance
- Nazrina Umarji, B.Ed, JD, Hearings Director and In-house Legal Counsel
- Jeremy Beach, MBBS, MD, FRCPC, Assistant Registrar
- Michael Caffaro, MD, Assistant Registrar
- Charl Els, MBChB, FCPsych[SA], MMedPsych(cum laude), Dip.ABAM, MROCC, DESS, ACBOM, FIAIME, Assistant Registrar (attending virtually)
- Gordon Giddings, MD MBA FCFP, Assistant Registrar
- Ed Jess, BA, Chief Innovation Officer
- Tracy Simons, CPA, CA, Chief Financial Officer

Guests (Internal):

- Rhonda Marrazzo, Project Manager, Continuing Competence
- Phong Van, Director, Continuing Competence
- Chantelle Dick, BA, Standards of Practice Advisory
- Keely McBride, BA, MPH, Program Manager, Policy
- Monica Wickland Weller, MD, Senior Medical Advisor (attending virtually)
- Danielle Michaels, MD, M. Eng, CCFP, Senior Medical Advisor
- Ewan Affleck, CM, MDCM, CCFP, Senior Medical Advisor, (attending virtually)

Regrets:

- Maryana Kravtsenyuk
- Brenda Hemmelgarn, MD, PhD, Dean FoMD
- Dawn Hartfield, Assistant Registrar, Professional Conduct

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

Council Meeting Minutes - Public

CPSA Council Chambers
2700-10020-100 Street, Edmonton

Thursday, February 23, 2023 starting at 0800

1.0 Call to Order, Introductions, and Check-in for In-Camera Session (Council, Registrar, Chief of Staff, Governance Program Manager and Recording Secretary)

Council met in-camera with the Registrar, Assistant Registrars, Hearing Directors, Chief Financial Officer, Chief Innovation Officer and Governance Program Manager.

2.0 Call to Order and Introductions – public session

Stacey Strilchuk, Council Chair, called the public session to order at 0842.

2.1 Traditional Territorial Acknowledgement

At each Council meeting, individuals are invited to share a personalized message to recognize and respect Indigenous Peoples who lived and continue to live on this territory, and for the land to which we are all connected. This type of acknowledgement is part of CPSA's ongoing efforts to develop healthy and reciprocal relations with Alberta's Indigenous communities—a key element of reconciliation, a process we are committed to.

Nicole Cardinal, elected member of Council, provided the land acknowledgement and shared her personal history as a member of the Saddle Lake Cree Nation. Reflecting on a recent report regarding the life expectancy of First Nations people, she shared that the shorter life expectancy is related to the impacts of residential schools, colonialism and trauma. To combat these impacts, she is an advocate for the calls to action from the Truth and Reconciliation Commission and encouraged everyone to read these calls to action to understand what reconciliation looks like.

2.2 Conflict of Interest Declaration (Real, Potential or Perceived)

Stacey Strilchuk, Council Chair noted that the annual Conflict of Interest declarations made by each Council member is available in SharePoint for the reference of all Council members. In addition to these ongoing conflicts, Council members are asked to declare any emergent conflicts at each Council meeting.

No additional conflicts were declared at this time.

2.3 Approval of agenda and consent agenda items

*Consent Agenda matters are proposed for unanimous consent and without debate, however Council members may seek clarification or ask questions. Any Council member may also request that a consent agenda item be moved to the regular agenda by notifying the Chair **prior** to the meeting. By approving the consent agenda, any individual approvals such as those noted below are considered approved.*

- Minutes, December 1 and 2 Council meeting, Decision items from December 1 and 2 In-camera sessions and electronic vote confirmation on December 30, 2022 (**for approval**).
- Building Fund Initiatives Working Group (**for information**)
- Competence Committee Meeting Summary Report (**for information**)
- Executive Committee Meeting Summary Report (**for information**)
- Finance and Audit Committee Meeting Summary Report (**for information**)
    - Appointment of Co-Chair to Finance and Audit Committee (**for approval**)
- Governance Committee Meeting Summary Report (**for information**)
    - Appointment of learner on Competence Committee (**for approval**)
    - Appointment of Co-Chair to Governance Committee (**for approval**)
    - Extension of appointments for individuals on Complaints Review Committee/Hearing Tribunal List (**for approval**)
- Patient Relations Fund Annual Report (**for information**)
- Report and Recommendation from Communications regarding Live Tweeting of Council Meetings (**for approval**)

Prior to approving and/or receiving as information the items on the Consent Agenda, clarification was provided to Council regarding the need to extend the appointments of individuals on the Complaints Review Committee (CRC)/Hearing Tribunal (HT) List. As reported by Levonne Louie, Co-chair of the Governance Committee, the recruitment of additional regulated members to serve on this listing is ongoing. Until additional individuals with sufficient training and experience are in place, it is critical to ensure the listing has an adequate number of members to avoid unnecessary delays in the hearing and complaint review processes.

MOTION C03-23:

Moved by Levonne Louie and seconded by Daisy Fung that Council approves the agenda and items on the Consent agenda as circulated. Carried.

In passing the above motion, the following items are approved:

- Council minutes:
    - December 1 and 2, 2022 Public Session
    - Decision items from December 1 and 2, 2022 In-Camera Session
    - Electronic Vote on December 30, 2022
- The appointment of Daisy Fung as Co-Chair to the Finance & Audit Committee for 2023.

- The appointment of Alexander Beke as an observer on the Competence Committee for a one-year term, effective immediately.
- The appointment of Laurie Steinbach as Co-Chair to the Governance Committee for 2023.
- The extension of the following regulated members to the Complaints Review Committee and Hearing Tribunal List for a further three-years commencing immediately:
  - Dr. Don Yee
  - Dr. Randall Sargent
  - Dr. John Pasternak
- Live Tweeting of Council meetings by the Communications Department on a permanent basis.

And the following were received as information:

- Building Fund Initiatives Working Group Report
- Competence Committee Meeting Summary Report
- Executive Committee Meeting Summary Report
- Finance and Audit Committee Meeting Summary Report
- Governance Committee Meeting Summary Report
- Patient Relations Fund Annual Report

3.0 Reports

3.1 Chair's Report

The Chair's written report highlighted the events and meetings that Stacey Strilchuk has attended on behalf of Council since the December Council meeting.

3.2 Executive Committee Report

- Council Vaccination Policy/Guidelines

Stacey Strilchuk, Executive Committee Chair, presented the report from the Committee regarding the *Council Vaccination for COVID-19* Policy. The suspension of this policy aligns with the organizational decision to suspend the staff vaccination policy. However, the Executive Committee felt guidance should be provided to prevent the spread of COVID-19 in CPSA's workplace. As such the new policy is presented in conjunction with the request to suspend the *Council Vaccination for COVID-19* Policy. Council was advised that, if necessary and if approved by Council, the vaccination policy could be reinstated.

MOTION C04-23:

Moved by Patrick Etokudo and seconded by Daisy Fung that Council approves suspending the CPSA *Council Vaccination for COVID-19 Policy*, and further that Council approves the *CPSA Council Position Statement and Guidance on COVID-19 Prevention at CPSA Council Meetings*. Carried.

3.3 Registrar's Report

The Registrar's written report was accepted as presented. During his verbal report, Scott McLeod highlighted and/or discussed the following:

- Staff Engagement Survey – next steps
- CPSA 2022 Annual Report – process for approval and request to respond in a timely manner to review the draft report.
- Outreach to healthcare partners, MLA's, and others interested in the work of CPSA
  - Council asked for additional consideration in formalizing the connections with Alberta Health and Alberta Health Services by providing these organizations with a non-voting member position on CPSA Council. This matter was forwarded to the Governance Committee for further discussion.
  - In response to a question from Council about responding to information shared in the media, Dr. McLeod noted that each situation is assessed and responses are made as appropriate. He added that fact sheets as well as a media relations plan are under development to ensure there is broad understanding of CPSA and its mandate. Council was also reminded that trends on social media may not be reflective of every Albertan given disparities in ability to access social media.
- National licensure and its relationship to registration and regulation

<u>ACTION:</u>

The Governance Committee will discuss and bring forward a recommendation regarding a non-voting member position for an individual from each of Alberta Health and Alberta Health Services.

4.0 Registration

4.1 Revision to Limited Practice Register Policy

Michael Caffaro, Assistant Registrar, Registration, presented the request to update the Limited Practice Register Policy. This policy is followed to register clinical assistants and surgical assistants in the province. Representatives from Alberta Health Services were consulted on the proposed changes and are in support of removing the clause requiring a candidate to have previous experience as a most responsible physician. Once an individual is registered on the Limited Practice Register, they are assessed by Alberta Health Services to ensure they can provide competent care.

Through discussions by Council, additional revisions were suggested to ensure any potential barriers for candidates were removed while at the same time providing those who hire candidates into these positions with the responsibility to ensure the candidate has the specific training needed for a particular position.

The revised policy will continue to include a requirement that training needs to have occurred within the last 3 years. However, Council requested that additional information be provided regarding how 3 years was determined to be the optimal threshold to define currency of practice.

MOTION: C05-23:

Moved by Lyle Oberg and seconded by Daisy Fung that Council approves removing the word "discipline-specific" from the updated version of the Limited Practice Register Policy and approves it for immediate implementation. Carried (Nicole Cardinal abstained from voting).

MOTION C06-23:

Moved by Levonne Louie and seconded by Jaelene Mannerfeldt that Council approves an additional amendment to the Limited Practice Register Policy to add "as assessed at the discretion of the Registrar" to the requirement to provide evidence of postgraduate training or independent practice within the last three years. Carried

ACTION:

Information will be brought back to Council around the determination of currency of practice.

4.2 Accelerated Practice Readiness Assessment Pilot

Dr. Caffaro advised Council that since implementing the Accelerated Practice Readiness Assessment Pilot Project, over 40 physicians have applied to the program. Council noted its appreciation of the work done by Dr. Caffaro and his team to create a faster route to registration for physicians from specific jurisdictions.

4.3 Alberta Sponsorship Model for Practice Readiness Assessments

By way of introduction for the new members of Council, Dr. Caffaro noted that this conversation is in follow up to the direction given to CPSA staff in December to explore an expansion of the current sponsorship model. The information enclosed in the agenda materials includes a recommendation for approval as well as the proposed criteria which any potential sponsor would be required to meet prior to being approved as a sponsor. He added that the Rural Health Professions Action Plan (RhPAP) will be discussing this proposal at their next meeting.

Discussion with Council noted the following:

- Regulated members will be expected to uphold the Standards of Practice and the Code of Ethics. If a sponsor is encouraging a member to do otherwise, that sponsor could have their sponsorship ability revoked.
- Privileging of physicians to work in an Alberta Health Services facility will still belong to Alberta Health Services.
- The source of a sponsor's funding to sponsor a position will not be a factor for consideration during the sponsorship application.
- Council will need to receive regular updates from the Registrar. If needed, the process will be revised based on progress made and issues identified during the initial implementation of the model.
- Opportunities have been built in such that the Alberta Medical Association will also have a role in safeguarding the well-being of sponsored physicians.
- Alberta Health Services is supportive of this work moving forward and is willing to work with CPSA to ensure any gaps around sponsorship are addressed.
- Additional information will be brought forward at the May Council meeting to develop a process to consider areas of high need.
- Next steps will be to include this work in the business planning and budgeting processes for 2024 and beyond. Through that process a timeline will be developed.

MOTION C07-23:

Moved by Levonne Louie and seconded by Jaelene Mannerfeldt that Council approves the expansion of Alberta's physician sponsorship to include non-AHS sponsors as part of the CPSA Practice Readiness Assessment (PRA) program and that Council appoints the Registrar as the delegated authority to approve/decline sponsor applications for this CPSA model. Carried.

ACTION:

Additional details will be shared at the May Council meeting.

5.0 Standards

5.1 Consultation 025 – approval for implementation

- Safe Prescribing

Monica Wickland-Weller, Senior Medical Advisor, presented the revised standard on Safe Prescribing which included the most recent revisions requested by Alberta Health. Based on Council discussions, an additional revision was made to clause 8 of the Standard regarding the drugs acceptable for Opioid Use Disorder treatment outside of the programs licensed by the government.

Council was advised that a comprehensive communication plan is in place to share information with the profession about the revised standard and expectations of physicians relative to legislative changes.

MOTION C08-23:

Moved by Oluseyi Oladele and seconded by Daisy Fung that Council approves the Safe Prescribing for Opioid Use Disorder standards of practice as presented for implementation effective immediately. Carried.

- Female Genital Mutilation

Danielle Michaels, Senior Medical Advisor with CPSA, presented the Standard of Practice for Female Genital Mutilation. This Standard was required based on legislation introduced by the Government of Alberta. It has been reviewed by legal counsel and includes gender inclusive and culturally safe language. An Advice to the Profession and an Advice to Albertans will be developed to accompany the standard when it comes into effect on May 1.

MOTION C09-23:

Moved by Levonne Louie and seconded by Laurie Steinbach that Council approves the Female Genital Mutilation standard of practice as presented for implementation effective May 1, 2023. Carried.

- Medical Assistance in Dying (MAID)

Michael Caffaro, Assistant Registrar, Registration noted that the decision to delay allowing MAID when the sole underlying condition is mental health is still making its way through parliament. As such, language around providing MAID will be adjusted if parliament does act prior to March 17. The Advice to the Profession will reference cultural practices. Additionally, the Conscientious Objection Standard of Practice will be reviewed in the coming months and additional information about cultural practices could be included in that Standard.

MOTION C10-23:

Moved by Lyle Oberg and seconded by Laurie Steinbach that Council approves the Medical Assistance in Dying standard of practice as presented for implementation effective March 17, 2023. Carried (Tyler White abstained from voting).

6.0	**Committee Reports**
6.1	Finance and Audit Committee

- Accreditation Fees for Psychedelic Assisted Psychotherapy Facilities (PAPT)

Council was provided with background details around accreditation fees. CPSA accredits both public and private facilities and all accredited facilities adhere to the same standards. The fees paid by the private facilities as well as the fees recovered through a contract with Alberta Health Services are developed to ensure the work is done on a cost recovery basis such that physician fees do not support any part of this work. The Finance and Audit Committee reviewed the proposed fees and the Accreditation department will be developing the standards for these facilities. A Communication Plan is also under development. Accreditation fees are regularly reviewed to ensure they are appropriate and covering all costs related to accreditation, however, when new programs are implemented additional time is needed to understand the ongoing costs and needs of the program.

MOTION C11-23:

Moved by Levonne Louie and seconded by Patrick Etokudo that Council approves the following fees for Psychedelic Assisted Psychotherapy Facilities:

Fee type	Amount (+ GST)
Registration	$300
Annual	$4212
Assessment	$2116
Post renovation/move assessment	$670

Carried.

ACTION:

The Accreditation department will develop the accreditation standards and a communication plan regarding the accreditation of Psychedelic Assisted Psychotherapy Facilities.

6.2 2023 Council Learning Plan

Sue Welke, Program Manager, Governance, presented the Council Learning plan as reviewed by the Governance Committee. Council members were encouraged to let Ms. Welke know of any individual learning sessions they have found valuable that could be added to the suggested courses. When Council members use their individual learning funding, they will be asked to provide a summary of the course to be shared with Council as part of the consent agenda. Council was also reminded that a list of individual learning opportunities, including participation in courses from the Institute of Corporate Directors, is included with each Council agenda. As well, any course on leadership development would qualify for reimbursement.

Council discussed the group learning and noted that some of the topics could also be considered as part of the annual orientation session or part of a Council retreat. Plans are underway to develop a session for all Council members around appeals and reviews and aspects of decision writing that is needed by all Council members. Decisions around whether or not such training is mandatory will be discussed once the program is developed.

Council agreed to the following as the educational topics for the upcoming Council meetings:

- **May 2023**: Anti-Racism Anti-Discrimination – presentation from another Canadian regulator (e.g.: CPSO or CPSBC) about their work in this area. Speaker: TBD
- **September 2023**: Chairing meetings – the role of the Chair and effective meetings. Speaker: TBD
- **December 2023**: Council Culture: Giving and receiving feedback. Speaker: TBD

MOTION C12-23:

Moved by Daisy Fung and seconded by Jaelene Mannerfeldt that Council approves the 2023 Council Learning Plan with revisions as discussed. Carried.

ACTION:

- A plan will be developed for Council learning around Council appeals and reviews.
- Options for a Blanket Exercise Workshop, possibly as part of a Council meeting on a Friday morning or as part of a Council retreat will be investigated.

The public session adjourned for the day at 1450

7.0 In Camera (Council and others by invitation of the Chair)

Council met in-camera with the Registrar, Assistant Registrars, Hearing Director, Chief Financial Officer, Chief Innovation Officer, and the Governance Program Manager.

8.0 Call to Order for In-Camera Session

Council met in-camera prior to the opening of the public session.

9.0 Call to Order and Introductions for public session

Stacey Strilchuk, Council Chair, called the meeting to order at 0815.

9.1 Traditional Territorial Acknowledgement

At each Council meeting, individuals are invited to share a personalized message to recognize and respect Indigenous Peoples who lived and continue to live on this territory, and for the land to which we are all connected. This type of acknowledgement is part of CPSA's ongoing efforts to develop healthy and reciprocal relations with Alberta's Indigenous communities—a key element of reconciliation, a process we are committed to.

Laurie Steinbach, public member of Council, provided the traditional territorial acknowledgement on the second day of the Council meeting. Ms. Steinbach expressed her commitment to learning, to doing better and to doing her part. She is mindful that Indigenous peoples have borne the burden of teaching and we all have work to do to ensure equal access to equal healthcare for all. Council Chair, Stacey Strilchuk, reminded everyone to take time to reflect on the importance and impact of the land acknowledgments shared by Nicole Cardinal and Laurie Steinbach over the past two days and a moment of silence was shared by all.

10.0 Committee Reports

10.1 Indigenous Advisory Circle

The written report from the Indigenous Advisory Circle was received as information.

10.2 Anti-Racism Anti-Discrimination Action Advisory Committee Report

Daisy Fung, Chair of the Anti-Racism Anti-Discrimination Action Advisory Committee presented the Committee's report from their February meeting. At the meeting, the Committee discussed the collection of information on race and ethnicity from regulated members. This is still under consideration and will require a fulsome communication plan that includes what information is being collected and why as well as how it will be used, along with assurances of privacy and confidentiality. Council provided feedback on the matter with specific questions about the legality of asking for this data and understanding that how an individual self-identifies themselves may be different from how they are perceived by others.

It was also noted that the Committee will be recruiting additional members and that the Terms of Reference will be adjusted to reflect recent changes to the Committee's membership.

11.0 Strategic Plan

Ed Jess, Chief Innovation Officer, provided Council with an overview of the development of the Strategic Plan, including the work by CPSA team members to propose actions to meet the objectives within the Plan. The next phase of work is to develop the Key Performance Indicators (KPIs) that will assist in prioritizing the work of the organization. Ms. Strilchuk added that one of the key responsibilities of Council is to hold CPSA accountable for the agreed upon KPI's. Discussion with Council noted the following:

- KPIs must be measurable
- Language of the proposed KPIs needs to be clarified
- KPIs should demonstrate how the public is protected
- The number of KPIs to be monitored should be fewer than 10
- Need to distinguish between operational KPI and those that demonstrate that CPSA is fulfilling its mandate.

ACTION:

Additional consideration will be given to the proposed KPIs, and a small working group of Council will be consulted on revised KPIs prior to the May Council meeting.

12.0 Council Education

12.1 Finance 101

Tracy Simons, Chief Financial Officer, gave a presentation to Council regarding Council's responsibilities relative to financial matters of CPSA. The objectives of the presentation were to ensure Council members are able to:

- Review and understand CPSA financial statements
- Ask informed questions about the financials
- Understand variance reporting

13.0 Analytics, Innovation and Research (AIR)

- Virtual Care

Ewan Affleck, Senior Medical Advisor and CPSA representative on the *Alberta Virtual Care Coordinating Body (AVCCB),* shared information about the AVCCB and its work to optimize quality patient care by promoting a harmonized approach to virtual care.

The public session of the Council meeting adjourned at 1205.

14.0 In Camera (Council and others by invitation)

Council met in camera prior to adjourning the meeting at 1315**.**

Gail Jones and Kimberley Murphy
Recording Secretaries

From: Gail Jones
To: Council 2022
Cc: Sue Welke; Keely McBride; "Scott McLeod"
Subject: Confirmation of Approval
Date: Friday, December 30, 2022 2:10:00 PM

Thank you Council members. This e-mail confirms that the following motion has now passed:

MOTION C71-22: Moved by Richard Buckley and seconded by John O'Connor that Council approves the *Physicians, Surgeons, Osteopaths and Physician Assistants Profession Amendment Regulation* as circulated and that Council directs Ms. Keely McBride to finalize the draft certificate and circulate it for signature by Stacey Strilchuk (Council President) or Scott McLeod (Registrar and CEO). Carried.

Gail Jones, BComm **(she/her)**
Senior Executive Assistant to Dr. Scott McLeod, Registrar

780-969-4970 | 1-800-561-3899 ext. 4970
2700 - 10020 100 Street NW Edmonton AB T5J 0N3
gail.jones@cpsa.ab.ca| cpsa.ca |

CPSA's office is closed from 4:15 p.m on Dec. 23, 2022 through Jan. 2, 2023. We will re-open at 8:15 a.m. on Jan. 3, 2023.
For urgent requests during our office closure, please call 1-800-561-3899. For annual renewal inquiries, please email annual.billing@cpsa.ab.ca and we will respond when our office reopens. Your practice permit will remain active in the meantime.

From: Gail Jones
Sent: Thursday, December 22, 2022 3:14 PM
To: Council 2022 <Council.2022@cpsa.ab.ca>
Cc: [redacted]
Subject: Response Required By Dec. 31 - Approval

Council Members,
As part of the ongoing work to fulfill the requirements of Bill 46, Council approval of the revised draft regulation and certificate is required before the end of the year. Information about this approval is provided in a Covering Report to Council that has been uploaded to SharePoint and is available for your review at this link.

In order to pass this motion, I will need a voting member to indicate they will move the motion (see proposed motion below) and then another voting member to indicate they second the motion. Once I have that in place, I will send a follow up e-mail to call for the vote.

Proposed Motion:

- That Council approves the *Physicians, Surgeons, Osteopaths and Physician Assistants Profession Amendment Regulation* as circulated and that Council directs Ms. Keely McBride to finalize the draft certificate and circulate it for signature by Stacey Strilchuk (Council President) or Scott McLeod (Registrar and CEO).

If you have any questions about the regulation or the certificate process, Keely [redacted] will be available via e-mail to respond.

Gail Jones, BComm **(she/her)**
Senior Executive Assistant to Dr. Scott McLeod, Registrar

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For urgent requests during our office closure, please call 1-800-561-3899. For annual renewal inquiries, please email annual.billing@cpsa.ab.ca and we will respond when our office reopens. Your practice permit will remain active in the meantime.

This email was sent from the traditional territory of the Treaty 6 First Nations and the homelands of the Métis people.

From:

Subject:	Motion has passed
Date:	Wednesday, May 10, 2023 7:39:00 AM

This e-mail is to confirm that the motion noted below has passed and will be recorded in the Motions Database as Motion C13-23.
I also wish to advise you that, on the recommendation of our Government Relations Consultant, the photo on page 2 of the report is being replaced. This will likely be reflected in the document that will be included in the Council dossier.
Gail

From: Gail Jones
Sent: Tuesday, May 9, 2023 11:34 AM
To:

Subject: RE: 2022 Annual Report approval requested: please respond by 2 p.m. on Monday, May 15, 2023

Good morning!
The motion below has been updated to include the mover and seconder. (I did have multiple people reach out and have gone with the first and second individual to contact me). Please respond to me on this e-mail to indicate if you approve the motion.
Thanks
Gail

From: Gail Jones
Sent: Monday, May 8, 2023 2:13 PM
To:

Subject: 2022 Annual Report approval requested: please respond by 2 p.m. on Monday, May 15, 2023
Importance: High

Council members,

Please respond to this e-mail **by 2 p.m. on Monday, May 15, 2023.** As a first step, I will need a Council member willing to move the motion below as well as someone to indicate they will second the motion:

> **PROPOSED MOTION**: Moved by Ian Walker and seconded by Patrick Etokudo that Council approves the CPSA 2022 Annual Report, version 050423 (attached).

Please note, the attached proof has some minor content edits noted within, which will be made prior to printing.

Once I have a mover and seconder for the motion, I will recirculate this email to confirm and then gather everyone's responses. Once the motion is passed, either Sue or I will send out an email to confirm the motion has passed.

Given that this report has been provided to all Council members for final approval, if anyone finds any substantive errors or omissions in the report, we ask that you oppose approval, noting the area that requires correction. Voting will be discontinued until the error/omission is corrected and a revised version will be made available to Council for approval.

As previously shared with Council, in order to meet the Alberta Government's submission deadlines, Council approval for the Annual Report is needed via email, prior to the May Council meeting.

Project co-leads Kennedy and Melissa have asked that I share the following message with you in regards to the Annual Report.

> *On behalf of the CPSA Communications team, we are excited to share CPSA's 2022 annual report for your formal approval via email. In March, we shared a draft of the annual report content with CPSA Council for your opportunity to review and provide feedback. We are now seeking your approval on the print version, which is attached to this email.*
>
> ***About the 2022 report***
>
> *The theme of our report is **Recognizing Resilience**. Through the report and our supplementary storytelling, we want to recognize the resilience of our regulated members, who continue to provide safe, high-quality care in difficult circumstances, and the resilience of Albertans and the entire CPSA team, who continue to adapt to changing environments and new challenges.*
>
> *The elements you'll find in the print report include:*
>
> - *Messages from our President, Registrar, Physician Members and Public Members*
> - *Governance, leadership and committee information*
> - *Statistics and department descriptions*
> - *Cross-promotion of the multimedia stories that are still in development and will be available beginning in June on our Albertan engagement website, conversations.cpsa.ca.*

Please note, draft financial statements are not yet included in the report as those are still being finalized.

Thank you for your ongoing guidance and support. Pending Council's approval of the report via email and of the audited financials at the May Council meeting, our team will finalize the print files, send the report to the printers, begin distribution, and begin publishing our supplementary content online.

Please let us know if you have any questions and thank you again for your time and support!

Kennedy and Melissa

Gail Jones, BComm **(she/her)**
Senior Executive Assistant to Dr. Scott McLeod, Registrar

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2700 - 10020 100 Street NW Edmonton AB T5J 0N3
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This email was sent from the traditional territory of the Treaty 6 First Nations and the homelands of the Métis people.

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

Submission to:	**Council**

Meeting Date:	Submitted by:		
May 25, 2023	Stacey Strilchuk		
Agenda Item Title:	Executive Committee Meeting Summary Report		
Action Requested:	☐ The following items require approval by Choose an item. See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☒ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	N/A		
Background:	The Executive Committee met on May 1, 2023 and discussed the following matters: 1. CEO/Registrar's Performance Evaluation – the process to be followed in 2023 was discussed. Approval of the process is included under separate cover. The proposed goals and objectives will be discussed during Council's in camera session. 2. Provision of guidance to Council regarding the upcoming Provincial Election – the Committee directed the Secretariat to prepare a document to guide Council members about responding to potential questions related to the upcoming provincial election. That document was provided to all Council members on XXX 3. May 2023 Council Agenda – The Committee used the following to develop the agenda: a. Council Meeting Action Items and Follow-up List b. Data from the February Council Meeting Feedback Survey c. Ideas submitted by Council members For the May Council meeting, and potentially all future meetings, the first day of Council will be a public session while the second day will be dedicated to in-camera discussions, including Council education sessions. The decision will be revisited and evaluated regularly.		

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

4. Council Evaluation Policy – minor revisions to the policy, including a name change were reviewed and the policy is recommended for approval by Council under separate cover. The results of the 2022 Council member self assessment surveys were also shared with the Committee.
5. Council Retreat Deliverables – having received the report from the January retreat, the Committee reviewed the report and will be asking the Governance Committee to review the materials at their next meeting in June.
6. Governance Review Implementation – the Committee was provided with an overview of the status of the ongoing work to implement the recommendations from the Governance Review.
7. In-Camera Meeting Guidelines – Proposed guidelines to be followed by Council regarding in-camera meetings were shared and will be reviewed by the Governance committee at their June meeting.
8. May 31meeting with AMA Executive Committee – in preparation for its upcoming meeting with the Executive Committee of the Alberta Medical Association, the Committee discussed potential agenda topics.

List of Attachments:

1. Registrar Performance Evaluation Process (for approval)
2. Council Effectiveness Evaluation Policy (for approval)

COLLEGE OF PHYSICIANS & SURGEONS OF ALBERTA

Submission to:	Council

Meeting Date:	Submitted by:		
May 25-26, 2023	Executive Committee		
Agenda Item Title:	Registrar and CEO's Performance Evaluation Process for 2023		
Action Requested:	☒ The following items require approval by Council See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☐ The attached is for information only. No action is required.

AGENDA ITEM DETAILS	
Recommendations:	That Council approves the Council Chair as the Lead, with support of Executive Committee for the 2023 Registrar and CEO's Performance Management process.
Background:	The attached Registrar and CEO Performance Management Process was revised in 2022 (attachment 1). Last year, there was recognition that the process has worked well to date, and continues to be relevant and useful. At this time planning is underway to formalize the process and move this work into a policy using the CPSA Policy Template. Once completed, the policy will be reviewed by the Governance Committee. The policy allows for the designation of a Subcommittee to lead the performance evaluation process. Last year, Executive Committee filled this role, and it is proposed that Executive Committee fulfill the role again this year.
Next Steps:	The 2023 Registrar performance evaluation process will follow the process in the attached policy, with one update: • "Annual performance goals, objectives and leadership expectations are outlined and agreed upon by Registrar and CEO and CPSA Council" occurs in May instead of January for 2023 only.

List of Attachments:
CPSA Registrar Performance Management Process (approved 2018, revised August 2022)

College of Physicians and Surgeons of Alberta

Registrar and Chief Executive Officer Performance Management Process

Approved: November 2018
Revised: August 2022

College of Physicians and Surgeons of Alberta (CPSA)
Registrar and Chief Executive Officer
Performance Management Process

BACKGROUND

An organization is guaranteed a certain level of success when the employer and all its employees share a clear understanding of where they are heading and how they are going to get there.

There are many elements that contribute to this common understanding including a shared vision, shared values and the organization's strategic plan.

- These elements underpin the agreement that each employee has with the organization – specifically, what is expected of him/her, what resources and authorities will be provided and how the employee is held accountable for achieving results.

Increasingly, organizations are going to an accountability model that creates a formal loop of written expectations shared between the employer and employee leading to an equally formal evaluation of performance.

The philosophy that should underlie such a process is one that espouses openness, honesty and mutual respect.

- Performance planning and evaluation is a "process" not an "event".
- The objectives should include high levels of achievement, growth and mutual benefit.
- The process should be iterative, involving a cycle of shared expectations, review, feedback and revised expectations.
- There should never be any "surprises" at the end of an evaluation cycle.

Feedback of an informal nature throughout the year should allow for timely identification and resolution of performance related issues.

A key responsibility of the CPSA Governing Council is to evaluate the performance of the Registrar and Chief Executive Officer (CEO).

The process being proposed for a sustained and consistent approach to evaluating the performance of the CPSA Registrar and CEO includes:

- Establishing performance criteria related to the organization's strategic plan and priorities
- Ensuring the Registrar and CEO is being evaluated on organizational key performance indicators, outcomes, and accomplishments, rather than on personality traits
- Enabling the Registrar and CEO to give CPSA staff direction for their work and performance
- Identifying opportunities, challenges, and strategic issues that the CPSA Governing Council and Registrar and CEO can address before problems arise
- Giving the Registrar and CEO a clear picture of how the CPSA Governing Council perceives the quality of his or her work
- Improving the performance of the Registrar and CEO and the organization
- Building a better working relationship between the Registrar and CEO and the CPSA Governing Council.

The process outlined below represents the ideal, iterative approach in a normal annual process. In addition, a modified/compacted version is also offered which recognizes the current reality/ time period that the CPSA is operating under and a desire to provide feedback and direction for the Registrar upon completion of first full year of leadership (e.g., beyond initial probationary period).

The process and associated instruments should themselves be evaluated, revised and modified upon a full year's worth of experience and as required in subsequent evaluation periods.

PERFORMANCE MANAGEMENT PROCESS

Principles

The performance management process is based on several principles:

- Facilitated communication between the Executive Committee on behalf of Governing Council and the Registrar regarding the performance and performance management process of the Registrar and CEO and organization.

- The Registrar and CEO's performance goals and objectives aligned with the CPSA Strategic Plan.

    - All efforts should be made to establish goals, objectives and related performance measures which are objective, e.g., accomplishment of the strategic plan, effective implementation of CPSA policies, stakeholder engagement/satisfaction with the services provided, etc.

- The performance management process should be viewed as a cycle that includes: clarifying expectations; setting goals jointly; monitoring performance and evaluating results achieved; discussing issues and providing feedback; and recognizing strengths, identifying concerns and setting growth targets. The process should be designed to reinforce positive behavior and focus the Registrar and CEO's time and commitment to high priority initiatives.

    - Goals and objectives are set at the start of or immediately in advance of the performance management period.

- Goals and objectives are aligned and cascaded down through the organizational structure of the CPSA as applicable; the sum of the Assistant Registrars' and other direct reports' goals and objectives should equal the Registrar and CEO's goals and objectives.

- CPSA Governing Council should give a consistent, unified message to the Registrar and CEO regarding performance expectations and results. If there is significant divergence of opinion, this must be resolved amongst the Councillors.

- Input into the evaluation of the performance of the Registrar is collected from multiple sources who are credible.

- Credibility is defined as significant and meaningful interaction with the Registrar and CEO forming the basis of experience relevant to undertaking the performance management process either on the basis of understanding of the goals and objectives or of desired leadership behaviors.

KEY ROLES AND RESPONSIBILITIES

CPSA Governing Council

- Develops and oversees the CPSA Strategic Plan
- Establishes the relationship expectations and accountabilities between CPSA Governing Council and the Registrar and CEO
- Sets and directs the role and responsibilities of the Registrar and CEO
- Establishes the total compensation for the Registrar and CEO and ensures congruency with the results of the performance management process
- Delegates the role and responsibilities assigned to a Council committee (e.g. Executive Committee) as required regarding the Registrar and CEO performance management proces with timelines and reporting requirements
- Reviews and approves recommendations arising from the Registrar and CEO performance management process

Designated Subcommittee (as required)

- Conducts the performance management process of the Registrar and CEO, including the achievement of consensus of measurable goals and objectives
- Recommends Registrar and CEO compensation adjustments, bonuses and/or employment agreement/ contractual changes
- Manages the performance management process, including the gathering of information, negotiating goals and objectives with the Registrar and CEO, conducting performance feedback interviews, preparing written documentation of the performance management process outcome, developing recommendations to present to CPSA Governing Council
- Provides regular information and feedback to the Registrar and CEO and CPSA Governing Council regarding the ongoing performance of the Registrar and CEO
- Consult with external stakeholders as required

President

- Meets with the Registrar and CEO quarterly to develop and review performance management goals and objectives and provide feedback to the Regisrar and CEO

Registrar and CEO

- Self-evaluates performance relative to the agreed upon goals, objectives, role and responsibilities

Chief of Staff or Designate

- Provides administrative support to CPSA Governing Council/designated committee (e.g. Executive Committee) and President
- Schedules the quarterly and annual session between the President and the Registrar and CEO, as well as the performance management process and activities
- Brings forward the milestones of the performance management process to the attention of CPSA Governing Council, designated committee as required as well as the Registrar and CEO.

PROCESS

The performance management process is based on the belief that the Registrar and CEO is accountable to CPSA Governing Council for the leadership and direction of the CPSA.

CPSA Governing Council is accountable for establishing and prioritizing the goals for the CPSA and monitoring the progress in achieving the goals.

- CPSA Governing Council may delegate the responsibility for the Registrar and CEO performance management process to a committee, such as the Executive Committee.

The performance management process will include the establishment of expectations and the management of performance in three (3) key areas:

1. The roles and key responsibilities outlined in the employment agreement/contract or other mutually agreed upon agreement with the Registrar and CEO.

2. Goals and objectives established and agreed to by CPSA Governing Council or relevant Council committee (e.g. Executive Committee) and the Registrar and CEO at the beginning of the performance management cycle and aligned with the CPSA's Strategic Plan and associated Business Plan and budget.

3. The essential behaviors and characteristics required by the Registrar and CEO. These should also be established/confirmed in advance of any performance management period and well-developed, documented and understood by CPSA Governing Council, Council committee (e.g. Executive Committee) and the Registrar and CEO.

TIMELINE(S)

The activities of the performance management process are scheduled over a 1 year cycle commencing January 1st of each calendar year.

January
- Annual performance goals, objectives and leadership expectations are outlined and agreed upon by Registrar and CEO and CPSA Governing Council
- **Lead – President**

April
- Quarterly performance review of Registrar and CEO
- **Lead – President and Registrar and CEO**

July
- Quarterly performance review of Registrar and CEO
- **Lead – President and Registrar and CEO**

September

- Performance management review commences and performance management tool, supporting documentation and process is agreed upon by Registrar and CEO and President
- The performance management process, tool and supporting documentation is reviewed and approved by CPSA Governing Council
- Note – a 360 leadership assessment is completed every 3 years
- **Lead – Chief of Staff, President and Registrar and CEO**

October

- Quarterly performance review of Registrar and CEO
- **Lead – President and Registrar and CEO**

- The Registrar and CEO's performance management process is initiated and completed
- The Registrar and CEO completes a self-assessment
- **Lead – President, Registrar and CEO, Chief of Staff**

November

- Review of the process management tool results and supporting documentation is complete
- A summary report and recommendations regarding the Registar and CEO's performance review management process and results are developed for Executive Committee and CPSA Governing Council
- **Lead – President and Chief of Staff**

December

- A summary report and recommendations regarding the Registrar and CEO's performance review management process and results are presented to CPSA Governing Council for review, discussion and approval
- **Lead – President and Executive Committee**

- Annual performance review of Registrar and CEO
- **Lead – President and Registrar and CEO**

- A completed annual performance review confirmation and any supporting recommendations and documentation is signed and emailed to CPSA Chief Financial Officer
- A review of the overall Registrar and CEO performance management process is conducted with Registrar and CEO and orientation on the Registrar and CEO performance management process is provided to incoming President and Executive Commitee
- **Lead – President and Executive Committee**

Attachment(s)

- Roles and Responsibilites/Position Profile CPSA Registrar and CEO
- CPSA Strategic Plan
- CPSA Business Plan and Associated Budget

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

Submission to:	**Council**

<table>
<tr><td>Meeting Date:</td><td colspan="3">Submitted by:</td></tr>
<tr><td>May 25-26, 2023</td><td colspan="3">Executive Committee</td></tr>
<tr><td>Agenda Item Title:</td><td colspan="3">Council Effectiveness Evaluation Policy</td></tr>
<tr><td>Action Requested:</td><td>☒ The following items require approval by Council See below for details of the recommendation.</td><td>☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.</td><td>☐ The attached is for information only. No action is required.</td></tr>
<tr><td colspan="4">AGENDA ITEM DETAILS</td></tr>
<tr><td>Recommendation:</td><td colspan="3">That Council approves the revised Council Effectiveness Evaluation Policy.</td></tr>
<tr><td>Background:</td><td colspan="3">CPSA Council's Policy to Measure Council Effectiveness and Self Evaluation (Attachment 1) was approved in 2019, and last reviewed in 2020. Some minor revisions to the Policy are proposed (Attachment 2), including:

• addition of Policy Statement and Process sections
• reference to CPSA's mandate/vision/mission and the CPSA Strategic Plan
• new title: Council Effectiveness Evaluation Policy
• reference to the GoA Public Agencies Secretariat public member self-evaluation as the self-evaluation for all Council members
• addition of responsibility of individual Council Members to reflect on their contributions to an effective Council.

Governance Committee and Executive Committee have reviewed the changes, and, in addition to the Policy, discussed the survey tools that are used to measure Council and Council member effectiveness.</td></tr>
<tr><td>Next Steps:</td><td colspan="3">• Upon Council approval, the Policy will be updated on the CPSA website.
• The policy may be revisited after several upcoming tasks related to the Governance Review are implemented (e.g.: the development of a governance performance framework)</td></tr>
<tr><td colspan="4">List of Attachments:</td></tr>
</table>

1. *Policy to Measure Council Effectiveness and Self Evaluation*
2. Revised policy: *Council Effectiveness Evaluation Policy* *(draft)*

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

Council Policy

Policy Title	Council Effectiveness Evaluation Policy
Date Revised	February 28, 2023 (for discussion at Governance Committee and Executive Committee) May 2023 (proposed approval)
Date of next Review	2028 (TBC)

1. POLICY STATEMENT

The Council Effectiveness Evaluation Policy establishes CPSA Council's commitment to regular evaluations of its work as a Council.

2. PURPOSE

The policy ensures CPSA Council regularly evaluates its effectiveness as a governing body overseeing the regulation of physicians and physician assistants in Alberta. Regular evaluation and action on the results will improve effectiveness of the Council.

3. SCOPE

Measuring Council effectiveness will be accomplished through three evaluations:

a) Council Meeting Evaluation (quarterly following Council meetings)

b) Council Member Self Evaluation (annually in December/January)

c) Evaluation of Council Effectiveness (annually in December/January)

Evaluation questionnaires will focus on how well CPSA Council fulfills CPSA's mandate to protect Albertans and serve the public interest.

4. RESPONSIBILITIES

Governance Committee develops the policy and process for Council effectiveness evaluation and it is reviewed every 5 years, or as required.

Executive Committee reviews the data gathered from evaluations, and takes action as required to ensure Council effectiveness and the achievement of CPSA's mandate.

Individual Council Members are responsible for reflecting on their self-assessment, and for participating in learning opportunities/activities that enhance their governance and leadership competencies, and their contributions to an effective Council.

5. PROCESS

Measuring Council and Council member effectiveness will be accomplished through three evaluations:

a) Council Meeting Evaluation – following each Council meeting, Council members will respond to a survey designed to evaluate the effectiveness of that meeting, and provide suggestions for future meetings. The data gathered will be reviewed and acted upon by the Executive Committee when Council meeting agendas are developed.

b) Council Member Self Evaluation –on an annual basis, Council members will complete a self-evaluation. The self-evaluation tool/questionnaire is the same tool used by the Government of Alberta in public member self-evaluation[1]. The Executive Committee will review the results of the evaluation to help determine how best to meet the learning needs of Council, and support skills and competency development of Council members, and to address any areas impacting Council effectiveness.

c) Evaluation of Council Effectiveness – on an annual basis, Council will complete a questionnaire to evaluate the functioning and effectiveness of Council as a whole. The questionnaire will be reviewed annually by the Governance Committee and if there are substantive changes to the questionnaire it will be recommended to Council for approval before the evaluation is carried out. The Executive Committee will use the results of this evaluation to propose changes that would help to improve Council's effectiveness.

6. APPROVAL

CPSA Council approves this policy.

[1] Government of Alberta Evaluation Guidebook for Public Agencies : https://open.alberta.ca/dataset/8411c657-523f-4bb8-be90-f51c16dace21/resource/4b6964ea-ec90-4f8a-9817-4c400db49961/download/psc-member-evaluation-guidebook-for-public-agencies-2021-07.pdf

7. SUPPORTING DOCUMENTS

- Annual Council Learning Plan
- Government of Alberta Evaluation Guidebook for Public Agencies

8. DOCUMENT HISTORY

VERSION NO.	Version Date	DESCRIPTION OF CHANGE
1	July 25, 2019	Formatted using approved template.
2	Jan. 24, 2020	Created policy on template with new branding
3	March 15, 2023	Reviewed and revised per Governance Review
APPROVAL	DATE	Signature
Council Motion C19-19	May 30, 2019	

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

Submission to:	**Council**

Meeting Date:	Submitted by:		
May 25, 2023	Levonne Louie and Daisy Fung, FAC Co-Chairs		
Agenda Item Title:	Finance & Audit Committee (FAC) Meeting Summary Report		
Action Requested:	☐ The following items require approval by Council See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☒ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	n/a		
Background:	The Finance & Audit Committee (FAC) met on May 12, 2023 and addressed the following issues:		

1) Financial results December 31, 2022

FAC discussed a report from management regarding the budget variances for the 2022 financial results. For 2022, there is a year-to-date **deficiency of revenue over expenditure, before other items,** of $445,000 compared to the budgeted deficiency of $4,759,000 resulting in more revenue, or a positive variance, of $4,314,000.

	31-Dec-22	Budget	Variance	
Revenues	(33,190,000)	(29,350,000)	3,840,000	13%
Expenditures	33,635,000	34,109,000	474,000	1%
Deficiency of revenues over expenditures before other items	**445,000**	**4,759,000**	**4,314,000**	
Development Costs	208,000	233,000	25,000	11%

Sub-total after Development Costs	653,000	4,992,000	4,339,000	
Accreditation, net	(171,000)	(197,000)	(26,000)	13%
Sub-total	482,000	4,795,000	4,313,000	
Fair value changes in investments	3,493,000	(300,000)	(3,793,000)	
Investment income building fund – net of expenditures	(69,000)	0	69,000	
Deficiency of revenues over expenditures for the year	**3,906,000**	**4,495,000**	**589,000**	

The fair value changes in investments consists of a decrease in the market value of investments at December 31, 2022 compared to the market value at December 31, 2021. The total decrease for 2022 is $3,493,000.

The total <u>deficiency of revenue over expenditures for the year</u> is $3,906,000 primarily attributed to the loss in market value of investments.

The budget for 2022 planned for a total deficiency of $4,495,000 as a portion of the building fund internally restricted funds were approved by Council to be applied towards operations for 2022.

A breakdown of the main contributors to the total deficiency to the end of year include the following variances to budget:

a. **Higher revenues** $3,840,000

Physician annual fees	$685,000
Physician registration	318,000
Professional Corporation fees	106,000
Continuing competence fees (individual practice reviews)	<126,000>
Practice Readiness fees	1,388,000
Recovery of Investigation & Hearings	569,000
Investment income	809,000
Fines /penalties	156,000
Other	< 65,000>
	3,840,000

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b. Reduced overall expenditures $477,000

A significant factor for overall reduced spending was reduced staffing costs due to delays in hiring positions and choosing not to hire three IT programming staff due to difficulties in sourcing IT professionals. Instead, IT is hiring contractors as needed.

c. Decrease in fair value changes in investments $3,493,000

CPSA is required to record our investments and building fund investments at market value.

Net Asset summary

The net assets (or accumulated surplus) at December 31, 2022 is $43.2 million. The breakdown between restricted and unrestricted is as follows:

Net Assets:	
Invested in equipment and leasehold improvements	$ 4,492,000
Internally restricted*	6,001,000
Unrestricted	32,676,000
Total	$43,169,000

*The internally restricted net assets consists of the following:

Building fund	$5,069,000
Accreditation program	932,000
Total internally restricted	$6,001,000

For 2022, the Building Fund balance was reduced $4,766,000 to be used for operations that is shown as a transfer to unrestricted net assets, and $5,000,000 was approved by Council for the CPSA Healthier Albertan Grant. During 2022 interest less expenditures amounted to $69,000 which added to the building fund balance.

Accounting rules for the defined benefit pension plan require the re-measurement of the pension obligation to be recorded in the statement of changes in net assets. The total charge recorded to the CPSA's net assets in 2022 was a decrease of $4,862,000 (2021 = $2,882,539 increase).

The re-measurement calculation includes:

- The difference between the actual return on the pension assets and the return calculated using the discount rate <$7,883,000>
- a gain on the obligation $3,021,000

Total re-measurement charge to net assets	<$4,862,000>

In other words, the pension asset returns were lower than expected, and the obligation did not grow as large as expected in 2022.

Overall, there is a decrease to the CPSA's surplus in 2022.

The total unrestricted surplus as of December 31, 2022 of $32,676,435 represents approximately 80% of one year's gross operating expenses (based on 2023 budgeted total expenses).

The higher level of surplus will allow CPSA to plan for shortfalls in future years' budgets and if necessary, will allow us to draw down the unrestricted surplus as operating expenses increase.

CPSA's current policy on reserves targets the unrestricted surplus at 60% of one year's gross operating expenses. The FAC will be reviewing the policy on reserves later in 2023 in conjunction with the review of the 2024 budget.

2) CPSA audited financial statements

FAC received a report from PwC, CPSA's auditors, on the 2022 audited financial statements, the summary financial statements and the pension fund financial statements.

A summary is provided under a separate report to Council.

3) Appointment of auditors for 2023

FAC approved PwC as auditors for the 2023 fiscal year.

4) Credit Card fees

Management sought input from FAC on payment methods accepted by CPSA and the concept of charging customers a fee who use credit cards for payment.

CPSA currently accepts payment from customers by cash/cheque, pre-authorized payment and credit cards. There are a handful of payments received by eTransfer, but this method is not promoted as it is labor intensive for data entry.

During annual billing, the majority of payments are received via credit card with the second form of payment being pre-authorized payments.

Annually CPSA pays approximately $500,000 in credit card fees.

	2022	2021	2020	2019
Credit card fees	$534,261	$495,365	$539,008	$491,132

The credit card fees vary depending on the type of card (MasterCard, Visa or American Express) and the tiers (such as world, world elite, premium) the customer presents. Many of our customers have the elite and premium cards allowing the customer to collect the largest level of points.

For 2023, with the physician annual fee of $2200, the credit card fees for Visa premium elite = $56.98 and for Mastercard world elite = $50.16.

The cost to CPSA of a pre-authorized payment is $0.15/ transaction.

New Canadian court rulings were announced in October 2022 allowing companies to charge a portion of the credit card fees back to their customers. A company cannot recoup all the fees paid. Previously credit card merchants in Canada did not allow companies to charge a premium for collecting payment by credit cards.

The committee discussed their experiences as more companies are moving to charge a fee to accept credit card payments.

FAC provided feedback to educate the regulated members about the cost to CPSA on using credit cards for payment and about possible mechanisms to encourage people to pay using other methods such as pre-authorized payments where CPSA incurs a lower cost.

5) Non-Clinical practice category limited practice register fees

FAC received a report from Dr. Michael Caffaro, Assistant Registrar on a fee proposed for the proposed new non-clinical category limited practice register. Earlier, Council approved a non-clinical practice category and fee to the general register and the provisional register. This proposes to expand the limited practice register to include a non-clinical practice category.

FAC supported the fee of 25% of the annual fee for the limited practice register fee.

6) Q1 2023 activity update

a. CPSA Risk Register

FAC received a report from management on the CPSA Risk Register. Quarterly the leadership team identifies new risks and reviews existing risks to CPSA. Risks are classified as under the following categories:

- Financial
- Legal
- Operational/Strategic
- Reputational

FAC reviewed the process followed by management to identify and manage risk factors relating to the financial and operation management of CPSA and was satisfied with the process.

b. Business Activity Update

The Business Activity Update lists the key performance indicators (KPI), the associated targets and the actions/ tactics from the approved 2023 Business Plan. The document is broken down by the four business pillars.

FAC received a report on the business activity to the end of March 2023.

c. People & Culture Statistics and staffing update

FAC received a report for information outlining key human resource statistics for the first 3 months in 2023 compared to prior years.

d. Financial Results Q1 2023

As of March 31, 2023, there is a year-to-date excess of revenue over expenditures, before other items, of **$641,000** compared to the budgeted deficiency of $56,000 resulting in more revenue, or positive variance, of $697,000.

	31-Mar-23	Budget	Variance	
Revenues	(10,194,000)	(9,386,000)	808,000	9%
Expenditures	9,553,000	9,442,000	(111,000)	(1%)

Excess of revenue over expenditures before other items	**(641,000)**	**56,000**	**697,000**	
Development Costs	0	19,000	19,000	100%
Sub-total after Development Costs	(641,000)	75,000	716,000	
Amortization	215,000	219,000	4,000	2%
Accreditation, net	37,000	(27,000)	(64,000)	
Sub-total	(389,000)	267,000	656,000	
Fair value changes in investments	(1,401,000)	0	1,401,000	
Excess of revenues over expenditures for the year	**(1,790,000)**	**267,000**	**2,057,000**	

The fair value changes in investments consists of gains in the market value of investments since December 31, 2022.

The total excess of revenue over expenditures to the end of the quarter is $1,790,000.

7) Summary of FAC activity for 2022

FAC reviewed a summary of activity for 2022 compared to its role as listed in its Terms of Reference. The summary will be forwarded to the Governance Committee.

Next Steps:	n/a
List of Attachments:	
none	

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Submission to:	Council

Meeting Date:	Submitted by:		
May 25, 2023	Levonne Louie and Laurie Steinbach, Co-Chairs		
Agenda Item Title:	Governance Committee Meeting Summary Report		
Action Requested:	☐ The following items require approval by Choose an item. See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☒ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	N/A		
Background:	The Governance Committee met on March 15 and April 12, 2023, and discussed the following matters: 1. Evaluation Policy – Revisions to the Evaluation Policy were shared with the Committee before presenting it to the Executive Committee and Council for approval. See consent agenda. 2. Governance Structure – The Committee reviewed recommended changes to the Governance Structure at CPSA as well as a proposed policy for Committees. Further discussion on this topic and approval of the policy is included on Council's agenda. 3. Update re: Council member terms. – As part of the Governance Review Implementation Plan, processes, including an assessment tool, are being developed to allow for a renewal after the first three-year term for the regulated member positions on Council. This process will not be implemented until 2024. A recommendation will be brought forth at a future Council meeting for discussion and subsequent approval. 4. Nominations/Competency-based CPSA Council Member Selection Model – Discussions were held at both meetings and further information will be brought forward to Council for discussion on Council's May agenda. 5. Election of Council Chair at May Council Meeting – The Committee discussed the process and recommended		

revisions to the nomination form for the election of Council Chair. Nominations for Chair opened on April 3 and closed on April 28. The election (if required) will be conducted as part of the in-camera session on May 26, 2023.

6. Bylaw Review Work Plan – A brief update was provided to the Committee in March with an expectation that a full report on the plan to overhaul the CPSA Bylaws will be presented at the June Committee meeting.
7. Alberta Health and Alberta Health Services as part of CPSA Council – As requested at the February Council meeting, the Committee discussed this proposal. Further details, along with the decision of the Committee will be shared during the Council meeting.
8. Committee Annual Reports – As per its Terms of Reference, the Committee is tasked with annually confirming the Council Committee mandates. To facilitate this process, Committees are asked to submit an annual report of the activities they carried out in the previous year. As not all reports were available for the April meeting, the Committee will review all the reports at their June meeting. All reports will be shared with Council in September.
9. Regulated Member Election – The Committee reviewed the proposed timeline for the upcoming physician member election and provided feedback regarding promotion of the election in The Messenger. The timeline for the election of one regulated member for a term with an effective start date of January 1, 2024, is:

    August 16 – nominations open
    September 13 – nominations close
    September 20 – voting opens.
    October 18 – voting closes.

10. Committee Appointment – the Committee reviewed the request to appoint Jaelene Mannerfeldt to the Anti-Racism Anti-Discrimination Action Advisory Committee. See attached for the recommendation for Council approval of same.
11. Council observers/non-voting roles – The Committee is working to develop clarity around the expectations for Council observers and how to ensure expectations are aligned with Council's mandate and responsibilities. The conversation will be revisited in June.
12. Communications Plan around Governance Review Changes – Andrea Garland, Communications Director attended the Committee meeting to discuss the Communication Plan relative to the implementation of the Governance Review. Of

	particular interest for the Committee is ensuring the membership is aware of the proposed changes to the election of physician members on CPSA Council. This work is ongoing. 13. Council Retreat, 2024 – a list of potential topics for the 2024 Council Retreat were reviewed and shortened. Additional information and a recommendation are provided under separate cover.

List of Attachments:
1. Council Retreat 2024 (for approval) 2. Appointment to Anti-Racism Anti-Discrimination Action Advisory Committee (for approval)

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

Submission to:	**Council**

<table>
<tr><td>Meeting Date:</td><td colspan="3">Submitted by:</td></tr>
<tr><td>May 25-26, 2023</td><td colspan="3">Governance Committee</td></tr>
<tr><td>Agenda Item Title:</td><td colspan="3">2024 Council Retreat</td></tr>
<tr><td>Action Requested:</td><td>☒ The following items require approval by Council See below for details of the recommendation.</td><td>☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.</td><td>☐ The attached is for information only. No action is required.</td></tr>
<tr><td colspan="4">AGENDA ITEM DETAILS</td></tr>
<tr><td>Recommendation:</td><td colspan="3">That Council approves the theme of: Authentic Indigenous Connections for the 2024 Council Retreat.</td></tr>
<tr><td>Background:</td><td colspan="3">The Governance Committee TOR includes the following Role/Responsibility:

• Develops themes and goals for the annual Council retreat.

The 2023 CPSA Council Retreat themes were:

• The future of health care: challenging Council to think innovatively about how CPSA delivers on its mandate to ensure a successful and safe future for Albertans accessing medical care.
• Good governance/High-performing Council: considering shared purpose and how to work together effectively in challenging and uncertain times.

At its April 2023 meeting, Governance Committee considered several ideas for the 2024 CPSA Council Retreat (Tentative dates: January 26-27) and support a Retreat that furthers CPSA Council's work on Authentic Indigenous Connections. The Retreat could include the following:
• view the film "Unforgotten" with a facilitated discussion.
• visit Blue Quills residential school, a tour and discussion facilitated with a residential school survivor (Blue Quills is located 2 hours north east of Edmonton).</td></tr>
</table>

	◦ an alternate location of southern Alberta was also suggested, with further work to be done to identify the specific location.
	
	In addition to the above suggestions, the Committee also discussed engaging a speaker with a message of hope, strength and resilience (one suggestion was Ryan Straschnitzki, a member of the Humboldt Broncos or someone with a similar message).
	
	Some other topics that were supported:
	• Anti-racism anti-discrimination – workshop with facilitated discussion (and perhaps scenarios and debriefing) to make progress in becoming anti-racist and anti-discriminatory, perhaps with a focus on micro-aggressions to expand on the online micro-aggressions course for physicians. (one suggestion for a speaker/facilitator is: Dr. Nicole Johnson)
	• Trust in public institutions.
	    • Is it important that people have trust in public institutions?
	    • What are the general risks of declining trust in public institutions?
	    • What are the risks for the public interest?
	    • What are key drivers of trust in institutions/regulators?
	    • What can CPSA do to build trust amongst the public?
	        ◦ Enhanced understanding of the role of the College through increased communications/engagement with the public
	        ◦ Measure the understanding and levels of trust

Next Steps:	• Council to approve a Retreat theme. • Governance Committee will provide input to the Retreat Agenda as it is developed.

List of Attachments:
N/A

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& SURGEONS OF ALBERTA

Submission to:	Governance Committee

<table>
<tr><td>Meeting Date:</td><td colspan="3">Submitted by:</td></tr>
<tr><td>May 25, 2023</td><td colspan="3">Levonne Louie and Laurie Steinbach, Co-chairs</td></tr>
<tr><td>Agenda Item Title:</td><td colspan="3">Anti-Racism Anti-Discrimination Action Advisory Committee Appointment</td></tr>
<tr><td>Action Requested:</td><td>☒ The following items require approval by Governance Committee See below for details of the recommendation.</td><td>☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.</td><td>☐ The attached is for information only. No action is required.</td></tr>
<tr><td colspan="4">AGENDA ITEM DETAILS</td></tr>
<tr><td>Recommendation :</td><td colspan="3">The Governance Committee recommends that Council appoints Jaelene Mannerfeldt to the Anti-Racism Anti-Discrimination Action Advisory Committee (ARADAAC) for the remainder of 2023.

And further

That Dr. Mannerfeldt be retroactively reimbursed for her participation in the May 4 ARADAAC meeting.</td></tr>
<tr><td>Background:</td><td colspan="3">The ARADAAC Terms of Reference state that up to 6 Council members can be part of the Committee. Currently 2 Council members are appointed to the Committee. As such and in consultation with ARADAAC, Dr. Jaelene Mannerfeldt has put her name forward to join the Committee.</td></tr>
<tr><td>Next Steps:</td><td colspan="3"></td></tr>
<tr><td colspan="4">List of Attachments:</td></tr>
<tr><td colspan="4">1. ARADAAC TOR</td></tr>
</table>

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

Submission to:	Council

<table>
<tr><td>Meeting Date:</td><td colspan="3">Submitted by:</td></tr>
<tr><td>May 25, 2023</td><td colspan="3">Dr. Gordon Giddings, Assistant Registrar, Accreditation</td></tr>
<tr><td>Agenda Item Title:</td><td colspan="3">Medical Facility Accreditation Committee Report</td></tr>
<tr><td>Action Requested:</td><td>☐ The following items require approval by Choose an item. See below for details of the recommendation.</td><td>☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.</td><td>☒ The attached is for information only. No action is required.</td></tr>
<tr><td colspan="4">AGENDA ITEM DETAILS</td></tr>
<tr><td>Recommendation (if applicable):</td><td colspan="3">Not applicable</td></tr>
<tr><td>Background:</td><td colspan="3">The Medical Facility Accreditation Committee (MFAC) met on February 15, 2023 and April 26, 2023 addressed the following:

1. Welcome to New Chair
• Dr. Ian Walker, Council Physician Member

2. Welcome to New Members
• Dr. Maria Bacchus
• Dr. Jesse Slade Shantz
• Dr. Nazneem Wahab
• Dr. Dominic Cave

3. Facility Accreditation/Physician Approvals
• Completed a 4 Year review of the following accredited facilities:
o Pulmonary Function - 16
o Sleep Medicine - 4
o Diagnostic Imaging – 102
o Laboratory Medicine - 19
o Neurodiagnostics – 9
o Non-Hospital Surgical Facilities - 1

• Completed the accreditation of the following new facilities/new modalities/facility moves/facility closures/facility renovations:
o Sleep Medicine – 13
o Diagnostic Imaging – 28
o Pulmonary – 5
o Neurodiagnostics – 3</td></tr>
</table>

- Laboratory – 1

4. New Advisory Committee Member Approvals

- Laboratory medicine – 1

5. Advisory Committees – Terms of Reference

MFAC approved the revisions to the Terms of References for the Advisory Committees removing the privileging and physician approvals pieces from the Roles and Responsibilities sections.

6. Standards

The following annual standards revisions were approved:

- Laboratory Medicine
- Diagnostic Imaging (except the Teleradiology component)
- Pulmonary Function Diagnostics

Standard revisions regarding the discontinuation of physician approvals by CPSA were approved for all disciplines as applicable.

The following new standard documents were recommended to Council for approval:

- Psychedelic Assisted Psychotherapy

7. The following were discussed In Camera:

- Neurodiagnostic Advisory Committee structure (not for decision)
- MFAC Meetings – change to advisory committee audit process
- Planned review of NHSF Program

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& SURGEONS OF ALBERTA

Submission to:	**Council**

Meeting Date:	Submitted by:		
May 25, 2023	Dr. Gordon Giddings, Assistant Registrar, Accreditation		
Agenda Item Title:	Standards for Non-Hospital Surgical Facility Accreditation: General		
Action Requested:	☒ The following items require approval by Council See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☐ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable):	Approve the revised Standards for Non-Hospital Surgical Facility Accreditation General		
Background:	Revisions have occurred to the NHSF standards. The revisions comprised of amalgamating facility process requirements and removing the specificity of perioperative personnel qualifications. MFAC (Medical Facility Accreditation Committee) has approved these revisions and requests Council consideration and approval. Council has previously reviewed and supported these standards. A revised version of the NHSF accreditation Standards was distributed October 12, 2021 with an expected implementation in fall 2022. After circulation, the NHSF community strongly requested further revisions to the standards including considerations for the COVID-19 response. A decision to delay the implementation to facilitate further review of the standards was communicated by Dr. Giddings to Council at the March 2022 meeting. Revisions have been completed based on the feedback of stakeholders and pending Council approval, they will be circulated to NHSFs in early October, 2023. Assessments would begin in January, 2024. The three-month timeframe for facilities to adopt		

	revised standards is reasonable considering they are not new standards, facilities have reviewed previous versions, and the revisions have less prescriptive requirements. CPSA and College of Dental Surgeons of Alberta (CDSA) are working on a collaborative facility accreditation model in facilities where both colleges have regulatory oversight (dental facilities where physicians provide anaesthesia). In order to facilitate this process, there was an agreement that these standards would only apply to medical facilities at this time and facilities that complete primarily dental procedures will continue to follow the current standard until a specific standard and process is developed by MFAC and DFAC (Dental Facility Accreditation Committee) for consideration. The enclosed standards reflect the applicable changes
Next Steps:	The new standards will be circulated to facilities in early fall of 2023 through Accreditations standards process. NHSFs will be assessed by these revised facility accreditation standards in 2024. These new standards will only apply to medical facilities. Facilities where the services are primarily dental surgery will continue to be assessed to the current standards. CDSA and CPSA have agreed to the impacted facilities. CDSA (Dental Facility Accreditation Committee) and CPSA (MFAC) will collaborate to develop a specific standard and shared process for these facilities to be brought forward for approval at a future date.
List of Attachments:	

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Submission to:	**Council**

Meeting Date:	Submitted by:		
May 25, 2023	Dr. Michael Caffaro		
Agenda Item Title:	Currency of Practice		
Action Requested:	☐ The following items require approval by Choose an item. See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☒ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	N/A		
Background:	At Council's February 2023 meeting, staff were asked to provide information on 'currency of practice' determinations in the registration process. FMRAC's Model Standards for Medical Registration in Canada (December 2021) outline the current recommended currency standard for an applicant to independent medical practice: "1.2 Currency of practice Upon submission of the completed application, the candidate must provide documented evidence of having been in discipline-specific formal training or discipline-specific independent practice within the last three years." FMRAC's Registration Working Group will be reviewing the Model Standards in the near future, inclusive of currency of practice. The College of Physicians and Surgeons of Nova Scotia have (February 2022) commissioned a review of available literature on currency by Dr. E. Wenghofer (Laurentian University); her information suggested an 'average' time of 2.8 years as representing lack of currency.		
Next Steps:	Update Council as FMRAC Model Standards for Registration evolve.		

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List of Attachments:
1. FMRAC Model Standards for Medical Registration 2. CPSNS Briefing note February 10, 2022

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PHYSICIANS & SURGEONS
OF NOVA SCOTIA

Suite 400 – 175 Western Parkway
Bedford, Nova Scotia
Canada B4B 0V1
Phone: (902) 422-5823
Toll-free: 1-877-282-7767
Fax: (902) 422-5035
www.cpsns.ns.ca

BRIEFING NOTE

TO:	Registration Policy Committee
FROM:	Dr. Keri McAdoo, Deputy Registrar
SUBJECT:	Currency of Practice Experience
MEETING DATE:	Thursday, February 10, 2022

ISSUE BEFORE THE COMMITTEE

Summary of Issue

The College's policy on *Currency of Practice* (attached) has evolved over the years to define "currency" more precisely and to allow a greater range of practice arrangements to be considered current, without compromising patient safety.

The current policy states that a physician must be engaged in half-time practice for at least 6 months of the previous 3 years. The 6 months in practice do not have to be consecutive.

During this year's annual licence renewal, we came across physicians who were unfairly identified as "out of currency" because of their unique practice arrangements. The stumbling block was the requirement that half-time practice specifically occur over 6 months.

Because of this, the College recommends that we remove the requirement for time in practice to occur over 6 months in a 3-year period. Instead, we recommend that we assess currency simply as a number of hours over a 3-year period.

Affected Policies

Currency of Practice Experience (attached)

Pathway to Licensure for International Medical Graduates via a Practice Ready Assessment – Family Medicine (attached)

Pathway to Licensure for International Medical Graduates via a Practice Ready Assessment: Specialists and SEAP Status Affiliates (with a primary specialty of Internal Medicine) (attached)

> The change to our currency requirement affects only one sentence in each of the two PRA policies. As the PRA policies are very long, we have bookmarked the revised sentence in the policies.

Committee's Authority to Provide Direction on this Issue

Section 11(1)(a) of the *Medical Act* gives the committee the authority to make regulations (that is, policies) respecting registration and licensing.

ABOUT THE POLICY

Legislative Authority for the Policy

Section 16(1) of the Medical Practitioners Regulations ("the Regs") states that a physician must undergo a competence assessment when returning to practice after an absence of 3 years or more.

Similarly, Section 16(2) of the Regs state that a physician must demonstrate competence when changing their scope of practice to one in which they have not practised for 3 years.

However, neither of these clauses specify what is meant by "absence" or "not practised" and thus, a policy is needed to expand on the legislation.

Current Policy

The College policy on *Currency of Practice Experience* defines how much a physician must work over a 3-year period to avoid being absent from practice – or in other words, to be considered current in practice.

Under the existing policy, a physician must be engaged in "regular" practice, for at least 6 months of the previous 3 years. The 6 months in practice do not have to be consecutive.

The College defines "regular" practice as a minimum of half-time clinical practice. Half-time is considered to be 900 hours per year (or 75 hours per month). This value assumes that full-time practice is 1800 hours per year (or 150 hours per month).

Thus, a physician working half time for 6 months would work 450 hours.

National Standards on Currency

Our policy on *Currency of Practice Experience* takes its direction from legislation – primarily in regard to the requirement for currency to be measured over a 3-year period.

However, it is reassuring to note that we are in alignment with the FMRAC Model Standards for Medical Registration in Canada ("the model standards") [link to an attachment], which defines currency of practice as "discipline-specific formal training or discipline-specific independent practice within the last three years."

DISCUSSION: POLICY CHANGE

Need for a More Flexible Definition of Currency

During this year's annual licence renewal, we came across physicians who are unfairly identified as "out of currency" because of their unique practice arrangements – Academic physicians being a notable example. See the attached correspondence from Dr. Mulvagh. [link]

Academic physicians are required to maintain a clinical practice that is 20-50% of their overall practice. The remaining 50-80% of their time is spent teaching and in research. Often, these physicians do not meet the half-time requirement for clinical practice in any given month, however they are engaged in clinical practice on a consistent and ongoing basis.

Similarly, we learned that many Family Medicine physicians have a regular 20-50% clinical practice which falls short of the current policy.

It does not make sense to flag these physicians as lacking currency, given the consistent and ongoing nature of their practices. Furthermore, if we flagged these physicians as lacking currency, our policy would require us to work with them to ensure they are meeting the 50% marker for clinical practice at least 6 months over 3 years. This would not be a productive use of anyone's time, under the circumstances.

Thus, I recommend that we continue to require 450 hours in clinical practice over a 3-year period, however the hours may be spread out in any way over the 3 years, rather than required in 6 monthly sessions.

This change maintains the spirit and intention of our policy, which is that physicians remain current in practice by working a minimum number of hours.

Research on Currency

In early 2021, I asked Elizabeth Wenghofer, PhD and Full Professor at Laurentian University in the School of Rural and Northern Health to review evidence regarding currency of practice. Dr. Wenghofer's response was that there is really no evidence that definitively suggests how long out of practice is too long.

Dr. Wenghofer provided some articles most closely related to this question. One article looked at performance on assessment which showed the longer a physician is out of practice, the worse the outcome. Another showed that the average length of time considered to be out of currency was 2.8 years with a mode of 2 years. Other articles focused on challenges in re-entry and approaches.

Jurisdictional Scan

In early 2021, we conducted a jurisdictional scan on currency, shown below. Currency practices across the country have not changed since early 2021.

As you can see, most provinces measure currency within the last 3 years, in accordance with the Model Standards. However, the requirement for time in practice in that 3-year period varies widely.

Nova Scotia is most closely aligned with British Columbia; that province requires 960 hours over a 3-year period. Some look to the Australian standard which requires a minimum of 12 weeks full-time equivalents over 3 years which is a total of 456 hours.

Three years as the limit	
QC	either no practice in 3 years *or* 2 years if it was due to suspension or restriction *or* less than 12 months in 5 years
SK	requires practice in last 3 years *and* at least 5 months in last 5 years
AB	require at least 1 year of practice in 'home' discipline in the previous 3 years
BC	24 weeks of practice (8 hours per day, 5 days per week) in last 3 years

Two years as the limit	
NB	must practice within last 2 years. For every year of inactive practice, must retrain for 1 month
ON	must have practised within previous 2 years with no set minimum amount. They have moved to this requirement from 3 years *or* 6 months over 5 years

Conclusion

We will continue to monitor our policy on *Currency of Practice Experience* as we gather information from physicians and as the body of research in this area grows.

DISCUSSION: RELATED ISSUES

How Many Hours is Full Time?

The College is attempting to increase awareness among physicians of the importance of maintaining currency. To that end, we added questions on the 2022 annual renewal form about currency of practice.

In response to these questions, we received feedback from specialties that consider full-time practice to be less than 1800 hours. For example:

- The accepted 1.0 FTE in Emergency Medicine is 1340 hours per year.
- The accepted 1.0 FTE in Family Medicine is 1760 hours per year.

You will also have seen Dr. Mulvagh's request[link] that we consider different clinical practice hour requirements for academic and non-academic practitioners, as well as general practice/family practice, and subspecialty practice practitioners, according to scope of practice.

Thus, it is possible that our current benchmark for full-time practice is unfair. For now, we just want the committee to be aware of this feedback. We do not recommend any changes to the policy to address this issue at this time.

I have asked various departments to provide the College with written submissions that support their positions regarding how many hours constitute 1.0 FTE. Once we have more information and a recommendation for policy change, we will present it to the committee.

Other Issues Raised by Dr. Mulvagh

In addition to the aforementioned requests from Dr. Mulvagh, [link] she would like the College to consider:

- Inclusion of educator roles as evidence of currency of practice.
- Pro-rating CPSNS dues according to clinical practice FTE.

We will consider the first request when we review our benchmark for full-time practice. I will forward her second request to the Finance and Audit Committee.

ACTION REQUESTED OF COMMITTEE

The committee is asked to approve the following revised policies:

Currency of Practice Experience (attached)

Pathway to Licensure for International Medical Graduates via a Practice Ready Assessment – Family Medicine (attached)

Pathway to Licensure for International Medical Graduates via a Practice Ready Assessment: Specialists and SEAP Status Affiliates (with a primary specialty of Internal Medicine) (attached)

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

Submission to:	**Council**

Meeting Date:	Submitted by:		
May 25, 2023	Dr. Michael Caffaro		
Agenda Item Title:	New registration policy – 'Nonclinical Practice Category Limited Practice Register – Clinical Surgical Associates'		
Action Requested:	☒ The following items require approval by Council See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☐ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	THAT Council approves: • the Limited Practice Register (Non-clinical) Policy that creates the registration category of "nonclinical" for members on the Limited Practice Register; and • the cost for the 'non-clinical' category is set at 25% of the regular permit fee.		
Background:	CPSA Council, at its September 2022 meeting, provided its approval for regulated members on either the General or Provisional Registers to have a "nonclinical" category applied to their registration, with the annual fee set at 25% of the regular annual permit. Regulated members and CPSA staff have identified the need for a similar "nonclinical" category for those on the Limited Practice Register.		
Next Steps:	• Non-clinical category will be available to the Limited Practice Register as soon as possible. • All policies related to the new non-clinical category will be posted to the CPSA website.		
List of Attachments:			
Refer to the CPSA website for the approved policy			

COLLEGE OF PHYSICIANS & SURGEONS OF ALBERTA

Submission to:	**Council**

Meeting Date:	Submitted by:		
May 25, 2023	Dr. Michael Caffaro		
Agenda Item Title:	Registration - Non-accredited approvals		
Action Requested:	☐ The following items require approval by Choose an item. See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☒ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	N/A.		
Background:	At the September 8, 2022, meeting, Council was presented with a request to rescind the *Standard of Practice Medical Services Requiring of Accreditation Outside of Hospitals,* which would remove the requirement for CPSA approval for both hair transplantation and acupuncture. Historically, hair transplantation was originally felt to carry a greater risk to the public and require more attention in infection prevention and control (IPAC), thus justifying specific approval (Council Motion C-21-09). Advancements in practice and improvement in IPAC processes have been significant, and risks to Albertans is seen to be minimal. Acupuncture was originally viewed as a treatment outside conventional therapy, justifying specific approval (Council Motions C-162-91 and C-77-94). Previous CPSA Council (December 2020) supported the removal of acupuncture as a specific approval as only one other province at the time regulated the practice and risk to Albertans was seen as minimal.		
Next Steps:	Approvals for Acupuncture and Hair Transplantation will be removed from CPSA's website.		
List of Attachments: 1. Council Report Form on Consultation 022 September 8, 2022 2. Council Motions C-21-09 C-162-91 C-77-94			

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

Submission to:	**Council**

Meeting Date:	Submitted by:		
September 8, 2022	Mr. Jason MacDonald and Ms. Chantelle Dick		
Agenda Item Title:	Consultation 022: approval for implementation		
Action Requested:	☒ The following items require approval by Council See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☐ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Background:	Consultation on proposed amendments to the draft *Infection Prevention and Control* (IPAC)-formerly *Reprocessing Medical Equipment*-standard and the rescission of the *Medical Services Requiring Accreditation Outside of Hospitals* standard took place from Mar. 21-Apr. 20, 2022. IPAC Standard of Practice The IPAC standard received 22 responses consisting of comments from 10 physicians, 3 partner organizations and 9 surveys completed. Feedback included predictable concern regarding the burdens that come with complying with infection prevention and control requirements, but overall there was support for the changes. The IPAC standard was last amended in 2010 and has been renamed and broadened to better clarify and emphasize that regulated members must follow all infection prevention and control requirements set out by CPSA, not just those for reprocessing medical devices. Amending this standard does not add, remove or alter any existing requirements and is supported in full by the IPAC Program and Advisory Committee. This change aims to eliminate confusion expressed around multiple uses of the term "standards." Currently, the standard of practice requires physicians to follow the Medical Device Reprocessing Standards. Upon approval of the IPAC standard, the program area will rename its "standards" as "requirements" to eliminate this confusion. The current IPAC General Standards will be renamed "IPAC Requirements for Medical Clinics." The current Medical Device Reprocessing Standards will be "Reusable & Single Use Medical Device Requirements for Medical Clinics."		

COLLEGE OF PHYSICIANS & SURGEONS OF ALBERTA

	<u>*Medical Services Requiring Accreditation Outside of Hospital* Standard of Practice</u> The *Medical Services…* standard has also not been updated since it was published in 2010. As it is addressed by Accreditation's Non-Hospital Surgical Facilities standard, facility inspection, approval and operation is the purview of the Accreditation Department, making this standard redundant. The *Medical Services…* standard received 24 responses consisting of comments from 6 physicians, 1 partner organization and 17 surveys completed. Concerns were raised regarding the loss of the approval process for acupuncture and hair transplantation that would accompany rescission of this standard. The acupuncture approval requirement was reviewed when the *Practising Outside of Established Conventional Medicine* standard (formerly *Complementary and Alternative Medicine*) was updated in Dec. 2020. CPSA is the only regulator in Canada–other than CPS –with an approval process for acupuncture. At that time, Council supported the removal of this requirement, as it is no longer considered an alternative treatment, and the risk to the public is minimal. Historically, it was thought that hair transplantation required approval in order to mitigate infection prevention and control risks associated with reprocessing unique types of medical devices. This approach has created inconsistency between this procedure and other similar invasive aesthetic procedures that do not require Registrar approval. In addition, hair transplant technology and modalities have improved significantly since the standard was published, reducing patient risk. These services will not become unregulated; regulated members who perform acupuncture or hair transplantation will remain accountable to follow measures set out in the IPAC standard (e.g., hand hygiene, sharps management, sterilization, etc.). Further, risks associated to these and other invasive procedures will be more quickly identified and mitigated with the commencement of a CPSA medical clinic registry.
Recommendation:	That Council approves the updated version of the *Infection Protection and Control* standard (formerly *Reprocessing of Medical Equipment*) which incorporates the feedback from the consultation process, for implementation on November 1, 2022. That Council approves the rescission of the *Medical Services Requiring Accreditation Outside of Hospitals* standard effective October 1, 2022 as recommended during the consultation process.

C-21-09 That a physician who performs hair transplantation on patients outside of a hospital must provide evidence of training and compliance with infection prevention and control standards and be approved by the Registrar.

C-162-91 THAT, because medical acupuncture is an accepted treatment modality carrying risks if inappropriately administered, the procedure should only be carried out by physicians approved for same by the Registrar.

THAT, for a medical practitioner to practise acupuncture in the Province of Alberta, he/she must hold a Certificate from the Acupuncture Foundation of Canada and be accredited by the College of Physicians and Surgeons of Alberta.

C-77-94 THAT, for a medical practitioner to practise acupuncture in the Province of Alberta, he/she must hold a certificate from either the Acupuncture Foundation of Canada or the University of Alberta Program on Medical Acupuncture, and must be accredited by the College of Physicians and Surgeons of Alberta.

Chair's Report
College of Physicians and Surgeons of Alberta Governing Council

Prepared for May Council – May 25th and 26th, 2023.

March 2023

- March 7th — Canadian Strategy Group – UCP Leadership Dinner
- March 9th — Alberta Medical Association Spring Rep Forum
- March 10th — Alberta Medical Association Spring Rep Forum
- March 15th — Governance Committee Meeting
- March 21st — Rural Municipalities of Alberta Conference
- March 22nd — Building Fund Initiatives Working Group

April 2023

- April 3rd — Meeting with the Registrar
- April 12th — Governance Committee Meeting
- April 12th — Building Fund Initiatives Working Group
- April 17th — Council Agenda Planning Meeting
- April 25th — Meeting with College of Dental Surgeons of Alberta
- April 26th — MFAC Meeting
- April 27th — KPI Working Group Meeting

May 2023

- May 1st — Building Fund Initiatives Working Group
- May 1st — Executive Committee Meeting
- May 2nd – 6th — Federation of State Medical Boards Conference
- May 4th — Building Fund Initiatives Working Group
- May 12th — FAC Meeting
- May 18th — RhPAP Presentation
- May 25th — CPSA Council
- May 26th — CPSA Council
- May 29th — Competence Committee Meeting
- May 31st — CPSA AMA Executive Committee Meeting

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

Registrar Report

To: CPSA Council
From: Scott McLeod
Date: May 25th, 2023

Introduction

We're only days away from the conclusion of the Provincial election and with that comes a great deal of uncertainty for the coming months. No matter the outcome of the election, CPSA's approach will be consistently focused on our mandate. We will continue to do our work in the best interest of Albertans and meet our legislated mandate to protect and serve the public. We have always been, and will continue to be, an apolitical organization that lives by its values and is guided by our Strategic Plan.

There is a great deal going on in regulation across Canada and around the world right now and my intent with this report is to provide you with a very brief summary of some of what's going on. Some of this will be my broader interpretation of trends and may not have significant evidence behind it yet, but that will unfold in the months and years to come.

I. CPSA Organizational Updates

A. Staff Engagement Survey –

One of the key findings in the engagement survey was related to productivity. This was mostly directed toward our IT systems and therefore the Chief Information Officer, Jim Kiddo, and his team did a thorough review of our systems. They reached out to each department to identify the specific concerns and came up several options to address the major concerns. This exercise was very informative, and the CIO has already started implementing solutions such as upgrading some existing computers and replacing others. It has also become apparent that we need fewer software systems, and we need more training in how to use the software we have across CPSA.

The People and Culture Department has also established an advisory group for CPSA called the Culture Crew, with representation from each department. This team has helped prioritize the efforts in addressing the findings from the engagement survey. One that has been prioritized is breaking down the silos in our organization. They have initiated some activities to improve everyone's understanding of other departments and build connections with others across the organization.

We have also started a CPSA 101 training day to help all new employees onboard with the organization and learn more about the work of each department.

There is still a great deal of work ahead of us, but I believe we are on our way, by focusing on truly seeing everyone and their contributions and being seen more by increasing the transparency of our decision making.

B. Age Related Cognitive Decline

In 2021 Council supported the development of a report on age related cognitive change among physicians. This was directly related to the reality that Alberta has an aging population of physicians, and aging may be associated with cognitive changes. At the time CPSA had no good understanding of the likely implications of this. After a request for proposals went out to generate the report, several replies were received and the consultancy group *Risk Sciences International (RSI)* was selected to undertake the work. Work included a comprehensive, systematic literature review to address specific questions. A final report on this project has now been provided to CPSA. In order to try to make the best use of the work, a manuscript has been produced for publication in a peer reviewed journal.

The main conclusions of the report were:

1. Cognitive abilities of physicians, such as visual information processing, reaction time, visual learning and memory, verbal memory, and reasoning, decline with increasing age in an age range where physicians are still practicing. The rate of decline varies both across different cognitive functions and among individuals.
2. Many studies have suggested that physician competence and clinical performance also decline with age.
3. Cognitive test scores are lower in physicians referred for assessment because of competency or clinical performance concerns when compared to control physicians with no such concerns.
4. Physicians are not able to accurately assess their own cognitive abilities or clinical performance. Physicians may continue to practice despite a significant decline in the quality of care they provide; on the other hand, perceived cognitive decline, although it does not reflect true abilities, may accelerate physicians' decisions to retire. Physicians are also generally reluctant to report their colleagues' cognitive problems.
5. Scientific evidence linking cognitive test results with physician performance is still a significant data gap. Furthermore, there are no known standards on the level of cognitive decline at which a doctor is no longer fit to practice. Domains of cognitive abilities required for different medical specialties likely vary broadly, due to the diversity of skill sets across medical fields.
6. Outcomes of most currently available cognitive assessment tools are difficult to interpret due to lack of normative data for physicians. Cultural and language factors affect performance on cognitive testing, which should be accounted for because many practicing physicians are graduates from international medical schools.
7. There are additional complex factors that will need to be weighed in the decision-making process for implementing any proposed cognitive assessment of physicians, including ethical, legal, and financial considerations.

This report will be helpful to CPSA Council and Staff in determining any necessary actions regarding aging physicians in Alberta. The full report, 'Physician Age Related Cognitive Decline', is available at this link in the meeting folder. Importantly, one outcome of the review undertaken was a recognition that while the report addressed cognitive changes associated with 'normal' aging, it did not address cognitive changes that may occur due to health conditions associated with increased age, such as diabetes, hypertension, Parkinson's disease, stroke, etc. Additional work is currently being considered to address this issue.

C. Registration updates

1. *Practice Readiness Assessment (PRA) Pilot Project*: As of the week of May 1, 2023, there were a total of 86 applicants for eligibility under the pilot project for approved jurisdictions. The majority of these are nonfamily medicine specialists. Only 12 of these individuals were family medicine physicians. This may however not be a surprise, as most family medicine practitioners coming from the approved jurisdictions will likely have their credentials accepted as equivalent by the College of Family Physicians of Canada and proceed directly onto the General Register.

   There are currently four candidates who have now moved into Assessment and are either in or about to enter a Supervised Practice Assessment (representing practices in anesthesiology and obstetrics and gynecology).

   The REVU team has put together a proposal for assessing the effectiveness and safety of the pilot program. Attached is a summary of that proposed methodology for your information.

   The PRA Pilot remains the subject of interest by our colleagues in other regulatory jurisdictions.

2. *The Non-specialist specialist category of registrant*: This has recently come under fire because there are several physicians in Alberta who are practicing in their discipline and being paid different rates because they are classified as a "non-specialist" by CPSA. The reason they have been differentiated is normally because they do not have the same qualifications as a Canadian specialist, and this is a historic way of differentiating them. At the end of the day CPSA has deemed them to be competent to practice. We are looking at solutions on how we can better classify these registrants, but at the end of the day CPSA is not involved in how Alberta Health chooses to pay physicians. This should be a matter between the Alberta Medical Association and Alberta Health.

3. There have been many changes to the registration of International Medical Graduates for other jurisdictions in Canada therefore the following is a brief summary of some important changes.
   a. College of Physicians and Surgeons of Nova Scotia (CPSNS) was the first of two jurisdictions to offer a route to general licensure for American Board-certified physicians (without having evidence of completing Royal College certification) as of March 6, 2023. The impact of this move is currently unknown as CPSNS has not provided any updates regarding the impact of this decision.
   b. The College of Physicians and Surgeons of Ontario identified similar changes to their registration process, including a defined oversight period to allow for limited practice by American Board eligible applicants. These individuals are expected to complete either their US certification examinations or Royal College examinations in a relatively short

timeframe or their practice permit is rescinded. Information provided suggests there has been minimal to no increase in active registration of American Board-certified individuals in Ontario since that announcement.

c. There has been no discernible impact on CPSO's registrations following the introduction of the Ontario government's "as of right" proposal (allowing healthcare professionals to work in that province without registration). The reality of this new approach is not as open as the media may have portrayed it and details will unfold over time. For example, it is my understanding that these physicians must still practice in an environment where they require privileges to practice. In most of those situations, you need a licence before you can be privileged. Concern such as the ability of the practitioner to obtain a billing number remain.
d. While CPSBC is proceeding with registering Clinical Associates (the equivalent of CPSA's Limited Practice Register), they have not been given the legislative authority to begin the process of regulating Physician Assistants. Alberta, Manitoba and New Brunswick remain the only provincial jurisdictions which fully regulated Physician Assistants and allow "fullscope" practice.
e. The Government of Manitoba recently removed from legislation the requirement of MCC QE Part 1 completion prior to an internationally trained medical graduate obtaining provisional registration. Whilst CPSM has implemented this change for an applicant to their process, the IMG making application is still required to undergo a PRA and must still have a full LMCC (which at this writing includes the MCC QE 1) before transitioning to an unrestricted or full registration.

D. Continuing Competence

Attached is a short briefing note on some work that Continuing Competence has recently introduced into their quality assurance (QA) process. Essentially, they have added a trial screening question to detect bias and its effects on patient care to their QA assessments. I encourage you to read the attached briefing note.

E. Project Bluebird update

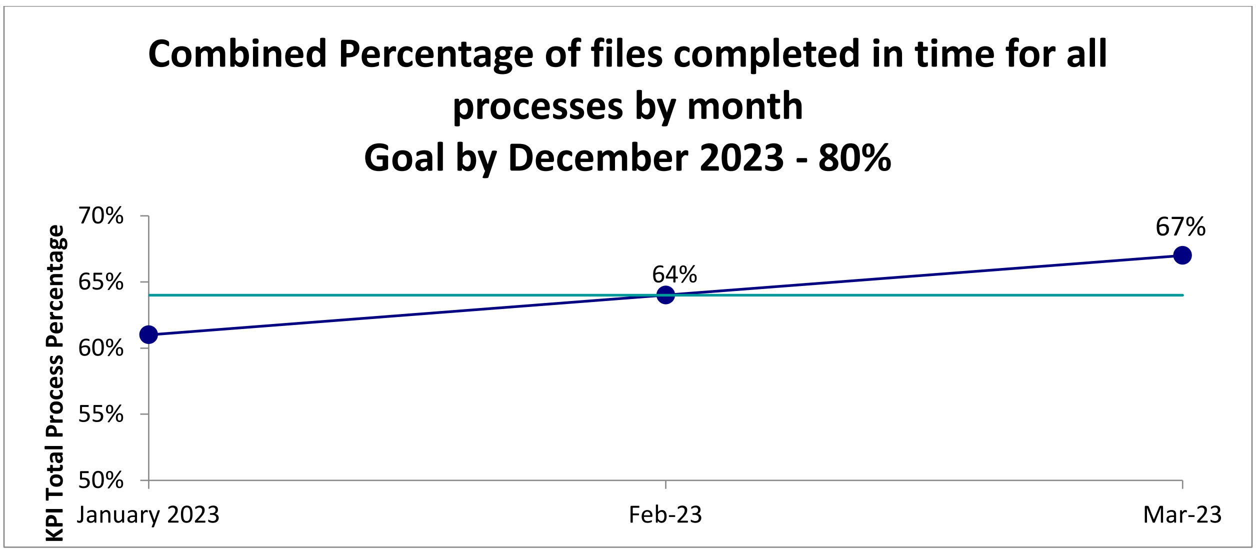
The Professional Conduct Department is now just over 2 years into their quality improvement journey commonly referred to as Project Bluebird.

During the first quarter of 2023, the department continues their work to transition to a new electronic complaint platform, which will allow complainants to submit complaints electronically. This will enable a complainant to track the progress of their complaint through the online platform. Of course, those who choose to submit a paper form may continue to do so. This platform will also enhance the efficiency of the team's work and enable better access to data to monitor processes.

In terms of recruitment, Professional Conduct has three positions that remain unfilled, which includes an Administrative Assistant for our Intake/Resolution team: an Investigator, as well as the new role of Deputy Complaints Director. In the meantime, the team is working hard to complete tasks within the original timeframe despite ongoing gaps in their workforce. They anticipate all roles will be filled by the fall of 2023.

The department continues to fine tune data collection, which has been very important for ongoing monitoring of processes. They are beginning to see the results of the changes to the system as the backlog of work resolves:

- In 2023, 278 new complaints were opened, and 169 complaints have been closed.
- In January of 2022 there were 177 complaint files awaiting assignment to an investigator. As of May 3, 2023, there are 76.
- In January of 2023, 55 files were awaiting assignment for expert opinion, as of April 2023 there are 15.



The reporting metric for Council is a combined weighted score from all work streams that provides the percentage of files completed in window by work stream. The team is on track to achieve the target team score of 80% by December 2023. At this time, they are making tremendous progress around expert opinion and investigation area, which are areas of delays. They have done this by having a team "blitz" to identify experts in January of 2023, and the ongoing use of external investigator firms to assist with the backlog of investigation files amongst other tweaks to the system.

F. Online Micro-Aggressions Training Course for Physicians

Anti-racist action is aligned with the strategic directions of CPSA, AHS and AMA. Beginning in Summer 2022, the three organizations worked as partners to develop a 1.5-hour online course: "Micro-Aggression Training for Physicians". A Steering Committee and the multi-stakeholder Course Content Working Group met regularly starting in September 2022. The

Course Content Working Group, made up mainly of physicians with lived experience with racism and discrimination, was pivotal to ensuring content was relevant. Onlea was the online education company that was contracted to develop the course.

The goal of the project was to help position CPSA's regulated members as leaders in addressing racism in healthcare settings.

The course will be hosted on CPSA's online learning platform, myCPSA, accessible through the Physician Portal. Completion of the course is voluntary; CME accreditation is being pursued to incentivize participation.

In March/April, approximately 30 individuals were identified by the partner organizations to test the course and provide comments and thoughts about future work. The course has now been finalized, and uploading to myCPSA is in progress.

Next steps are:
- A "soft" launch of the course planned for mid-June.
- An application for MainPRO+ and MOC credits.
- Final launch of the course in Fall 2023.
- The partners are writing a Project Report, with recommendations to executive sponsors regarding future collaborative anti-racism anti-discrimination work.

G. Business Activity Update

As 2023 is the transition year between Strategic Plans, a decision was made to forgo providing Council with the KPI Dashboard and opt instead to share only the Business Activity Update.

II. The Profession

I don't think it would be an understatement if I was to say the profession of medicine is struggling to meet the demands required from the health system overall, but this is not unique to Alberta. While attending the Federation of State Medical Boards meeting in Minneapolis, it was shared that not only is the US struggling to meet the current demands for health care, but they are also predicting that in the absence of action, there will be a shortage of 144 000 physicians in the next 10 years, with 44 000 of those being primary care physicians. As we are trying to recruit physicians from the US and around the world, the US is doing the same. I spoke with more than one regulator who expressed interest in Canadian graduates. Essentially since our training programs are so good, they have no problem licensing them. If Canada does not become competitive in this market, we have the real threat of losing talent to the US.

III. Provincial Update

A. Siksika Memorandum of Understanding (MOU)

CPSA and Siksika Health Services are about to sign a historic MOU that we believe is the first of it's kind in Canada. It would not be appropriate to share details on this MOU at this time, but it is anticipated that this will be a tremendous opportunity for us to clarify any confusion about jurisdictional authority.

B. Alberta Federation of Regulated Health professions

CPSA continues to be engaged with the Federation. Our Chief of Staff, Michael Neth, and our Manager for Policy, Keely McBride, are both engaged on a regular basis, and we have found tremendous value in learning from the other health regulators. For example, we recently reached out to our colleagues to learn more about how they manage the Standard of Practice consultation process to make improvements to our process.

C. Medical Assistance in Dying (MAID)

As you are aware, on March 9, 2023, Bill C-39 received Royal Assent and immediately came into effect, officially postponing the eligibility date for persons suffering solely from a mental illness until March 17, 2024.This has allowed more time for regulators to develop standards for their professions.

Health Canada has developed a standard for the provision of MAID for persons suffering solely from a mental illness. We are working with our colleagues from across Canada to develop consistency across Canada. Options being considered include such things as: all medical regulatory authorities (MRAs) adopting the Health Canada (HC) Standard; MRAs adopting key parts of the HC standard or referring to the HC standard as a reference to our existing standards.

CPSA continues to work closely with Alberta College of Pharmacy (ACP) and the College of Regulated Nurses of Alberta (CRNA) to develop a collaborative and consistent approach to the regulatory oversight of clinicians involved in providing MAID service in Alberta. We will likely be developing some form of agreement between our organizations to ensure that consistency exists across professions.

D. Communication with the Government of Alberta (GOA), Alberta Health (AH) and Alberta Health Services (AHS).

Our connections with the GOA, AH and AHS continue to be strong. Our connections with the Minister's Office and senior AH staff such as the Deputy Minister, Assistant Deputy Ministers, Executive Directors and Directors continues to be collaborative and positive. Some examples of our communications include:

1. Provincial Budget – I was invited to attend the GOA Budget briefing and with that I was invited to the Minister's office along with several other key players in health care that included 4 other health regulators, three associations, AHS, Modernizing Alberta's Primary Health Care System (MAPS) leadership and others. We had an excellent discussion for 90 minutes about the broader requirement in health care that go beyond the budget. This was a productive sharing of information and a chance to continue building strong bonds with our partners and the Minister.

2. Regular Meetings with the Deputy Minister (DM) – I continue to have monthly meetings with the DM where we address many issues related to regulation and much more.

3. Meetings with MLA Tany Yao, MLA Garth Rowswell and MLA Jackie Lovely. Since CPSA has gained the reputation of being an organization that is open and

transparent, when interested elected officials need information, it is not uncommon for them to reach out to us. In this case, we have had two meetings with these three specific MLAs to talk about registration of international graduates for rural communities. All three are very interested in learning about CPSA and with each meeting we have shared information about advances being made by CPSA regarding the regulation of international medical graduates. Often, we are clarifying misinformation that has come their way.

4. CPSA team members continue to meet regularly with the operational physician leadership at AHS. This was historically led by the Deputy Registrar, however in the absence of a deputy, Dr. Gordon Giddings has taken over as CPSA lead for these meetings. This is an opportunity for physician leaders from both organizations to meet and address shared concerns.

5. On a more senior level of engagement with AHS, I continue to have regular meetings with the Chief Medical Officer (CMO) for AHS and have now restarted regular leadership meetings with the CPSA registrar's the CMO and the Zone medical leadership to discuss topics of joint interest.

Many of the concerns brought to the attention of CPSA by elected officials are often only a concern because the official has not been provided with all the information they require. We also recognize that misunderstandings have occurred which could be managed sooner if the individuals in question had just reached out to us. This is why CPSA is focused on making our organization more approachable. Our investment in enhancing the "customer experience" is important for us to overcome the reputation we have as a regulator. The initiation of the Customer Experience (CX) team just over 6 months ago has already proven to be a positive addition to the organization. The pilot is deemed to be concluded and the CX team is now a permanent operational unit of CPSA.

E. Outreach

1. MD- International

Dr. Caffaro and I spent an evening with the leadership from MD-International on March 9th, 2023. The evening was an excellent opportunity for us to better understand the challenges related to the registration of internationally educated physicians, many of whom are currently working as clinical assistants who would like a route to an independent licence. It was also an ideal chance for us to share some of things we are working on, such as Council's discussions on currency of practice requirements for the limited practice register.

We will continue to work with these physician leaders to better inform us moving forward.

2. Canadian Association of Nigerian Physicians and Dentists (CANPAD)

Dr. Caffaro and I also met with the CANPAD leadership to discuss our registration process for international graduates and hear their ideas for improvements. As a direct result of that meeting, we are looking at some of their proposals as plausible options.

3. Rural Municipalities Association (RMA)
On March 21st, 2023, Council Chair Stacey Strilchuk and I were invited to attend the Rural Municipalities Convention in Edmonton where we provided a short presentation on the roles of CPSA, some of the work we are doing to improve registration and how they can reach out to us as the source of truth. It is my understanding from comments made through our Government Relations Advisor that the presentation was well received, and we will likely be invited back again in the future.

IV. National Updates

A. Federation Of Medical Regulatory Authorities of Canada (FMRAC)

I neglected to share with Council in my earlier updates that in December of 2022, FMRAC approved the "*Framework on Wise Practices and Medical Regulation Towards an equitable and safe experience for Indigenous people*." Dr. Dawn Hartfield was CPSA's representative on the working group that generated this framework. The document outlines the key recommendations for each of the MRAs in addressing anti-indigenous racism. I'm happy to report that CPSA is in a strong position relative to the recommendations in that document and I'm confident we can continue to make a significant difference.

B. Medical Council of Canada

On March 15th, 2023, it was announced that MCC received a grant from the Federal Government to establish the National Registry of Physicians (NRP) and CPSA was one of 12 provincial and territorial Medical Regulatory Authorities (MRAs) that supported this project. This is a significant step forward in the integration of regulatory data in Canada and will certainly support CPSA in the work that we do and make the registration process more streamlined across Canada.

C. College of Family Physicians of Canada (CFPC)

Practicing family medicine in Alberta is becoming more and more challenging. The increasing complexity of providing full scope family practice to an aging population with chronic disease, rising rates of mental illness, increasing expectations for the public and the government along with trying to run a business with increased costs due to inflation, it's no wonder why so few physicians are interested in taking on this role.

As everyone is likely aware, family medicine had a hard time filling its residency positions this year and Alberta certainly had a significant challenge. After the second round of the match there were still 22 vacancies for family medicine in Alberta. In addition to this we keep seeing fewer and fewer graduates from these residency positions going into full scope family medicine. We have family physicians of 30 plus years looking for someone to take over their practice and very few are willing to take on that work. We continue to hear of family physicians leaving their practices to take on hospitalist work or just do locums, because the lifestyle and pay is better. In addition to that I've been told that 30-50% of family medicine residents, when surveyed, say they have no intention of practicing family medicine.

From FMRAC's latest meeting with the CFPC, we learned they are still planning on introducing a third year to the family medicine training program in the coming years and there are concerns this may also be a deterrent. If things don't change in the system to recognize family physicians for the challenging work they do, I fear the problem will only get worse.

In addition to this reality, I believe what we are learning is that we need an alternate route to licensure that is outside the traditional Royal College or CFPC route. The system clearly needs hospitalists to support care in hospital and our training systems are not generating those physicians that are required. There may be a time soon where something like the rotating internship and general practitioner model is reintroduced.

D. Canadian Medical Association (CMA)

National Licensure remains a hot topic for the CMA, unfortunately this can, at times, distract the efforts to meet the core needs of enhanced physician mobility. As I have shared with Council in the past, effects-based planning is an essential component of achieving the goal of whatever you're trying to accomplish. You identify the effect you're trying to achieve then you engage those who can assist in achieving that effect. From CMA's own survey, physicians noted two impediments to enhancing mobility: the process is complex, and costs are prohibitive. A national licence is not required to overcome those impediments and will take more effort than other options that can be considered. Thus, in the meantime, the Medical Regulators will continue looking at options such as fast track licensure and a "trusted traveller" type of approach.

E. Royal College of Physicians and Surgeons of Canada
Nothing to report.

F. Association of the Faculties of Medicine of Canada
Nothing to report.

V. International Updates

A. International Association of Medical Regulatory Authorities (IAMRA)
Nothing to report.

B. Federation of State Medical Boards (FSMB)

This year's FSMB meeting took place in Minneapolis, MN from May 4-6th.This year I attended with CPSA Council Chair, Stacey Strilchuk. I found this year's meeting to be better than many others because the topics were applicable to what we too are dealing with in Canada.

Some key topics covered included the following:

1. Performance measurement in regulation – Malcolm Sparrow discussed the importance of measuring performance in a regulatory environment which supports the approach CPSA is currently working on.
2. Federal priorities in the Opioid Crisis – Dr. Rahul Gupta presented a shift in thinking from viewing the crisis as one related to prescribing to trying to tackle the issues

related to the synthetic opioids flooding the market. Treating substance use disorders requires a multipronged approach.

3. Compassionomics – The Scientific Evidence that Caring Makes a Difference. This was a foundation lunch presentation by the author, Dr. Steven Trzeciak, of the book “Compassionomics.” In his talk he covered the evidence behind more compassion leading to better outcomes for patients and care providers.
4. Mitigating Implicit Bias – This was a discussion about the biases we all have and the microaggressions that can result if we are unaware. The presentation highlighted that the work we have recently done in developing microaggression training is appropriate and important work.
5. Innovations and trends in medical education – This session did not really present any answers other than to say there is a great deal of work ahead of us to meet the future needs of medical education in the coming years. Addressing things like training for virtual care and recognizing that Artificial Intelligence is a part of medicine will be important considerations.
6. State Medical Boards and Physician Health Programs – This discussion talked about some of the models for addressing physician impairments and the importance of the regulator. The three core models discussed were the association model, the regulator model and the third-party model. The consensus was that the third-party model was best for all.

Overall, this conference was one of the best I have attended in the past 5 years. Most of the topics were directly applicable to CPSA and confirmed that our approach is in alignment with others.

Conclusion

I said at the beginning of the year that 2023 will be another challenging year and so far, that has been true. The sudden loss of Susan Babiuk has been hard on the team, especially those who worked directly with her in Professional Conduct. However, the resilience of a team is best demonstrated in these difficult times. I know our team will grow from this and be able to continue the great work that Susan was so proud of.

We have a great deal of uncertainly in the months to come with the election results only days away, but we will be prepared to support the people of Alberta, no matter what the outcome.

RISK SCIENCES INTERNATIONAL
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Physician Age-Related Cognitive Decline

Report prepared for: College of Physicians and Surgeons of Alberta

Prepared by:

Risk Sciences International

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Risk Sciences International Inc., 700-251 Laurier Ave. W., Ottawa, ON K1P 5J6 Canada
+1.613.260.1424 | inquiries@support.riskciences.com | risksciences.com

Contents

1 Executive Summary

The aim of this review was to synthesize evidence regarding the effect of aging on cognitive abilities of physicians, for use by the Physician Health Monitoring Program of the College of Physicians & Surgeons of Alberta. Specifically, the review would be used to better understand cognitive decline in aging physicians, to assess its impact on physician competence to practice, and to support informed decisions on the possible implementation of cognitive screening for aging physicians.

The underlying question for this review was whether there is evidence that would support the use of cognitive assessments in older physicians.

To address the overarching question, the report addressed several research questions:

1. Which cognitive domains or cognitive abilities are impacted by age-related cognitive decline?
2. Which cognitive domains or cognitive abilities are the first to be impacted by age-related cognitive decline?
3. What factors modify age-related cognitive decline?
4. What is the association between age-related cognitive decline and physician performance? Is there a threshold that represents a level of cognitive decline sufficient to render a physician no longer fit to practice?
5. What are the important methodological considerations when assessing age-related cognitive decline?
6. Which screening instruments are preferred for assessing age-related cognitive decline in physicians?

Information relevant to questions 1 to 3, addressing age-related cognitive decline in the general population, was collected using primarily a systematic review of systematic reviews (SRSR) approach. When little or no information was identified using this approach, an environmental scan of other sources was conducted, including general grey literature searching (Google) and a review of existing policy documents from various agencies. A systematic review of original studies of physicians was conducted to answer question 4. Evidence on related considerations was collected with grey literature searching and described in narrative reviews. Question 5 was addressed by consideration of limitations in the literature reviewed in previous questions and expert opinions. Information relevant to question 6 was collected based on an environmental scan of opinion pieces and reviews, with each cognitive measurement tool summarized based on literature that described development and validation.

The focus of the project was on “normal” aging, i.e., age-related cognitive decline as distinct from morbidities or pathologies that lead to cognitive decline (e.g., Alzheimer’s disease). Because mild cognitive impairment (MCI) is viewed as a transition between normal and pathological cognitive aging, it was considered out of scope for this project. Although it was generally possible to identify and exclude systematic reviews focusing on pathological aging in the SRSR part of the review (questions 1 to 3), in literature specific to physicians (questions 4, 6, and part of question 5) scientific publications did not clearly distinguish the type or nature of the cognitive issues being considered. Therefore, physician-specific literature summarized in this review may have addressed both normal and pathological age-related cognitive decline.

Five bibliographical databases (Medline, EMBASE, PsycInfo, ERIC, and Cochrane Database of Systematic Reviews) were searched. References retrieved by searching bibliographical databases underwent two levels of screening for eligibility based on pre-defined eligibility criteria. Eligible systematic reviews (questions 1 to 3) were assessed for quality using a modified version of the Assessing the Methodological Quality of Systematic Reviews (AMSTAR) tool. Original studies (question 4) were assessed for quality using a checklist developed by the US National Heart, Lung, and Blood Institute (NHLBI) and adapted for this project. Grey literature was searched on websites of national and international professional organizations and regulatory agencies. A Google search was also performed using the same search terms.

Forty eligible systematic reviews were identified, of which four addressed question 1. These reviews suggest that older adults performed more poorly compared to their younger counterparts on a test of semantic inhibition (a component of executive functioning); older adults were slower but more accurate than younger adults on tasks for sustained attention; storage of information in working memory of older adults was disrupted when two tasks (storage and processing) were administered simultaneously; findings regarding the effect of age on divergent thinking were inconsistent. Using an environmental scan approach, three narrative reviews that provide a broad picture of age-related cognitive changes were identified. Based on information from these narrative reviews, the following cognitive functions decline at older ages: speed of information processing, selective attention, divided attention (multitasking), working memory, episodic memory, prospective memory, source memory, executive functioning (executive control), reasoning ability and spatial ability. Several functions are relatively stable over the lifespan, including sustained attention (or vigilance), semantic long-term memory, and wisdom (a multidimensional construct). Procedural memory (remembering how to perform an activity) and language functions are only partially affected in old age. Older adults are good at performing automatic or well learned procedures and can learn new procedures; however, they may be slower when performing familiar tasks and may learn new procedures at a slower rate than younger adults. Discourse skills improve with age; vocabulary, comprehension of the meaning of words do not decline with age. However, language production skills appear to decline, and understanding spoken language that is distorted or too rapid may be difficult for older adults.

No systematic reviews relevant to question 2 (sequence of decline) were identified. There are numerous theories and models of cognitive aging, the most influential being the processing speed theory and the prefrontal-executive theory. These theories propose, respectively, that slowdown in processing speed or decline in executive functioning mediate the age-related cognitive decline.

Most systematic reviews identified for this report address question 3, concerning factors potentially modifying the rate of cognitive decline. These factors can be grouped as 1) demographics; 2) physical health/biomarkers; 3) neurological conditions, psychological symptoms, mental health; 4) lifestyle; 5) diet; 6) socioeconomic factors. The strength and quality of evidence for different modifying factors is variable.

No longitudinal studies were identified that correlated cognitive function of physicians with their clinical performance, nor were any that determined a level of cognitive decline sufficient to render a physician unfit to practice. One retrospective study was aimed at developing an approach for derivation of a cut-off to identify "impaired" physicians. Because of methodological limitations of this study, it is not clear whether the cut-off derived using this approach can be used as a cognitive threshold for fitness to practice. It has been acknowledged by many experts that the levels of cognitive impairment precluding safe medical practice are not known, and that the process of cognitive evaluation should be specific to the physician's specialty and clinical privileges.

Overall, the findings of this review provide some support both for and against the use of cognitive testing of older physicians.

Studies identified for this review provide the following evidence to suggest that cognitive testing of late-career physicians may be useful:

- Cognitive abilities of physicians, such as visual information processing, reaction time, visual learning and memory, verbal memory, and reasoning, decline with increasing age in an age range where physicians are still practicing. The rate of decline varies both across different cognitive functions and among individuals.
- Many studies suggested that physician competence and clinical performance also declined with age.
- Cognitive test scores are lower in physicians referred for assessment because of competency or clinical performance concerns when compared to control physicians with no such concerns.
- Physicians are not able to accurately assess their own cognitive abilities or clinical performance. Physicians may continue to practice despite a significant decline in the quality of care they provide; on the other hand, perceived cognitive decline, although it does not reflect true abilities, may accelerate physicians' decision to retire.
- Physicians are generally reluctant to report their colleagues' cognitive problems.

Despite the findings above, there are complex factors that will need to be weighed in the decision-making process for implementing cognitive assessment of physicians, including ethical, legal, and financial considerations. These considerations were beyond the scope of this review. Scientific evidence linking cognitive test results with physician performance is still a significant data gap. Furthermore, there are no known standards on the level of cognitive decline at which a doctor is no longer fit to practice. Domains of cognitive abilities required for different medical specialties vary broadly, due to the diversity of skill sets across medical fields. Outcomes of most currently available cognitive assessment tools are difficult to interpret due to lack of normative data for physicians. Cultural and language factors affect performance on cognitive testing, which should be accounted for because many practicing physicians are graduates from international medical schools.

Methodological issues in studies of age-related cognitive decline in the general population include how a population sample for cognitive research is selected, possible recruitment and misclassification bias, strengths and limitations of longitudinal vs. cross-sectional studies, use of categorical vs. continuous variables and continuous vs. extreme age groups, selection of tests for each cognitive domain and for each population of interest, combining cognitive test results, and the effect of negative stereotypes about aging on performance in cognitive tests. Other challenges affect the interpretation of the evidence in the review, including definitions of fitness for practice and competence.

Data about the following cognitive screening tools that have been used, or are considered for use, in physicians are summarized in this report: MicroCog, Montreal Cognitive Assessment Tests (MoCA), Saint Louis University Mental Status (SLUMS) Examination, Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), Automated Neurophysiological Assessment Metrics (ANAM), National Institutes of Health ToolBox, Cambridge Neuropsychological Test Automated Battery (CANTAB), and Addenbrooke's Cognitive Examination (ACE). It appears that MicroCog and ANAM are more suitable for testing physicians. Both tools are computerized, are not familiar to physicians, have a very high score ceiling, include normative data for physicians, and measure processing speed; however, neither tool is available in languages other than English. Most cognitive assessment tools considered in this review were designed to identify progression to dementia or to detect mild cognitive impairment. Some experts suggest using tests for individual cognitive function critical to physicians, rather than cognitive screening tools.

Grey literature collected for this review also provides a description of recommendations of committees, programs, and policies (when those descriptions were available) that address cognitive assessment and screening of aging physicians. Most hospital-specific physician screening programs identified for this review include neurocognitive testing, are compulsory, and establish a specific age to start the screening, although clinical performance would be the focus. This age limit is 70 years in most programs, and 74.5 to 75 years in some programs.

2 Introduction

Aging affects the entire human body, including the brain, and changes in cognitive functioning are among the most noticeable features of growing old (Cohen, Marsiske, & Smith, 2019). As described in a recent commentary, a large proportion of physicians are over the age of 65, and there exists concern with the risk of cognitive impairment that may undermine patient safety (Dellinger, Pellegrini, & Gallagher, 2017). For example, based on data from the Quality in Australian Health Care Study, failure of cognitive function was the second most frequent cause of errors in the delivery of healthcare which led to adverse events in patients (Wilson, Harrison, Gibberd, & Hamilton, 1999).

The aim of the current review was to synthesize evidence for use by the Physician Health Monitoring Program of the College of Physicians & Surgeons of Alberta. Specifically, the review would be used to better understand cognitive decline in aging physicians and its relation to competency, and to support informed decisions with scientific evidence as the basis for possible introduction of cognitive-based screening.

A decline in cognitive functions associated with aging cannot always be attributed to pathological processes in the brain, such as neurodegeneration in Alzheimer's disease. For example, most older adults process information slower than they did when they were younger (Institute of Medicine, 2015). The focus of the project was on so-called "normal" age-related cognitive decline as distinct from morbidities or pathologies that lead to cognitive decline (e.g., Alzheimer's disease). The scope of the review also did not address mild cognitive impairment (MCI), which has been defined as a syndrome (Chertkow, 2002) with unclear diagnostic criteria. MCI generally refers to cognitive decline greater than expected for an individual's age and education level but one that does not interfere notably with activities of daily life (Gauthier et al., 2006). MCI can be viewed as a transition state between normal ageing and dementia. Given that some individuals with MCI remain stable while more than half progress to dementia within five years (Gauthier et al., 2006), MCI was excluded from the evidence review for the current project on age-related, normal, cognitive decline. As defined by the (Institute of Medicine, 2015), normal cognitive aging is "*a process of gradual, ongoing, yet highly variable changes in cognitive functions that occur as people get older. Cognitive aging is a lifelong process. It is not a disease or a quantifiable level of function.*" It is believed that normal aging, MCI, and dementia represent a continuum of cognitive states in the elderly (Chertkow, 2002), and distinguishing between normal age-related cognitive changes and those attributable to neurological diseases and conditions is "a daunting task" (Institute of Medicine, 2015). A future project may be designed to address MCI, pathological cognitive aging (e.g., leading to Alzheimer's disease), and morbidity-related cognitive decline.

The current project (the "RSI review") sought to conduct a series of reviews that address several research questions within scope of CPSA/PHPM's (CPSA) requirements. This work is intended to provide answers of direct relevance to the mandate of PHPM within the Alberta Health Professions Act, namely, to synthesize evidence that will in turn be used to inform decisions on age or competencies for aging physicians possibly facing cognitive decline.

The underlying question for this review was whether there is evidence that would support the possible implementation of a cognitive-based assessment in older physicians.

To address the underlying question, the report addressed several research questions:

1. Which cognitive domains or cognitive abilities are impacted by age-related cognitive decline?
2. Which cognitive domains or cognitive abilities are the first to be impacted by age-related cognitive decline?
3. What factors modify age-related cognitive decline?
4. What are the associations among age, cognitive decline, and physician competence? Is there a threshold that represents a level of cognitive decline sufficient to render a physician no longer fit to practice?
5. What are the important methodological considerations when assessing age-related cognitive studies?
6. Which screening instruments are preferred for assessing age-related cognitive decline in physicians?

Questions 1 to 3 were addressed using primarily a systematic review of systematic reviews (SRSR) approach. The eligibility for these questions was not restricted to reviews of physicians – the larger body of literature on age-related cognitive decline in the general population was used as the basis for this phase of the work. Relevant systematic reviews were identified by searching bibliographical databases. When little or no information was identified using this approach, an environmental scan of other sources was conducted, including general grey literature searching (google) and a review of existing policy documents from various agencies. Questions 4 to 6 were specific to physicians. A systematic review of original studies was conducted to answer question 4. Evidence on related considerations was collected as a narrative review. Question 5 was addressed by consideration of limitations in the literature reviewed in previous questions, a narrative review, and expert opinions. Information relevant to question 6 was collected using an environmental scan approach. Each section was, where appropriate, supplemented by grey literature searches.

As mentioned above, the focus of the project was on normal cognitive aging. Although it was generally possible to identify and exclude systematic reviews focusing on pathological aging in the SRSR part of the review (questions 1 to 3), in literature specific to physicians (questions 4, 6, and part of question 5) scientific publications did not clearly distinguish the type or nature of the cognitive issues being considered. Therefore, physician-specific literature summarized in this review may have addressed both normal and pathological age-related cognitive decline.

3 Methodology

3.1 Bibliographic database search

The RSI search strategy for the systematic review parts of the project has been implemented between May 5-6, 2021. Search for studies relevant to question 4 was updated on July 27, 2022. The search used both controlled vocabulary and keywords, was peer-reviewed, and conducted by expert epidemiologists. No search restrictions by time, language or other factors were applied to limit the search output. Details about the search strategy can be found in **Appendix 1**.

Literature for narrative review and expert opinion sections of this report was searched in bibliographical databases on May 5-6, 2021 and updated on August 25, 2022. These searches were constructed by combining keywords and MeSH terms relevant to aging physicians, cognitive assessment, professional competence, professional performance. The bibliographies of examined reviews were also inspected for additional relevant references not already identified through the original search.

The original bibliographic database search included Medline, EMBASE, PsycInfo, Education Resources Information Center (ERIC), and Cochrane Database of Systematic Reviews using Ovid interface. Search update did not include the ERIC database because: 1) the database interface was changed from Ovid to ProQuest, so that it was not possible to use the original search strings; 2) few citations were identified in this database during the original search.

3.2 Study selection for the systematic reviews

Identified references from all sources were collated using the EndNote reference management application, which was used to identify potential duplicates, with manual resolution employed to remove additional actual duplicates.

References retrieved by the search underwent two levels of screening for eligibility based on pre-defined eligibility criteria (**Appendix 2**). Level 1 (title and abstract) screening was conducted by one reviewer, and level 2 (full text) screening by two independent reviewers. Any conflicts generated were resolved through consensus or consultation of other team members. This multistep review process was completed using the Distiller Systematic Review software (Evidence Partners, 2022).

No universally accepted definition of a systematic review exists (Krnic Martinic, Pieper, Glatt, & Puljak, 2019). To address questions 1 to 3, RSI selected systematic reviews that met the standard quality of searching at least two electronic databases and conducting study selection (assessment of full text for eligibility) by two independent reviewers.

3.3 Data abstraction

For questions 1 to 3, based on reviews of cognitive decline in the general population, data abstraction tables were developed to abstract the following information: review objective(s), databases searched, dates searched, supplementary searches, number of included studies, inclusion/exclusion criteria, types of cognitive functions and/or abilities assessed, tests and/or methods of outcome assessment, effect estimates (if meta-analysis was conducted), and authors' reported conclusion. Key characteristics of the included reviews are summarized in Table 1 and Table 2 in this report and provided in full details in **Appendix 3**.

For question 4, based on original studies of physicians, data abstraction tables were developed to abstract the following information: study design, study population, measure of clinical performance or competence, measure of cognitive function(s), usefulness of the study for derivation of a cognitive threshold.

Key characteristics of the included studies are summarized in **Appendix 4**.

3.4 Quality assessment of studies and reviews

For questions 1-3, based on published reviews of studies of cognitive decline in the general population, the quality of evidence from the reviews was evaluated using a modified version of the AMSTAR-2 tool (Shea et al., 2017). This tool, designed only for reviews of clinical trials and non-randomized studies of interventions, includes 16 questions, 7 critical and 9 non-critical. Based on the assessment results, a review would be granted one of four levels of confidence: high, moderate, low, or critically low. To accommodate for the differences in design and methodology of intervention studies, a modified version of the AMSTAR-2 was used for assessing the risk of bias/quality of evidence in the included reviews (**Appendix 5**). In total, the modified tool contains 14 assessment questions, where 5 were identified as critical. Reviews were considered high quality if all conditions for critical questions were fully met, and low quality if conditions for 2 or more critical questions were unmet or partially met. Reviews that did not meet either criteria for high or low quality studies were considered moderate quality. Refer to Appendix 5 for the modified AMSTAR 2 assessment questions, as well as for the rubric used to categorize reviews by the level of quality. A summary of the risk of bias assessment of the include reviews will be shown in Table 1 and Table 2 in this report, with full details of the assessment provided in **Appendix 6.**

For question 4, based on original studies of physicians, a checklist developed by the National Heart, Lung, and Blood Institute (NHLBI, 2013) was adapted for quality assessment of studies identified for this project (**Appendix 6**).

3.5 Grey literature search and review strategy

Another search of major grey literature resources was conducted between April 23 and April 30, 2021 and updated between August 23 and September 1, 2022. These resources included national and international authoritative, professional, and technical health agencies, academic dissertations, and major scientific hubs.

The primary objective of the grey literature search was to identify and describe committees, programs and/or policies that address cognitive assessment and screening of aging physicians. The grey literature search strategy was not intended to be comprehensive. Rather, the intention was to determine whether such cognitive screening programs for older physicians existed, and if so, to briefly describe them. Any information that could be found regarding physician cognitive assessment programs from Canada, United States, United Kingdom, and Australia was considered.

The following professional organizations and regulatory agencies websites were searched using various search terms for aging physicians, cognitive decline, and cognitive assessment:

- College of Physicians and Surgeons Ontario
- Collège des Médecins du Québec
- College of Physicians and Surgeons British Columbia
- College of Physicians and Surgeons Alberta
- College of Physicians and Surgeons Saskatchewan
- College of Physicians and Surgeons Manitoba
- College of Physicians and Surgeons New Brunswick
- College of Physicians and Surgeons Nova Scotia
- College of Physicians and Surgeons PEI
- Royal College of Physicians and Surgeons of Canada
- Canadian Medical Protection Association (CMPA)
- The College of Family Physicians of Canada
- Health Canada
- Canadian Medical Association
- Ontario Medical Association
- American Medical Association (AMA)
- The American College of Physicians
- The American College of Surgeons
- Royal College of Physicians (UK)
- The Royal Australasian College of Physicians
- Australian Medical Association
- Agency for HealthCare Research and Quality (AHRQ)
- Joanna Briggs Institute
- EPPI-Centre database of educational research

A Google search was also performed during the same timeframe using key search terms. Grey literature from search results that were considered potentially relevant were exported for review. The reference lists of articles gathered for the systematic review portion of the project were also searched to gather additional grey literature. Grey literature materials were then reviewed for any relevant information regarding cognitive assessment programs/policies. Descriptions of any specific programs related to the cognitive assessment of older physicians were extracted and summarized.

4 Evidence for questions 1 to 3: Reviews of cognitive decline in the general population

The search strategy resulted in the retrieval of 5,431 records from five bibliographic databases. Electronic and manual de-duplication resulted in the removal of 1,918 records, leaving 3,513 records for title and abstract screening (level 1). After excluding 3,117 irrelevant records, 396 reviews remained for full text examination (level 2). This examination led to the exclusion of additional 356 reviews for not matching the inclusion/exclusion criteria. Forty reviews were retained for further analysis.

A PRISMA flow diagram (Moher, Liberati, Tetzlaff, Altman, & Group, 2009) detailing the selection process for systematic reviews relevant to questions 1 to 3 is shown in **Figure 1**.

When identifying literature relevant to questions 1 to 3, the focus was on "normal" cognitive aging. Systematic reviews of studies explicitly focusing on cognitive impairment and dementia were excluded. It should be noted, however, that the distinction between healthy and pathological aging was not always clear in primary studies included in the systematic reviews. For example, participants of the primary studies free of dementia diagnosis at the time of testing may develop cognitive impairment/dementia later, so that cognitive decline observed at the time of testing and classified as "normal" may be an early manifestation of an undiagnosed dementia.

A total of 40 reviews underwent risk of bias assessment using a modified AMSTAR 2 tool. Where the assessment questions were relevant to conducting a meta-analysis, reviews were not penalized if one was not conducted. The majority of reviews were found to be of low quality (N = 31), followed by moderate quality (N = 9). No high-quality reviews were identified. As all included reviews were either of low or moderate quality, caution should be taken with the interpretation of research findings.

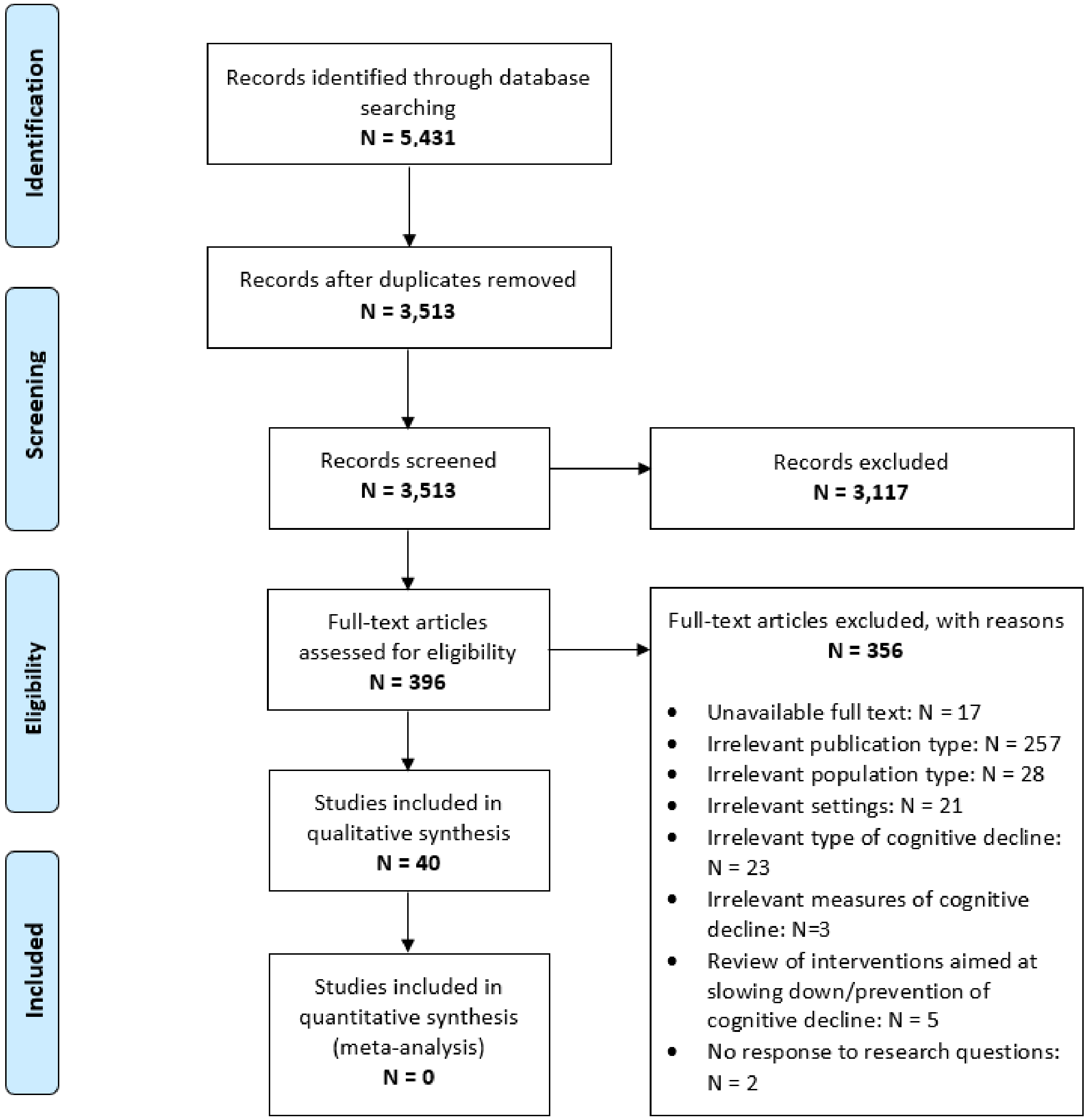

Figure 1: PRISMA flow diagram for questions 1 to 3

4.1 Which cognitive domains or abilities are impacted by age-related cognitive decline?

The Institute of Medicine (IOM) Committee on the Public Health Dimensions of Cognitive Aging (Institute of Medicine, 2015) provides the following definition of cognition:

> *"Cognition refers to the mental functions involved in attention, thinking, understanding, learning, remembering, solving problems, and making decisions. It is a fundamental aspect of an individual's ability to engage in activities, accomplish goals, and successfully negotiate the world. Although cognition is sometimes equated with memory, cognition is multidimensional because it involves a number of interrelated abilities that depend on brain anatomy and physiology. Distinguishing among these component abilities is important since they play different roles in the processing of information and behavior and are differentially affected by aging."*

The Committee acknowledged that cognitive aging is a very complex process, which makes it difficult to provide a succinct definition. Cognitive aging is "*a process of gradual, ongoing, yet highly variable changes in cognitive functions that occur as people get older. Cognitive aging is a lifelong process. It is not a disease or a quantifiable level of function*"(Institute of Medicine, 2015).

Four eligible systematic reviews address the question of cognitive domains / cognitive abilities impacted by age-related cognitive decline. Characteristics of the eligible reviews are summarized in Table 1; more details can be found in **Appendix 3.** The reviews were published between 2017 and 2021, searched three to four bibliographic databases, included 11 to 45 studies evaluating semantic inhibition (a component of executive functioning), sustained attention, divergent thinking (a measure of creativity) and working memory.

Table 1. Summary of characteristics of systematic reviews that reported on cognitive domains impacted by age

Reference	# Studies[1] Dates searched	Cognitive outcomes examined	Conclusion	Evidence quality	Comments
Vallesi, Tronelli, Lomi, and Pezzetta (2021)	• 12 studies • Inception – 20 December 2020	Sustained attention [performance on the go/no-go Sustained Attention to Response Task (SART)]	Age-related processing speed deficit, mostly suggested by longer go RTs, but also with an increased preference for a prudent strategy, as demonstrated by fewer no-go errors and greater post error slowing in older adults	Low	
Cervera-Crespo and Gonzalez-Alvarez (2017)	• 11 studies • Inception - NR	Executive function [semantic inhibition on the Hayling Sentence Completion test]	Older adults performed less well than young adults on the four measures of the Hayling test.	Low	
Fusi, Lavolpe, Crepaldi, and Rusconi (2021)	• 16 studies • NR-March 06, 2019	Divergent thinking [verbal and figural]	• Inconsistent findings • The relationship between age and DT may be "complex and multidimensional" • Older people may think as divergently as younger	Low	• Inconsistent findings may be due to methodological differences among studies included in the review.

[1] Only studies meeting the eligibility criteria of the current review

Reference	# Studies[1] Dates searched	Cognitive outcomes examined	Conclusion	Evidence quality	Comments
			people, especially in the verbal domain, under less demanding conditions (no time constraints and not too high workload).		
Jaroslawska and Rhodes (2019)	• 45 studies • NR to April - May 2017 (Update in November 2018 by searching only one database)	Effects of processing on storage in working memory ["dual tasking"; "the extent to which processing tasks disrupt storage"]	• Older adults' ability to retain information in working memory while concurrently performing a processing task is diminished compared to younger adults. • Age differences were larger when there was domain overlap between the two tasks (two verbal tasks or two non-verbal tasks) vs. no overlap. • Titration (adjusting the level of difficulty of the individual tasks prior to their combination) reduced the age difference in dual task performance.	Low	

4.1.1 Semantic inhibition as a component of executive functioning

Cervera-Crespo and Gonzalez-Alvarez (2017) conducted a systematic review and a meta-analysis of studies evaluating the performance of young and older adults on the Hayling Sentence Completion test for semantic inhibition to assess the effect of age on this function. To be eligible for this review, the study had to include a control group of young participants and one or more groups of participants older than 60 years with no cognitive, neurological, psychiatric disorders, or sensory impairment. Eleven studies were included in this review. The Hayling Sentence Completion test consists of two sections, Automatic and Inhibition. In both sections, the number of errors and the response time is registered. Results of the meta-analysis revealed inferior performance of older adults compared to young adults on all four measures of the test. In both the Automatic and the Inhibition sections, the age effect was larger for the latency of responses than for the errors. In the authors' view, this finding agrees with literature indicating that slow of processing is "a central feature of the cognitive changes associated with age". The authors observed heterogeneity in the effect sizes across studies, which they believed was at least partly explained by methodological differences or participant characteristics.

4.1.2 Divergent thinking

The aim of Fusi et al. (2021) was to summarize data on divergent thinking (DT) as an indicator of creative potential in healthy older adults. Studies were eligible for inclusion in this systematic review if they assessed DT abilities in older adults and compared performance of different age groups on these tasks. In commonly used psychometric tasks used to assess DT, participants were asked to produce multiple ideas in response to verbal (verbal DT) or figural prompts (figural DT). Sixteen studies were included in this review. The authors acknowledged that comparisons among these studies were difficult due to substantial differences between them, such as differences in design, sample characteristics, instruments and scoring methods used, data analyses conducted. The relationship between age and DT could be influenced by factors such as education, intelligence, and by other cognitive abilities such as working memory and speed of processing. For example, differences between young and older adults diminished when working memory or speed of processing were accounted for in the analyses. Not all studies considered these important covariates. The authors concluded that the relationship between age and performance on DT tasks was complex and multidimensional rather than simple linear; more recent studies indicated that older adults could think as divergently as younger adults, especially in the verbal domain with no time constraints and if the workload is not too high.

4.1.3 Sustained attention

The aim of Vallesi et al. (2021) was to compare performance on the go/no-go Sustained Attention to Response Task (SART) in younger and older adults. In this task, digits from 1 to 9 are presented in a quasi-random order, and the participant is instructed to respond to all the digits (go trial) except for 3 (no-go trial), which is the no-go target. Results of this systematic review and meta-analysis suggest that older adults were slower than younger adults on go trials and more accurate than younger adults on no-go trials. Older adults were also slower than younger adults after an error on a no-go trial. The authors explain these findings by age-related processing speed deficit and by older adults' "preference for a more prudent strategy, as demonstrated by fewer no-go errors and greater post error slowing in older adults." Because older adults outperformed younger adults on no-go trials by producing fewer false alarms, the authors of the review believe that their finding do not suggest an inhibitory deficit in older adults. The authors concluded: "These findings point to a more prudent strategy when using attentional resources in aging that allows reducing the false-alarm rate in tasks producing a tendency for automatic responding."

4.1.4 Working memory

Jaroslawska and Rhodes (2019) conducted a systematic review and meta-analysis comparing performance of older and younger adults on tasks assessing storage in working memory (single task) and the extent to which simultaneously administered processing tasks disrupt storage (dual task to assess "holding information in mind when performing a concurrent processing task"). This review and meta-analysis also assessed the influence of moderator variables on single- and dual task performance. This review includes 45 studies. Both memory accuracy and reaction time (RT, speed with which information stored in working memory is accessed) were assessed, but the review focused on memory accuracy, considering data on RT as secondary. The meta-analysis revealed the effect of age on accuracy in single (storage only) task performance. The dual task cost (the difference between performance in storage only and storage + processing task) was greater for older than for younger adults, which suggests that, relative to younger adults, the ability of older adults to retain information in working memory over short periods of time is disproportionately affected by a concurrent processing task. Moderator analysis indicated that age-related differences in the dual task cost were larger when there was a domain overlap between the two tasks (for example, both tasks were verbal or both non-verbal - pictures, non-linguistic sounds, or shapes) relative to when there was no domain overlap (one task verbal and the other non-verbal). Titrating (i.e., equating) single task performance across age groups before concurrent tasks are combined, resulted in smaller and nonsignificant age-differences in dual task costs.

4.1.5 Synthesis of evidence from systematic reviews

One review was identified for each of the following cognitive functions: semantic inhibition (a component of executive functioning), sustained attention, divergent thinking (a measure of creativity) and working memory. Cervera-Crespo and Gonzalez-Alvarez (2017) showed that older adults performed poorer compared to their younger counterparts on test for semantic inhibition. Aging affected latency of responses to a greater extent than accuracy of responses, which, in the authors view, is in line with literature indicating that slow processing is a central feature of cognitive aging. Although differences in performance between younger and older adults were observed on tasks for divergent thinking, these differences could, to some extent, be mediated by the effects of aging on other cognitive functions. For example, older adults performed similarly to younger adults if there were no time constraints and if the workload was not too high (Fusi et al., 2021). Older adults were slower than younger adults on tasks for sustained attention, which is explained by age-related processing speed deficit; however, older adults were more accurate than their younger counterparts (Vallesi et al., 2021). Jaroslawska and Rhodes (2019) found that processing tasks administered simultaneously with storage tasks, disrupt storage of information in working memory of older adults. However, the difference between older and younger adults diminished when single task performance was titrated (e.g., equated) across age groups before the two concurrent tasks were combined.

4.1.6 Evidence from narrative reviews

Because only four systematic reviews addressing this question and meeting the eligibility criteria were identified, an environmental scan was conducted by google searching. Three narrative reviews were identified that provide a broad picture of age-related cognitive changes. These include two book chapters (Cohen et al., 2019; Glisky, 2007), and a review by a scientific committee appointed by the Institute of Medicine (2015).

The process of cognitive aging is highly variable, both within and between individuals. Not all cognitive functions decline with age; some do not change, and others, such as wisdom and knowledge, even improve as a person is aging. The trajectory of change varies for different cognitive functions. Inter-individual variability is explained by factors such as genetics, lifestyle, physical health, mental and emotional health factors, socioeconomic status, education, and life experiences. Intra-individual variability in cognitive function has been examined in studies that measure performance of the same people across two or more sessions longitudinally, typically every 5 or 10 years, in longitudinal studies over a period of years. However, intra-individual variability can be seen over shorter periods of time, such as days, due to, for example, fatigue, acute illness, distractions, or lapses in attention (Institute of Medicine, 2015).

When discussing age-related cognitive decline, it is useful to differentiate between crystallized intelligence and fluid intelligence. Crystallized intelligence is more dependent on acquired knowledge and core capacities, such as language skills or knowledge about a specific topic. Fluid intelligence reflects processing current or new information, i.e., a person's ability to solve problems in novel situations. Observations regarding cognitive performance from cross-sectional and longitudinal studies indicate that crystallized abilities tend to remain stable until a very old age, whereas fluid abilities begin to decline earlier, and the decline is gradual across the life span (Cohen et al., 2019; Institute of Medicine, 2015).

4.1.6.1 Cognitive functions declining with age

Speed of information processing. Slowing of information processing speed accounts for or contributes to many other age-related cognitive changes (Cohen et al., 2019). Examples of assessment tools that can be used to assess information processing speed: the Pattern Comparison Processing Speed Test and the Digit Symbol Substitution Test (Institute of Medicine, 2015).

Selective attention defined is the ability to focus on select items while disregarding other irrelevant stimuli. Selective attention can be assessed using visual search tasks or the Stroop Test (Glisky, 2007; Institute of Medicine, 2015).

Divided attention reflects the ability to split one's focus between two or more competing tasks or multiple sources of information—also known as multitasking (Glisky, 2007; Institute of Medicine, 2015).

Working memory reflects the ability to temporarily, for the short-term, hold information in one's mind while it is processed or used (Cohen et al., 2019; Institute of Medicine, 2015). Working memory has been suggested as the fundamental source of age-related deficits in many other cognitive functions, such as long-term memory, language, problem solving, and decision making (Glisky, 2007). Working memory can be assessed using tests that measure the longest sequence of letters, numbers, or words that an individual can remember correctly. One example of such tests is the List Sorting Test (Institute of Medicine, 2015).

Episodic memory refers to the memory of personally experienced events that includes times, places, associated emotions, and other contextual information. Episodic memory can be assessed using the Picture Sequence Memory Test (Glisky, 2007; Institute of Medicine, 2015).

Prospective memory involves remembering to do things in the future. Time-based prospective memory is the ability to remember to do something at a certain later time, and event-based prospective memory is the ability to do something after a certain event. Although both types of prospective memory decline with age, the decline is greater for time-based prospective memory. The effect of age on prospective memory may be greater when measured in standardized tasks, compared to measurements using "more naturalistic tasks" (Glisky, 2007; Institute of Medicine, 2015).

Source memory reflects the ability to remember contextual aspects of an experience with central content, peripheral details surrounding an event (Glisky, 2007; Institute of Medicine, 2015).

Executive functions (executive control) consist of different processes that regulate behavior and play a key role in essentially all aspects of cognition. This includes planning, organization, coordination, allocation of mental resources (cognitive flexibility), inhibition of irrelevant information, reasoning, decision making, solving novel problems, and adapting to new situations. Examples of tests that can be used to assess executive functioning include the Wisconsin Card Sorting Test as a measure of cognitive flexibility; the Trail Making Test and the Visual-Verbal Test for attention and set shifting (switching between tasks); series completion tests; proverb interpretation tests (Cohen et al., 2019; Glisky, 2007; Institute of Medicine, 2015).

Reasoning ability is sometimes considered an aspect of executive functioning. It reflects "logical thinking, or the process of drawing conclusions from information to inform problem solving or make decisions, such as medical or financial decisions". There are two aspects of reasoning. Deductive reasoning is an ability "to draw conclusions about specific events or situations based on premises or general theories assumed to be true". Inductive reasoning is an ability "to draw general conclusions based on specific observations". Laboratory tests suggest that both aspects decline with age beginning in middle adulthood. Examples of tests to assess the reasoning abilities include the Letter Sets Test (Institute of Medicine, 2015).

Spatial ability is defined as "the maintenance and manipulation of visual images" (Institute of Medicine, 2015). Although primary visual perceptions (object and spatial) tend to remain relatively stable, performance of older adults is usually inferior compared to younger adults on tasks that require mental rotation, assembly, visualization or remembering the location of objects, to depict and perceive the three-dimensionality of drawings. Spatial abilities can be measured using the Paper Folding Test, the Mental

Rotations Test, the Block Design subtest of the Wechsler Adult Intelligence Scale (WAIS) (Cohen et al., 2019; Institute of Medicine, 2015).

4.1.6.2 Cognitive functions that remain relatively stable over age

Sustained attention or vigilance defined is the ability to maintain concentration on a task for a long period of time. Generally, older adults are not impaired on tests for vigilance. Although diminished capacity to sustain attention has been demonstrated in advanced age, this effect is complicated and depends on slowed processing speed and motivation. The Connors Continuous Performance Test is one of the commonly used tools to assess this function (Cohen et al., 2019; Glisky, 2007; Institute of Medicine, 2015).

Semantic long-term memory refers to the ability to store general knowledge about the world acquired over a lifetime, including factual information, knowledge of words and concepts. Semantic knowledge increase in the sixth and seventh decades of life and may only slightly decline later in life. This aspect of the long-term memory can be assessed using the Category Fluency Test or the Boston Naming Test (Cohen et al., 2019; Glisky, 2007; Institute of Medicine, 2015).

Wisdom is a multidimensional construct that includes "cognitive, reflective, and affective elements" and can be defined as "an expert knowledge system… the amount and use of knowledge that someone has accumulated in life and how that person is able to use and apply this knowledge…" (Institute of Medicine, 2015). It is acknowledged that this higher-order cognitive function is difficult to characterize. There exist different definitions of wisdom and measures used to assess it. It is believed that wisdom and expertise are crystallized and relatively well preserved in aging, although studies of age differences in wisdom are few (Cohen et al., 2019; Institute of Medicine, 2015).

4.1.6.3 Functions partly affected by aging

Procedural memory refers to remembering how to perform an activity, such as riding a bicycle or playing the piano. Although older adults are generally good at performing automatic or well learned procedures and can learn new procedures, they may perform familiar tasks more slowly and may learn new procedures at a slower rate than younger adults (Glisky, 2007; Institute of Medicine, 2015).

Language function includes "understanding and producing speech, reading, writing, and naming" (Institute of Medicine, 2015). There is evidence that discourse skills improve with age (Glisky, 2007). Vocabulary, the comprehension of the meaning of words do not appear to decline with age, whereas language production skills appear to decline. Understanding spoken language that is distorted or too rapid may be difficult for older adults, which may be partly due to hearing loss (Glisky, 2007; Institute of Medicine, 2015). Examples of tests to measure language abilities include a word-by-word reading paradigm used to assess comprehension of sentences; the Token Test for language comprehension; the Boston Naming Test for word retrieval skills; the Category Fluency Test for the ability to retrieve words rapidly from a semantic lexicon; the Boston Diagnostic Aphasia Examination for repetition of phrases and written communication skills (Institute of Medicine, 2015).

4.2 Which cognitive domains and/or cognitive abilities are the first to be impacted by age-related cognitive decline?

No systematic reviews relevant to this question were identified.

There are debates regarding whether aging leads to widespread changes across brain regions or does aging affects different systems at different rates or to different degrees (Dennis, Gutchess, & Thomas, 2020).

Numerous theories and models of cognitive aging exist (Dennis et al., 2020); the processing speed theory and the prefrontal-executive theory are among the most influential and tested models (Albinet, Boucard, Bouquet, & Audiffren, 2012). These theories propose that slowdown in processing speed or decline in executive functioning mediate in whole or in part the age-related declines in cognitive functioning. Studies provide mixed results with some supporting the processing speed theory, others supporting the prefrontal-executive theory, and the two theories may not be mutually exclusive (Albinet et al., 2012). Neuroimaging research demonstrated decreases in integrity of white matter in the aging brain in the absence of neurological diseases, which suggests a central role of cortical disconnection in age-related cognitive decline. Studies reported that white matter integrity had stronger relationships with performance on tasks for executive function and processing speed (Bennett & Madden, 2014).

Information processing speed may affect performance on tests for other cognitive functions because even tests without explicit speed demands present stimuli at a fixed rate, for example, one word or digit per second in list learning and memory span tasks (Harvey, 2019). It has been argued that slowing of information processing speed is one of the most ubiquitous age-related changes and may account for many other age-associated cognitive changes (Cohen et al., 2019; Harada, Natelson Love, & Triebel, 2013), including multiple components of executive functioning in healthy older adults (Liebel et al., 2017). Processing speed starts slowing in the third decade of life (Harada et al., 2013)**.** However, analysis by von Krause, Radev, and Voss (2022)[2] of cross-sectional data from 1.2 million participants suggests that, although response time slowing begins at age 20, “this slowing was attributable to increases in decision caution and to slower non-decisional processes, rather than to differences in mental speed”. The authors argue that slowing of mental speed occurred only after approximately age 60 years.

Studies questioning the executive function theory show that, although executive functioning declines in older adults, the decline in executive functioning is not disproportionate compared to other functions and does not account for age-related changes in other measures of cognition (Reuter-Lorenz, Festini, & Jantz, 2021).

There exist data indicating a larger role of a global, domain-general factor in cognitive aging than domain-specific factors, although it is not clear what this global factor is (Dennis et al., 2020; Tucker-Drob, 2011; Tucker-Drob, Brandmaier, & Lindenberger, 2019).

Overall, this question is complex and requires a more thorough investigation, possibly by conducting a systematic review of original studies.

[2] Full text of this article is unavailable.

4.3 What factors modify age-related cognitive decline?

This question has been addressed by a systematic review of systematic reviews. Factors addressed in these systematic reviews were grouped as follows: 1) demographics; 2) physical health/biomarkers; 3) neurological conditions, psychological symptoms/mental health; 4) lifestyle; 5) diet; 6) socioeconomic factors. Each review addresses a specific factor or a group of related factors except Wu, Phyo, Al-Harbi, Woods, and Ryan (2020) who examined a broad range of possible influences on a cognitive trajectory over a lifespan. It should be noted that the list of potential modifiers of age-related cognitive decline is not comprehensive; it includes only those factors considered in the eligible systematic reviews.

Information collected from relevant systematic review is summarized in Table 2. More data about each review can be found in **Appendix 3**.

Table 2. Potential modifiers of age-related cognitive decline (data from systematic reviews) Specific cognitive functions (memory, visuospatial abilities, language abilities)

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
Demographics						
Wu et al. (2020)	• 10 studies • Inception – 6 November 2019	Gender	• Global cognition • Specific cognitive functions (episodic memory, executive function, processing speed, attention, language, visuospatial skills)	• Inconsistent evidence	• Low	Female gender predicted better cognit in eight studies and worse classes in two studies.
Physical health/biomarkers						
Anstey, Lipnicki, and Low (2008)	• 18 studies (5 studies address cognitive decline or cognitive performance change) • PubMed: 1950 – January 2007 • PsychINFO: 1872 – January 2007	Serum cholesterol [total, HDL, LDL] in midlife and late life	• Global cognition • Specific cognitive functions (memory, visuospatial abilities, language abilities)	• No evidence for an association between total cholesterol in late life and the risk of cognitive decline • Insufficient evidence for total cholesterol in midlife (one study that reported an inverse association)	• Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
	• Cochrane CENTRAL: 1800 – January 2007			• Insufficient evidence for HDL and LDL • Insufficient evidence for interaction between APOE and cholesterol (one study)		
Adhikari, Tripathy, Chuzi, Peterson, and Stone (2021)	• 24 studies (6 observational studies and 2 RCTs address the risk of decline in global cognition or specific functions) • Inception – October 6, 2019	Statin use	• Global cognition • Specific cognitive functions (memory, executive function, attention, visuospatial and language abilities)	• No evidence for an association between statin use and the rate of decline in global cognition or in individual domains.	• Low	The authors acknowledge the absence of studies with long-term follow-up (10–20 years) and recommend examining this association in studies with longer follow-up.
Forte and Casagrande (2020)	• 29 studies in "elderly" [65–74 years] and 11 studies in "old age" [≥75 years] • NR - August 2020	Blood pressure	• Global cognition • Specific cognitive functions (different types of memory, attention, executive function, mental control, abstract thinking, processing speed,	• Inconsistent evidence. The relationship may be non-linear, suggesting that there exists an optimal blood pressure level to maintain adequate cognitive functioning in older people.	• Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
			psychomotor speed, visuospatial abilities, verbal abilities/language skills)			
Gifford et al. (2013)	• 12 studies • PubMed: 1966 – October 1, 2013 • PsychINFO: 1877 – October 1, 2013	Blood pressure	• Global cognition • Specific cognitive functions (episodic memory, language, attention, executive function, information processing speed, visuoperceptual skills)	• Evidence for a modest negative association between blood pressure and scores in global cognition episodic memory, language, and executive functioning	• Low	
Lei, Deng, Li, and Zhong (2019)	• 22 studies • Cochrane Library: Issue 12, 2016 • Medline: 1966 – May 2016	Silent brain infarcts (SBI)	• Global cognition • Specific cognitive functions (intelligence, different types of memory, attention, abstraction,	• Evidence for association between SBI and decreases in global cognition and in specific cognitive functions	• Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
	• EMBASE: 1980 – May 2016 • China National Knowledge Infrastructure database: 1999 – May 2016		psychomotor speed, processing speed, calculation, executive function, word/verbal fluency, language, visual perception)			
Akintola et al. (2015)	• N = 15 • January 1966 – 1 April 2015	Subclinical hypothyroidism	• Cognitive impairment	• No evidence for association between subclinical hypothyroidism and cognitive decline.	• Low	
Arwert, Deijen, and Drent (2005)	• N=13 studies • 1985 – January 2005	The growth hormone Insulin-like growth factor I (IGF-I)	• Global cognition • Specific cognitive functions (information processing speed, crystallized intelligence, fluid intelligence, visual memory, verbal memory, spatial memory, spatial reasoning, divide attention)	• Evidence for a positive association between IGF-I level and cognition [negative impact of low IGF on cognition]	• Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
Chinnappa-Quinn et al. (2020)	• 24 studies (4 studies of cognitive changes were meta-analyzed) • Inception – January 2020	Acute illness hospitalizations	• Global cognition • Specific cognitive functions (memory, processing speed, executive function [word fluency, divided attention, mental flexibility])	• Evidence for an association between acute illness hospitalizations and a decline in cognition. • Insufficient domain-specific evidence.	Low	
Demnitz et al. (2016)	• 26 studies • 1990 – February 2015	Mobility (gait, lower-extremity function, balance)	• Global cognition • Specific cognitive functions (executive function, memory, processing speed)	• Evidence for a positive association between mobility and cognition (global cognition and specific functions)	Low	
Zammit, Robitaille, Piccinin, Muniz-Terrera, and Hofer (2019)	• N=6 • Inception – April 2017	Grip strength as an indicator of upper body muscle strength	• Premorbid IQ/General intelligence • Specific cognitive functions (memory, episodic memory, semantic memory, working memory,	• No evidence for an association	Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
			crystallized IQ, crystallized ability, processing speed, psychophysical speed, reaction time, reasoning, fluid reasoning, fluid intelligence)			
Duggan et al. (2020)	• 14 studies • Dates searched NR	Pulmonary function	• Global cognition • Specific cognitive functions (attention, different types of memory, reasoning, executive function, processing speed, spatial ability, verbal ability)	• Insufficient evidence from longitudinal studies • Evidence for a positive cross-sectional association (baseline measurements) between pulmonary function and cognition (higher pulmonary function is associated with better cognitive performance)	Moderate	
Wu et al. (2020)	• 37 studies (• Inception – 6 November 2019	• Self-rated health • Physical function • Physical limitation • Diabetes • Body mass index (BMI) • APOE ε4 allele	• Global cognition • Specific cognitive functions (episodic memory, executive function, processing speed, attention,	• Inconsistent evidence for self-rated health • Evidence for better physical function and higher body mass index being associated with a better cognitive trajectory (slower rate of cognitive decline)	Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
		• Higher amyloid burden	language, visuospatial skills)	• Evidence for diabetes, physical limitation, APOE ε4 alle, and higher amyloid burden being associated with a worse cognitive trajectory (higher rate of cognitive decline)		
Neurological conditions, psychological symptoms/mental health						
Loughrey, Kelly, Kelley, Brennan, and Lawlor (2018)	• 40 studies; 36 included in quantitative analysis, of which 35 studies of cognitive functioning • Inception-April 15, 2016	Age-related hearing loss (ARHL)	• Global cognition • Specific cognitive functions (attention, processing speed, reasoning, visuospatial ability, fluency, semantic memory, working memory, immediate recall, delayed recall)	• Evidence for an association between ARHL and accelerated multidomain cognitive decline	Low	
Hudon et al. (2020)	• 13 studies of cognitive score changes as an outcome	Behavioral and psychological symptoms	• Global cognition • Specific cognitive functions (verbal knowledge, verbal fluency, figural	• No evidence of an association for clinically significant anxiety (syndrome), difficulties initiating sleep	Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
	• Inception – January 17, 2017		memory, verbal memory, attention, working memory, spatial ability, processing speed, executive functions, visuospatial memory, episodic memory, language)	(sleep latency) and subjective sleep quality • Evidence for a positive association between depression or depressive symptoms, long or short sleep duration, and the risk of cognitive score change [decline]		
Bubu et al. (2020)	• 14 studies • NR – 1 May 2019	• Obstructive sleep apnea (OSA)	• Global cognition • Specific cognitive functions (IQ, memory, attention, executive function, construction, language, general cognitive/ intellectual ability, psychomotor vigilance)	• Inconsistent evidence (highly variable associations depending on the study type and setting)	Moderate	
Cross et al. (2017)	• 13 studies	• Obstructive sleep apnea (OSA)	• Global cognition • Specific cognitive functions	• Inconsistent evidence (highly variable associations	Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
	• Inception – August 2016		(executive function, processing speed, language, memory, motor learning, attention & vigilance, visuospatial ability), and general cognitive/ intellectual ability across cognitive domains	depending on study type and setting)		
Dotson et al. (2020)	• 76 studies, of which 3 in age category "Middle Aged to Older Adult" (45-85 years) and 29 in age category "Older Adult" (60-97 years)	• Depression	• Executive functioning (inhibition, planning, cognitive flexibility, set shifting, and a composite score)	• Evidence for a negative association between depression and scores on executive (cognitive) control measures with no significant variations across specific functions	Low	"Executive functioning is a broad neurocognitive domain that includes multiple cognitive control functions such as planning, problem solving, set-shifting, concept formation, inhibition, and initiation ...."

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
Wu et al. (2020)	• 37 studies (6 studies of depressive symptoms; number of studies of baseline cognition - NR) • Inception – 6 November 2019	• Depressive symptoms • Baseline cognition	• Global cognition • Specific cognitive functions (episodic memory, executive function, processing speed, attention, language, visuospatial skills)	• Evidence for depressive symptoms being associated with a worse cognitive trajectory (higher rate of cognitive decline) • Inconsistent evidence for baseline cognition	Low	
Rodriguez and Lachmann (2020)	• 14 studies (9 studies of cognitive decline) • NR-June 4, 2019	• Intelligence in childhood and mid-life	• Specific cognitive functions (verbal fluency, verbal memory, logical memory, search speed, visual search, learning abilities intelligence)	• No evidence for an association between early- and mid-life intelligence and cognitive decline	Low	In studies of cognitive decline, intelligence was assessed at age 11 years or 15 years.
Lifestyle						
Engeroff, Ingmann, and Banzer (2018)	• 23 studies • NR-November 8, 2017	Leisure physical activity throughout the adult lifespan	• Global cognition • Specific cognitive functions (attention, executive	• Evidence for a beneficial effect of moderate and vigorous leisure physical activity in mid- to late adulthood on global	Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
			function, memory, working memory)	cognition, executive functions, and memory, but not on attention or working memory. • Insufficient evidence for the effect on cognition of leisure physical activity in young adulthood.		
Gu, Zou, Loprinzi, Quan, and Huang (2019)	• 6 studies [observational studies that include adults aged >55 years] • Inception – December 2018	Physical exercise, open skill and closed skilled	• Specific cognitive functions (cognitive flexibility, visuospatial working memory, visuospatial attention, inhibitory control)	• Evidence for beneficial effects of exercise on cognition • Open skill exercise may be more effective in protecting cognition	Low	'Open skills are performed in a dynamic and changing environment, while closed skills take place in a predictable and static environment."
Ramalho, Petrica, and Rosado (2018)	• 15 studies (4 observational studies) • January 2000 to November 30, 2016	Sedentary behaviors	• Global cognition • Specific cognitive functions (verbal fluency, semantic memory, episodic memory, working memory, executive	• Evidence for a differential effect of sedentary behaviors on cognitive functioning. • TV viewing was associated with lower cognitive functioning. • Some sedentary behaviors, such as computer use,	Moderate	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
			function/mental flexibility)	reading, may help maintain cognitive functions.		
Roman-Caballero, Arnedo, Trivino, and Lupianez (2018)	• 9 studies • Inception – August 2018	Musical practice	• Specific cognitive functions (processing speed, attention, inhibition, verbal memory, verbal working memory, phonological verbal fluency, overall verbal fluency, semantic verbal fluency, naming, flexibility, visuospatial ability, visuoconstruction, visual memory, reasoning, visual working memory, verbal fluency)	• Evidence for a beneficial effect of musical practice on cognition, particularly early and long-term involvement with musical practice.	Low	
van den Noort et al. (2019)	• 34 studies (8 studies of cognitive decline) • NR-March 31, 2019	Bilingualism	• Global cognition • Specific cognitive functions (NR)	• Inconsistent evidence ["Several studies showed a protective effect whereas other studies failed to find it."]	Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
Pocuca et al. (2021)	• 3 studies in humans and 3 studies in animals • Inception - September 2019	Cannabis use	• Global cognition • Specific cognitive functions (working memory, episodic memory, delayed memory, vocabulary, oral reading skills, cognitive flexibility, processing speed, reaction time, learning)	• No evidence of an association between cannabis use and cognition in human studies • Evidence for varying effects of cannabis on cognition as a function of age and level of THC exposure in animal studies	Low	• "Existing human studies have several methodological limitations, potentially accounting for the predominantly null effects." • "The scant research in this area indicates that existing findings reported herein should be interpreted with caution, since replication and further research are required."
Scott, Brennan, and Benitez (2019)	• 7 studies of healthy aging • Inception – June 3, 2019	Cannabis use	• Global cognition • Specific cognitive functions (verbal memory, processing speed, executive	• Evidence of a modest negative effect of cannabis use on cognition	Moderate	"… variability in the cannabis products used, outcomes assessed, and study quality limits the

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
			functioning, immediate memory, delayed memory, working memory, reaction time, attention)			conclusions that can be made …”
Wu et al. (2020)	• 37 studies (3 studies of smoking)	Smoking	• Global cognition • Specific cognitive functions (episodic memory, executive function, processing speed, attention, language, visuospatial skills)	• Evidence for smoking being associated with a worse cognitive trajectory (higher rate of cognitive decline)	Low	
Diet						
Issa et al. (2006)	• 1 study of cognitive function in normal aging • Medline: 1966 – 2003 • PreMedline: December 2003	Omega–3 Fatty Acid Intake	• Global cognition	• Insufficient evidence	Moderate	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
	• Embase: 1980 – 2003 • Cochrane central Register of Controlled trials: Q4, 2003 • Dissertation abstracts: 1861 – 2003 • CAB Health: 1973 – 2003					
J. Lee, Fu, Chung, Jang, and Lee (2018)	• 8 studies (3 cohort studies of cognitive decline were meta-analyzed)	Milk intake with or without other dairy products	• Specific cognitive functions (verbal memory, processing speed, working memory, visual attention, verbal fluency, abstract reasoning, selective attention, executive function)	• Insufficient evidence	Moderate	"The existing evidence (mostly observational) is too poor to draw a firm conclusion regarding the effect of milk or dairy intake on the risk of cognitive decline or disorders in adults."

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
Loughrey, Lavecchia, Brennan, Lawlor, and Kelly (2017)	• 17 studies (16 studies meta-analyzed)	Mediterranean diet	• Global cognition • Specific cognitive functions (immediate recall, verbal fluency, attention, episodic memory, executive functioning, semantic memory, working memory, processing speed, reasoning, delayed recall, paired associates)	• Evidence for a beneficial effect of adherence to Mediterranean diet on global cognition and some specific cognitive functions.	Low	
Lourida et al. (2013)	• 12 studies (9 studies of cognitive decline or performance) • Inception - January 2012	Mediterranean diet	• Global cognition • Specific cognitive functions (short-term and long-term memory, language, executive function, visuospatial skills, orientation, abstract	• Evidence for an inverse association between adherence to Mediterranean diet and speed of cognitive decline	Moderate	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
			reasoning and construction)			
Rafnsson, Dilis, and Trichopoulou (2013)	• 10 studies • Medline: 1950–October week 3 2010 • EMBASE: 1980–week 43, 2010 • Global Health (1973–October 2010) • CAB abstracts: 1973–week 42, 2010 • PsychINFO: 1806–October week 4 2010	Antioxidant nutrients (carotenes, flavonoids, selenium, vitamins C and E)	• Global cognition • Specific cognitive functions (memory, executive function, attention, psychomotor speed, visual memory, verbal fluency, visuospatial attention)	• Evidence for a beneficial effects of antioxidant nutrients on cognition	Moderate	The authors acknowledged that evidence supporting beneficial effects of antioxidant nutrients comes from "a limited number of high-quality investigations … highlighting the need for additional and longer investigations."
Socioeconomic						
Chapko, McCormack, Black, Staff, and Murray (2018)	• N=9 [7 studies of education and 2 studies of occupation in cognitively healthy individuals]	• Education • Occupation	• Global cognition • Specific cognitive functions (non-verbal reasoning, fluid intelligence, crystallized intelligence,	• Inconsistent evidence for occupation as a cognitive reserve determinant • Evidence for a protective effect of education on global cognition	Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
	• Medline: 1946 – 06/09/13 • EMBASE: 1947 – 06/09/13 • PsycINFO: 1967 – 06/09/13		cognitive/mental speed, immediate and delayed verbal memory, visual short-term memory, logical intelligence and reasoning)			
Nexo, Meng, and Borg (2016)	• 11 studies • Inception – August 1, 2014	Psychosocial working conditions	• Global cognition • Specific cognitive functions (different types of memory, mental status, processing speed, attention, reasoning, verbal ability, spatial ability, intellectual flexibility, inductive reasoning, vocabulary, phonemic fluency, semantic fluency)	• Evidence for a beneficial effect on cognitive function of exposure to high levels of mental work demands, occupational complexity or job control • "Conflicting, weak or insufficient" evidence for an effect of these factors on the rate of age-related cognitive decline	Moderate	
Evans, Martyr, Collins,	• 65 studies (51 included in meta-analysis)	Social isolation (assessed in terms of social	• Global cognition • Specific cognitive functions	• Evidence for a beneficial effect on cognition of larger	Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
Brayne, and Clare (2019)	• Inception- 8 January 2018	network/contact or social engagement/activity)	(different types of memory, verbal fluency, perceptual speed, spatial ability, delayed spatial recognition, visuospatial ability, executive function, abstraction)	social networks and engagement in social activity		
Kelly et al. (2017)	• 39 studies	Social relationships (social activity, social networks, social support, and composite measures)	• Global cognition • Specific cognitive functions (different types of memory, overall memory ability, verbal fluency, reasoning, attention, processing speed, visuospatial ability, overall executive functioning, composite measures of	• Evidence for a beneficial effect of social relationships on cognition	Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
			cognitive functions)			
Wu et al. (2020)	• 37 studies (8 studies of social engagement, 3 studies of volunteering • Inception – 6 November 2019	• Social engagement • Volunteering activity • Education	• Global cognition • Specific cognitive functions (episodic memory, executive function, processing speed, attention, language, visuospatial skills)	• Evidence for social engagement and volunteering activity being associated with a better cognitive trajectory (slower cognitive decline)	Low	
Meng, Nexo, and Borg (2017)	• 7 studies • Inception - August 1, 2015	Retirement	Specific cognitive functions (episodic memory, working memory, spatial ability, verbal ability, memory, processing speed, mental status, short term verbal memory, inductive reasoning, verbal fluency, immediate	• Evidence for an association between retirement and accelerated decline in crystallized cognitive abilities (the evidence is weak and limited to individuals retiring from jobs high in complexity with people) • Inconsistent evidence for an association between retirement and the rate of decline in fluid cognitive abilities	Low	

Reference	# Studies Dates searched	Factors/modifiers	Cognitive Outcomes examined	Conclusion	Evidence quality	Comments
			memory, verbal memory)			
B. Armstrong, Gallant, Li, Patel, and Wong (2017)	• 23 studies NR - March 9, 2016	Stereotype threat [negative stereotype about aging and memory]	• Episodic memory • Working memory	• Exposure to negative stereotype negatively impacts both episodic and working memory performance. • Differential impact of blatant and subtle manipulations of stereotype threat on the two types of memory. • The effect on episodic memory performance is influenced by testing procedures (e.g., type and timing of test).	Low	

Wu et al. (2020) examined literature on a variety of demographic, socioeconomic, cognitive, lifestyle, physical and mental health, biological and genetic predictors of cognitive trajectories in the general population. A cognitive trajectory was defined as cognitive functioning assessed at three or more time points. Thirty-seven prospective/longitudinal studies included in this review assessed global cognition, episodic memory, executive functioning, processing speed, attention, language, and visuospatial skills using a variety of tests. Cognition of participants of the eligible studies was assessed three to nineteen times (median five times) over a follow-up of two to 21 years (median nine years). Three to four classes of cognitive trajectories were identified with progressively decreasing baseline and increasing rate of decline: "a stable-high" class characterized by maintaining cognitive functions at high level; "a minor-decline" or "stable-medium" class characterized by gradual decline over time, and "a rapid-decline" class characterized by the steepest decline. Thirty-two protective factors, 24 risk factors, and four factors with inconsistent results (age, female gender, baseline cognition, self-rated health) were identified. Commonly reported protective factors were higher education, social engagement, physical activity, physical function, cognitive activity, volunteering, higher BMI. Commonly reported risk factors were depressive symptoms, APOE ε4 allele, physical limitation, diabetes, higher amyloid burden, and smoking. Being married and church attendance were beneficial across all classes of cognitive trajectories. Older age and physical limitation were detrimental across all classes. Higher education was beneficial in the best class in one study and in the worst class in another study. Depression was detrimental in the best two classes. Social support was beneficial in the worst class. Parkinson's disease was detrimental for general cognition in the best class, and stroke was detrimental for non-memory cognition in the worst class. The authors concluded that cognitive aging is a dynamic process with significant inter-individual variability, and it is unclear whether cognitive aging follows a similar pattern across all cognitive domains.

4.3.1 Demographics

Gender was one of the factors reported by Wu et al. (2020) as not consistently predicting a cognitive trajectory. Specifically, being female predicted better classes in eight studies and worse classes in two studies.

4.3.2 Physical health/biomarkers

Twelve reviews address associations between indicators of physical health and cognition in older adults. These reviews were published between 2005 and 2021, searched between 2 and 7 databases and included from 6 to 37 studies. A variety of factors were evaluated in the identified systematic reviews, including self-rated health, parameters related to cardiovascular and cerebrovascular health, subclinical hypothyroidism, the level of growth hormone Insulin-like growth factor I (IGF-I), hospitalizations for acute illness, physical strength and mobility, and pulmonary function.

4.3.2.1 Self-rated health

Wu et al. (2020) found conflicting results regarding the effect of self-rated health on cognitive trajectory: self-rated health predicted the best trajectory class in males in one study, whereas another study provided opposite findings in males and females.

4.3.2.2 Indicators of cardiovascular and cerebrovascular health.

It has been demonstrated that indices of vascular ageing, such as stiffness of arteries and dysfunction of small blood vessels, are associated with cognitive decline (Forte & Casagrande, 2020). For example, total serum cholesterol is identified as one of the vascular risk factors for dementia (Anstey et al., 2008). The aim of Anstey et al. (2008) was to clarify the role of serum cholesterol (total cholesterol, high density lipoprotein - HDL, low density lipoprotein - LDL) in midlife and late life as a risk factor for cognitive decline and dementias of different aetiologies. The risk of cognitive decline is addressed in five of the 18 eligible studies. Only data on the risk of dementia were meta-analyzed. The review included prospective studies with at least 12 months of follow-up. Global cognition, memory, visuo-spatial and language abilities were assessed using the Mini-Mental State Examination (MMSE), the Short Portable Mental Status Questionnaire (SPMSQ), and the Digit Symbol test. Two studies reported on continuous cognitive performance change and three studies on dichotomous performance change (decline vs. no decline). One study [reference 42 of the review] suggested that high total cholesterol in late life was associated with a decreased risk of cognitive decline. However, studies with larger samples found no effect of late-life total cholesterol on cognitive decline. The authors concluded that there was no reliable evidence for an association between high total cholesterol in late-life and cognitive decline. One very small study found that high total cholesterol in midlife was associated with a decreased risk of cognitive decline. No significant associations were found for HDL or LDL. However, because few studies examined the effects of HDL and LDL, no strong conclusion could be made.

Statins, inhibitors of 3-hydroxy-3-methylglutaryl-coenzyme A (HMG-CoA) reductase, are efficient agents for reducing plasma cholesterol. It has been demonstrated that these agents reduce the progression and may even induce the regression of atherosclerosis, which is translated in reductions in the risk of cardiovascular and cerebrovascular morbidity and mortality (Stancu & Sima, 2001). At the same time, there exists a concern regarding potential adverse effects of statins on cognition (Adhikari et al., 2021). Therefore, the aim of Adhikari et al. (2021) was to review randomized controlled trials (RCTs) and prospective observational studies examining the association between statin use and incidence of dementia or the risk of cognitive decline. Six observational studies and two RCTs address the risk of decline in global cognition or specific functions (memory, executive function, attention, visuospatial abilities, and language). Meta-analysis was not conducted. This review found no evidence for an association between statin use and the rate of decline in global cognition or in individual cognitive domains. The authors acknowledge lack of studies with long follow-up (10–20 years) and recommend examining this association in studies with longer follow-up periods.

Exposure to high blood pressure damage microcirculation in the brain and thus may cause cognitive problems (Forte & Casagrande, 2020). Two reviews (Forte & Casagrande, 2020; Gifford et al., 2013) examined the effect of blood pressure on cognition in older adults. To be eligible for inclusion by Gifford et al. (2013), a study should include participants with hypertension (systolic blood pressure >140 mmHg and/or diastolic blood pressure >90 mmHg). This systematic review and meta-analysis included 12 studies that assessed global cognition, episodic memory, language, attention, executive function, information processing speed, and visuoperceptual abilities using a variety of tests. Meta-analysis of unadjusted studies revealed that blood pressure was weakly but significantly inversely correlated with global cognition (r=-0.07, p<0.001) and episodic memory (r=-0.18, p<0.001). Diastolic blood pressure was more strongly negatively correlated with episodic memory than systolic blood pressure. A trend for a weak positive correlation was observed between blood pressure and attention (r=0.09, p=0.02). Meta-analysis of studies adjusted for vascular covariates revealed a "modest" statistically significant inverse correlation of blood pressure with global cognition (r=-0.11, p<0.001) and episodic memory. A trend for a moderate inverse association was found for language abilities (r=-0.22, p=0.07) and executive functioning (r=-0.12, p=0.20). There was a weak but statistically significant positive correlation between blood pressure and attention (r=0.14, p=0.002). Diastolic blood pressure was more strongly negatively correlated with episodic memory than systolic blood pressure. Overall, this review suggests that "blood pressure is modestly correlated with lower cognitive performances, specifically within the areas of global cognition, episodic memory, language, and executive functioning."

The aim of Forte and Casagrande (2020) was to analyze whether high blood pressure was associated with cognitive performance. Of the 68 studies included in this review, 29 studies were in "elderly" individuals (65–74 years) and 11 studies in individuals of "old age" (≥75 years). Meta-analysis was not conducted. These studies assessed global cognition, as well as specific cognitive functions (different types of memory, attention, executive function, mental control, abstract thinking, processing speed, psychomotor speed, visuospatial abilities, verbal abilities/language skills). This review suggests that the association between blood pressure and cognitive performance may be non-linear. There may be an optimal levels of blood pressure to maintain cognitive functioning in older people.

The term silent brain infarct (SBI) describes cerebral infarcts seen on brain computed tomography or magnetic resonance imaging without obvious neurologic signs. SBIs are relatively common with estimated prevalence of 8% to 28%, depending on age (Lei et al., 2019). Because the relationship between SBI and cognitive functioning is controversial, Lei et al. (2019) conducted a systematic review of 22 studies to examine whether SBIs are associated with decline in global cognition and specific cognitive domains, including memory, visual perception, intelligence, attention, language, and executive function. Data on SBI and global cognition were meta-analyzed. Meta-analyses of both continuous and dichotomized data revealed significant associations between SBI and a decline in global cognition assessed using the Mini-Mental State Examination (MMSE) or the Montreal Cognitive Assessment Scale (MoCA). Qualitative analysis suggested that SBI was associated with decreases in specific areas of cognitive functioning. The authors concluded that their results "suggest that rather than being clinically silent, SBI might be a factor inducing cognitive dysfunction."

4.3.2.3 Subclinical hypothyroidism

It has been demonstrated that overt adult-onset hypothyroidism characterized by elevated thyroid stimulating hormone (TSH) levels and reduced levels of circulating thyroid hormones, is associated with cognitive deficits. However, it is not clear whether subclinical hypothyroidism (SCH) defined as mild elevation of TSH and normal free thyroxine, is also associated with declined cognition. The prevalence of subclinical hypothyroidism increases with age, and its estimated prevalence is up to 22% in women older than 60 years; the prevalence in men is somewhat lower (Akintola et al., 2015). The aim of a systematic review conducted by Akintola et al. (2015) was to examine the association between SCH and cognition in relatively healthy community dwelling older adults. Fifteen studies included in this review (nine cross-sectional and six longitudinal) assessed global cognition, memory, and executive function. Cross-sectional data on global cognition, executive function, and memory, as well as longitudinal data on global cognition, were meta-analyzed. This systematic review and meta-analyses found no evidence an association between SCH and decline in cognitive functioning. The authors, however, acknowledge that the amount of data from available prospective studies was limited.

4.3.2.4 The growth hormone Insulin-like growth factor I (IGF-I)

Arwert et al. (2005) conducted a systematic review and a meta-analysis of studies examining associations between serum levels of insulin-like growth factor I (IGF-I) and cognition in healthy elderly. Decreased functioning of the IGF-I axis had been previously demonstrated both in individuals with growth hormone deficiency and in normally aging individuals, and features of growth hormone deficiency (such as reduced bone mineral density and decreased cognitive functioning) were similar to those seen in aging individuals. Thus, the hypothesis of the review was that low IGF-I correlated with impaired cognitive functioning in aging. Thirteen studies included in this review assessed global cognition using MMSE, as well as information processing speed, crystallized and fluid intelligence, visual, verbal and spatial memory, spatial reasoning, and divided attention. Meta-analyses revealed that IGF-I was positively correlated with MMSE scores and with scores in a variety of tests used to assess individual cognitive functions. Thus, the results support the hypothesis that low IGF-I would be associated with declines in cognitive functioning.

4.3.2.5 Hospitalization for acute illness

Cognitive decline has previously been documented following intensive care unit admission, following hospitalizations complicated by delirium, as well as post-surgery; however, it is less clear whether any acute illness hospitalization could increase the risk of subsequent cognitive decline (Chinnappa-Quinn et al., 2020). The aim of a systematic-review and meta-analysis conducted by Chinnappa-Quinn et al. (2020) was to synthesize evidence from longitudinal observational studies of cognitive outcomes following hospitalization for any acute illness in older adults. This review includes 24 studies that assessed global cognition and specific cognitive functions: memory, processing speed, executive function (word fluency, divided attention, mental flexibility). Data from four studies of cognitive changes between pre- and post-hospitalization were meta-analyzed. The meta-analysis revealed worsened cognition after acute illness hospitalization: the effect size (Cohen's d) =-0.16 (p=0.02). The qualitative review also suggested increased cognitive decline following hospitalization for acute illness. Evidence was insufficient to characterize domain-specific effects.

4.3.2.6 Physical strength and mobility

Physical strength is an indicator of overall health; findings from cross-sectional studies consistently associated physical strength with cognitive abilities (Zammit et al., 2019). The aim of Zammit et al. (2019) was to review longitudinal studies addressing whether changes in grip strength (an indicator of upper body muscle strength) was associated with changes in cognitive function in healthy community-dwelling older adults. Evidence from six studies included in this review suggests that, although both cognitive functioning and grip strength decline in older age, their declines may not be associated. Meta-analysis was not conducted.

Demnitz et al. (2016) reviewed cross-sectional studies and conducted a meta-analysis to examine associations between measures of physical mobility (gait, lower-extremity function, balance) and cognitive functioning. Twenty-six studies included in this review assessed global cognition, as well as specific cognitive functions (executive function, memory, processing speed). Based on their systematic review and meta-analysis, the authors concluded that better physical mobility was associated with a better performance in tests for global cognition and specific functions. These associations were stronger for gait and lower-extremity function than for balance, possibly due to a greater number of studies measuring gait and lower-extremity function as a measure of mobility.

Wu et al. (2020) found that physical limitation was one of the risk factors predicting a worse cognitive trajectory (higher rate of cognitive decline, whereas better physical function was predictive of a better cognitive trajectory (slower rate of cognitive decline)

4.3.2.7 Pulmonary function

Evidence from cross-sectional studies suggest that pulmonary function may be a predictor of cognitive performance (Duggan et al., 2020). The aim of Duggan et al. (2020) was to systematically review longitudinal data on aging-related dynamics linking pulmonary function and cognitive performance. This systematic review includes 14 studies that assessed global cognition and specific cognitive functions (attention, different types of memory, reasoning, executive function, processing speed, spatial ability, verbal ability). However, only four studies met full inclusion criteria, i.e., had three or more measurement occasions on both pulmonary function and cognition. The other 10 studies were either “two-wave” (n=3; two measurement occasions of both cognition and pulmonary function) or “mixed-wave (n=7; a single measurement of one variable and two or more measurements of the other). Meta-analysis was not conducted. Cross-sectional analyses supported a positive association between pulmonary function and cognition (i.e., higher pulmonary function is associated with better cognitive performance). The authors concluded, however, that there was little longitudinal data to support this association.

4.3.2.8 Other factors related to physical health

Higher body mass index was associated with a better cognitive trajectory, whereas diabetes, higher amyloid burden and APOE ε4 allele were predictive of a higher rate of cognitive decline (Wu et al., 2020).

4.3.2.9 Evidence synthesis

Twelve reviews address associations between indicators of physical health and cognition.

Wu et al. (2020) found conflicting results regarding the effect of self-rated health on cognitive trajectory. Five reviews examined indicators of cardiovascular and cerebrovascular health. No evidence for an association between total cholesterol in late life and the risk of cognitive decline was found; evidence for the effects on cognition of total cholesterol in midlife, HDL or ADL, was insufficient (Anstey et al., 2008). No evidence was found that use of statins for reducing plasma cholesterol was associated with the risk of cognitive decline in older adults (Adhikari et al., 2021). One review addressing the effect of blood pressure on cognition (Gifford et al., 2013) found that higher blood pressure was modestly correlated with lower cognitive performances in older adults, whereas the other review (Forte & Casagrande, 2020) suggests that the association between blood pressure and cognition in older people may be non-linear; there may be an optimal blood pressure to maintain good cognitive functioning. Silent brain infarcts (those seen on brain imaging without obvious neurologic signs) was found to be associated with a decline in cognition (Lei et al., 2019).

In contrast to overt adult-onset hypothyroidism, no evidence was found that subclinical hypothyroidism was associated with poorer cognition in older people (Akintola et al., 2015).

Lower serum levels of insulin-like growth factor I (IGF-I) appears to have a negative impact on cognitive functioning in healthy elderly (Arwert et al., 2005).

Cognition in older individuals may worsened after hospitalization for an acute illness (Chinnappa-Quinn et al., 2020).

Although both cognitive functioning and grip strength (a measure of upper body muscle strength) decline over age, the declines in these two functions may not be associated (Zammit et al., 2019). Better physical mobility may have a positive impact on cognition in older adults (Demnitz et al., 2016). Wu et al. (2020) found that physical limitation was one of the factors predicting a worse cognitive trajectory (higher rate of cognitive decline), and better physical function was predictive of a better cognitive trajectory (slower rate of cognitive decline). Higher body mass index was associated with a better cognitive trajectory, whereas diabetes, higher amyloid burden and APOE ε4 allele were predictive of a higher rate of cognitive decline (Wu et al., 2020).

The review by Duggan et al. (2020) supports a positive cross-sectional association between pulmonary function and cognition. The authors, however, acknowledge that limited longitudinal data are available.

4.3.3 Neurological conditions, psychological symptoms, mental health

Seven reviews address this group of factors, which include hearing loss, depression or depressive symptoms, anxiety, sleep quality and sleep disturbances, intelligence in earlier life. These reviews were published between 2017 and 2020, searched from two to five databases and include from 13 to 40 studies.

4.3.3.1 Hearing loss

About one-third of adults aged over 65 years experiences a significant hearing loss, and there may exist a link between hearing loss and cognitive decline (Loughrey et al., 2018)**.** The aim of Loughrey et al. (2018) was to investigate the association between age-related hearing loss (ARHL) and changes in cognition. Thirty-five studies (26 cross-sectional and 9 cohort) reporting on changes in cognitive functioning were included in the meta-analysis. These studies assessed global cognition and specific cognitive functions (attention, processing speed, reasoning, visuospatial ability, fluency, semantic memory, working memory, immediate recall, delayed recall). Analysis of cross-sectional studies revealed a small but statistically significant association between ARHL and decline in all ten assessed cognitive domains. Eight cognitive domains were assessed in cohort studies (there were no cohort data for visuospatial ability or working memory). Of the eight domains examined in cohort studies, seven exhibited a significant association with ARHL; the association between ARHL and decline in fluency was not statistically significant. The authors concluded that their analysis revealed significant associations between ARHL and accelerated multidomain cognitive decline.

4.3.3.2 Behavioral and psychological symptoms

Hudon et al. (2020) conducted a systematic review and a meta-analysis to investigate most frequent behavioral and psychological symptoms as predictors of cognitive decline in older adults. Thirteen longitudinal studies which examined cognitive score change during a follow-up of at least one year, were included in this review. These studies assessed global cognition and specific cognitive functions (verbal knowledge, verbal fluency, figural memory, verbal memory, attention, working memory, spatial ability, processing speed, executive functions, visuospatial memory, episodic memory, language). This analysis demonstrated that depression or depressive symptoms, long and short sleep duration, as well as sleep disturbances, were significant predictors of a cognitive score change during follow-up. Examples of sleep disturbances studied by Hudon et al. (2020) included wake after sleep onset, number of long wake episodes, difficulties maintaining sleep, use of sleep medication. Difficulties initiating sleep (sleep latency) and subjective sleep quality did not predict a significant cognitive score change. Clinically significant anxiety did not predict a significant MMSE score change.

4.3.3.3 Sleep disturbances

Obstructive sleep apnea (OSA), a common sleep disturbance in older adults, is characterized by intermittent hypoxia and sleep fragmentation (Bubu et al., 2020). Two systematic reviews (Bubu et al., 2020; Cross et al., 2017) addressed the association between this specific type of sleep disturbance and cognitive performance in older adults. Both reviews found that evidence for a link between OSA and cognition was highly variable and inconsistent.

Cross et al. (2017) conducted a systematic review and meta-analysis of 13 studies describing associations between OSA and cognitive functioning in older adults. Studies included in this review assessed global cognition, executive function, processing speed, language, memory, motor learning, attention & vigilance, visuospatial ability), and general cognitive/intellectual ability across cognitive domains. The meta-analysis revealed a small negative association between OSA and general cognitive ability across a combined range of cognitive domains: the effect size (Hedge's g) =0.18; p=0.009. However, this effect appeared to be driven by smaller studies and studies with a higher risk of bias; larger studies with low risk of bias reported no association between OSA and cognition. Meta-analysis of case-control studies of populations from sleep clinics showed a significant medium strength negative association between OSA and cognition (g=0.49, p<0.001), whereas community-based cohort studies found no association (g=0.04, p=0.320). The authors concluded that "[a]ssociations between OSA and cognition in later life are highly variable and the findings differ based on the type and setting of study."

Bubu et al. (2020) conducted a systematic review of studies examining the link between OSA and cognition. Of 68 included studies, 14 observational studies examined cognitive functioning in older adults (mean age 60 years or older); 11 studies were cross-sectional and 3 longitudinal. Global cognition, IQ, memory, attention, executive functioning, construction, language, psychomotor vigilance, were assessed. The findings of these studies were inconsistent. Cross-sectional studies found weak or no links. One of the three longitudinal studies found a modest association between nocturnal hypoxemia and subsequent decline in a measure of global cognition; the other study found an association between apnea hypopnea index (AHI) and a slight decline in attention, which was more evident in subjects with severe OSA. The third longitudinal study found no evidence of an association between OSA severity or nocturnal hypoxemia with subsequent cognitive decline. Meta-analysis was not conducted. The authors of the systematic review concluded that cross-sectional and longitudinal associations between OSA and cognition in older adults "are highly variable, depending on the study type and setting, with small sleep clinic populations (i.e., more symptomatic patients) driving most of the positive findings."

4.3.3.4 Depression/depressive symptoms

The aim of Dotson et al. (2020) was to investigate a link between depression and cognitive (executive) control across the lifespan. In total, this review includes 76 studies of which 3 studies were conducted among individuals in age category "Middle Aged to Older Adult" (45-85 years) and 29 studies among individuals in age category "Older Adult" (60-97 years). Executive (cognitive) control functions assessed in these studies were inhibition, planning, cognitive flexibility set shift, and a cognitive score across functions was also used. As meta-analysis was conducted in age subgroups with more than four studies, only data from studies in "Older Adults" were meta-analyzed. The meta-analysis demonstrated a significant negative association between depression and cognitive control, with a slope of -0.45 (p<0.0001) for a composite score. Effect sizes did not significantly vary based on cognitive domain. The negative relationship was stronger for clinical depression than for subthreshold depression; the relationship was also stronger in individuals taking antidepressant medications.

Wu et al. (2020) found that depressive symptoms were among factors predicting higher odds of being in a worse class of cognitive trajectory.

4.3.3.5 Cognition in earlier life

Findings from studies examining associations between baseline cognition and the rate of cognitive decline were interpreted by Wu et al. (2020) as “discordant”: whereas most studies found that higher baseline cognition predicted a better cognitive trajectory, one study demonstrated that better baseline episodic memory predicted a declining memory.

Rodriguez and Lachmann (2020) designed their review to test a hypothesis that people with higher intelligence experience slower cognitive decline and a lower risk of dementia than people with lower intelligence. This review includes 14 studies, of which nine addressed cognitive decline. Although the aim was to investigate the role of intelligence in early and mid-life, the studies of cognitive decline assessed intelligence only in early life (at age 11 years or 15 years). These studies assessed specific cognitive functions (verbal fluency, verbal memory, logical memory, search speed, visual search, learning abilities intelligence). Meta-analysis was not conducted. The authors concluded that the evidence collected in their review suggests little or no association between intelligence in earlier life and the rate of cognitive decline at older ages, although initially better cognitive skills may mask cognitive deterioration for a longer period.

4.3.3.6 Evidence synthesis

One review (Loughrey et al., 2018) evaluated the effect of age-related hearing loss and revealed significant associations between hearing loss and accelerated multidomain cognitive decline.

Three reviews assessed associations between sleep disturbances and changes in cognition. Hudon et al. (2020) analyzed studies examining various types of sleep disturbances, such as wake after sleep onset, number of long wake episodes, difficulties maintaining sleep, use of sleep medication. This review found that sleep disturbances were significant predictors of a cognitive score change during follow-up. Hudon et al. (2020) also found that long or short sleep duration were consistently associated with a cognitive score change, whereas difficulties initiating sleep (sleep latency) and subjective sleep quality did not predict a significant cognitive score change. Two reviews (Bubu et al., 2020; Cross et al., 2017) examined a specific type of sleep disturbance, obstructive sleep apnea (OSA), and found inconsistent evidence regarding the effect of OSA on cognition in aging individuals.

Studies reviewed by Hudon et al. (2020) suggest that depression or depressive symptoms were significant predictors of a cognitive score change during follow-up. Dotson et al. (2020) demonstrated a relationship between depression and decline in cognitive (executive) control. Effect sizes did not significantly vary based on cognitive domain, but the relationship was stronger for clinical depression compared to subthreshold depression; the relationship was also stronger in individuals taking antidepressant medications. Wu et al. (2020) found that depressive symptoms predicted a cognitive trajectory with a steeper decline.

Clinically significant anxiety was not associated with a significant change in MMSE score (Hudon et al., 2020).

Evidence collected by Rodriguez and Lachmann (2020) suggests that there is little or no association between intelligence in earlier life and the rate of cognitive decline at older ages. Wu et al. (2020) classified findings from studies examining association between baseline cognitive function and a cognitive trajectory over the lifespan as “discordant”.

4.3.4 Lifestyle

Eight systematic reviews examined the effects of lifestyle factors on cognition in older adults. These reviews were published between 2018 and 2020, searched from two to six bibliographic databases and included from three to nine studies. Lifestyle factors evaluated in these reviews include physical activity, intellectual activity, cannabis use and smoking.

4.3.4.1 Physical activity

Engeroff et al. (2018) systematically reviewed studies examining the association between leisure physical activity (PA) throughout the adult lifespan and domain-specific cognitive function in old age. The authors defined leisure PA as “all activities that people participated in during their free time and that were not work related and did not involve life maintenance tasks such as housecleaning”. Twenty-three studies included in this review assessed global cognition and specific cognitive functions (attention, executive function, memory, working memory). This review provides evidence that moderate- and vigorous leisure PA was beneficial for global cognitive function, executive functioning, and memory but not for attention or working memory. The authors acknowledge that most studies included in their review assessed PA in mid- to late adulthood, and information regarding the effect of PA in young adulthood on cognition in old age is lacking.

Gu et al. (2019) evaluated literature regarding the effects of different types of physical exercise, open skill exercise (OSE) and closed skill exercise (CSE) on cognitive functioning. Open skill exercises are performed in a dynamic/changing/unpredictable environment and require active decision making and adaptability, whereas closed skill exercise take place in a stable and predictable environment. Examples of OSE: tennis, squash, basketball, boxing. Examples of CSE: running, swimming, cycling. In total, 19 studies were included, of which six observational studies included adults older than 55 years. These studies evaluated cognitive flexibility, visuospatial working memory, visuospatial attention, and inhibitory control using a variety of tests. This review provides evidence for beneficial role of exercise on cognitive function in older adults, and OSE may more effectively improve attention, audio-visual perception, and cognitive flexibility. The authors noted that, although OSE may provide superior cognitive benefits, beneficial effects of CSE should not be ignored.

Wu et al. (2020) found that physical activity was commonly reported as a protective factor, predicting higher odds of being in a better class for cognitive trajectory or lower odds of being in a worse class.

Ramalho et al. (2018) synthesized evidence on the relationship between sedentary behaviours and various psychological outcomes, including cognition, in older adults. Studies included in this review assessed global cognition and specific cognitive functions (verbal fluency, semantic memory, episodic memory, working memory, executive function/mental flexibility). This review suggests that sedentary behaviors are differentially associated with cognitive functioning. For example, TV viewing was associated with lower cognitive functioning. In contrast, sedentary behaviors that involve intellectual activity, such as computer use or reading, may help maintain cognitive functions in older adults, specifically different types of memory.

4.3.4.2 Intellectual activity

Roman-Caballero et al. (2018) systematically reviewed and a meta-analyzed studies on the effect of musical practice on healthy cognitive aging. Thirteen studies included in this review assessed verbal fluency, semantic memory, episodic memory, working memory, executive function/mental flexibility. Meta-analysis revealed a significant beneficial effect of musical practice on processing speed, inhibition, attention, verbal memory, verbal working memory, phonological verbal fluency, overall verbal fluency, naming, flexibility, and visuospatial ability. The effect of musical practice on semantic verbal fluency, visuoconstruction, visual memory, reasoning and visual working memory was also positive but not statistically significant. This review suggests that involvement in musical practice, especially early and long-term involvement, was associated with benefits in domain-specific functions and in a range of domain-general functions. The authors concluded that musical practice may be an effective tool for preventing the declines of healthy aging.

The aim of van den Noort et al. (2019) was to review evidence regarding the protective effect of bilingualism against cognitive decline. This systematic review includes 34 studies, of which eight address cognitive decline as an outcome. These studies assessed global cognition and specific cognitive functions; however, which specific cognitive functions were assessed is not reported. This review provides some evidence for a protective effect of bilingualism against cognitive decline in aging; however, the results were mixed: several studies showed a protective effect whereas other studies did not, depending on several factors, such as immigration status and individual experiences.

According to Wu et al. (2020), cognitive activity was among most frequently reported protective factors predicting higher odds of being in a better class for cognitive trajectory or lower odds of being in a worse class.

4.3.4.3 Other lifestyle choices

Scott, Brennan, et al. (2019) examined literature on the effects of cannabis on cognitive functioning in older adults (aged 50 years or older) with or without neurocognitive disorders. This review included seven studies of healthy aging, in which global cognition, as well as specific cognitive functions were assessed (verbal, immediate, delayed, and working memory, attention, processing speed, reaction time, and executive functioning). This review found “modest negative effects on cognition” of cannabis. The authors, however, acknowledged that small sample sizes and variability in study designs limited their ability to draw definitive conclusions.

The aim of Pocuca et al. (2021) was to summarize evidence regarding the effects of cannabis use on cognitive function in healthy aging. This review included six studies, of which three were in humans. These studies assessed global cognition and specific cognitive functions (working memory, episodic memory, delayed memory, vocabulary, oral reading skills, cognitive flexibility, processing speed, reaction time, learning). The human studies provided null results, which, in the authors’ view may be explained by methodological limitations. The authors also acknowledge scarcity of research in this area, which requires caution in interpretation of the findings.

Wu et al. (2020) found that tobacco smoking was among factors most frequently reported as predictive of a worse cognitive trajectory (higher rate of cognitive decline).

4.3.4.4 Evidence synthesis

Eight systematic reviews examined the effects of lifestyle factors on cognition in older adults. Three reviews (Engeroff et al., 2018; Gu et al., 2019; Wu et al., 2020) provide evidence for a beneficial effect of physical activity. Sedentary behaviors have a differential effect on cognition in older adults depending on whether the behavior involves intellectual activity (e.g, reading, computer use) (Ramalho et al., 2018). Wu et al. (2020) found that cognitive activity was among the commonly reported factors predictive of a better cognitive trajectory. Roman-Caballero et al. (2018) provided evidence that musical practice, as a form of intellectual activity, was associated with benefits to cognition in older adults. Some evidence for a protective effect of bilingualism against cognitive decline in aging was provided by van den Noort et al. (2019); however, not all studies demonstrated a protective effect, depending on several factors, such as immigration status and individual experiences. The effect of cannabis use on cognition in older adults was assessed in two systematic reviews. Scott, Brennan, et al. (2019) found modest negative effects of cannabis use on cognition, whereas Pocuca et al. (2021) reported null results. Authors of both reviews acknowledged methodological limitations of included studies, which limited the ability to draw definitive conclusions. Tobacco smoking was among commonly reported factors predictive of a worse cognitive trajectory (Wu et al., 2020).

4.3.5 Diet

Five systematic reviews examined the effects of diet. These reviews were published between 2006 and 2018, searched between three and eleven databases, included from one to seventeen studies, and evaluated the following elements of diet/dietary preferences: consumption of omega–3 fatty acids, antioxidant nutrients, milk intake, adherence to the Mediterranean diet.

4.3.5.1 Omega–3 fatty acids

The aim of Issa et al. (2006) was "to determine whether sufficient evidence exists to substantiate claims of a health benefit for omega–3 fatty acids on cognitive function in normal aging and in dementia". Only one study of cognitive function in normal aging was eligible for inclusion in this review. This was a cohort study that assessed global cognition using a Mini-Mental State Examination (MMSE). This study found no significant association between fish or total omega-3 consumption and cognitive decline defined as a drop of more than two points in the MMSE over a 3-year period. The authors concluded that the evidence is "insufficient to draw conclusion about the effects of omega–3 fatty acids on cognitive function in normal aging".

4.3.5.2 Milk intake

J. Lee et al. (2018) examined the effects of milk intake alone or in combination with other dairy products on the cognitive function. This review includes eight studies that assessed specific cognitive functions (verbal memory, processing speed, working memory, visual attention, verbal fluency, abstract reasoning, selective attention, executive function). Findings from included studies were synthesized qualitatively using a strength of evidence (SoE) approach, and three cohort studies of cognitive decline were meta-analyzed. The SoE regarding the associations between milk intake and cognitive decline was rated as insufficient. The meta-analysis did not show significant differences in risk for cognitive decline between the highest and the lowest milk intake groups. The authors concluded that "the overall strength of evidence is inadequate for the effects of milk or dairy consumption on cognitive decline and disorders, due to the insufficient number of high-quality studies and large heterogeneity across studies".

4.3.5.3 Adherence to the Mediterranean diet

Two systematic reviews were aimed at examining the effect of the Mediterranean diet on the cognitive functioning of older adults.

Loughrey et al. (2017) included 17 studies, of which 16 were meta-analyzed. These studies assessed global cognition and specific cognitive functions (immediate recall, verbal fluency, attention, episodic memory, executive functioning, semantic memory, working memory, processing speed, reasoning, delayed recall, paired associates). The results were consistent regarding beneficial effects of adherence to Mediterranean diet on global cognition. There were differences between randomized controlled trials and observational studies regarding the effect on specific cognitive functions. Cohort studies showed significant beneficial effect of the Mediterranean diet on processing speed and reasoning, whereas RCTs demonstrated that the Mediterranean diet improved delayed recall, working memory, and executive function.

Lourida et al. (2013) included 12 studies, of which nine studies assessed cognitive decline or cognitive performance as an outcome. These studies assessed global cognition and specific cognitive functions (short-term and long-term memory, language, executive function, visuospatial skills, orientation, abstract reasoning and construction). Based on qualitative analysis of data from included studies, the authors concluded that "greater adherence to Mediterranean diet is associated with slower cognitive decline …." Meta-analysis was not conducted.

4.3.5.4 Antioxidant nutrients

The aim of Rafnsson et al. (2013) was to systematically review population-based cohort studies examining the association between antioxidant nutrients (carotenes, flavonoids, selenium, vitamins C and E) and cognitive function in older people. Ten studies included in this review assessed global cognition and specific cognitive functions (memory, executive function, attention, psychomotor speed, visual memory, verbal fluency, visuospatial attention). These studies provide evidence for a beneficial effects of antioxidant nutrients on cognition. However, the authors of the review point out that the evidence comes from a limited number of high-quality studies and acknowledge the need for additional investigations.

4.3.5.5 Evidence synthesis

Five systematic reviews examined the effects of diet. Evidence regarding the effects omega–3 fatty acids (Issa et al., 2006) and milk intake (J. Lee et al., 2018) on cognition in older adults was insufficient to make a conclusion. Loughrey et al. (2017) and Lourida et al. (2013) provided evidence for a beneficial effect of adherence to the Mediterranean diet. Evidence for a beneficial effects of antioxidant nutrients (carotenes, flavonoids, selenium, vitamins C and E) comes from high-quality studies, but the number of studies examining the effect of these nutrients on cognition was limited (Rafnsson et al., 2013).

4.3.6 Socioeconomic-related factors

A total of 7 systematic reviews investigating the effects of socioeconomic-related factors on cognitive decline were identified for inclusion in the current systematic review. In general, these reviews were published between 2016 to 2020, searched 2 to 4 databases, and included 7 to 65 original studies each. A wide variety of socioeconomic-related risk factors were evaluated between the identified reviews. Specifically, these factors include stereotype threat, social relationships, retirement, occupation, psychosocial working conditions, and education.

4.3.6.1 Stereotypes about aging

The review by B. Armstrong et al. (2017) evaluated the relationship between stereotype threat (ST) and memory performance in older adults, as well as potential moderators of effect. Four bibliographic databases consisting of PsycINFO, PubMed, Web of Sciences, and Medline were searched on March 9, 2016. To supplement the search, a great literature search was performed, and authors of relevant publications were contacted. In total, 23 studies retrieved from the searches were eligible for inclusion. A random effects meta-analysis was conducted, and yielded a significant mean weighted effect size of 0.253 (95% CI: 0.074, 0.433) for the effect of ST on episodic memory, and 0.373 (95% CI: 0.040, 0.707) for the effect of ST on working memory. However, heterogeneity was also reported in both effect sizes. Overall, the review found that episodic and working memory performance was adversely affected by negative age-based stereotypes. Additional findings demonstrate that significant ST effects were observed with subtle manipulation and working memory tasks. The effect of ST on episodic memory was only significant with blatant manipulations, free recall memory performance, and immediate memory responses. Age and education level were not identified as moderators (B. Armstrong et al., 2017).

4.3.6.2 Social engagement

Kelly et al. (2017) investigated the association of social engagement, including social activity, networks, support, and integration, with cognitive functioning in adults above 50 years of age. Three electronic databases, consisting of PubMed, Medline and PsycInfo, were searched for relevant studies published between January 2000 to January 2017. Supplementary searches of Google Scholar, and the reference lists of included studies or pertinent reviews were also conducted. A total of 39 studies were eligible for inclusion, where 34 were of observational design. No meta-analyses were conducted. In conclusion, the review authors report that "there is an association between social relationships and the cognitive functioning of healthy older adults, although the specific nature of this association remains unclear. . . Evidence was most consistent in favour of a relationship between the distinct forms of social relationships and global cognition and working memory." (p. 16).

Evans et al. (2019) assessed the association of social isolation-related features, such as social activities and networks, with cognitive function in people age 50 years of age or older. Four bibliographic databases, consisting of PsycInfo, CINAHL, PubMed, and AgeLine, were searched for studies published up to October 11th, 2016; the search results were updated on January 8th, 2018. In total, 65 studies were eligible for inclusion, where 51 were included in a meta-analysis. The random effects meta-analysis for all social measures yielded effect sizes of 0.054 (95% CI: 0.043, 0.065) for all cognitive measures, 0.061 (95% CI: 0.044, 0.079) for global measures, 0.050 (95% CI: 0.028, 0.072) for memory, and 0.031 (0.015, 0.047) for executive function. Results for social activity included effect sizes of 0.070 (95% CI: 0.050, 0.089) for all cognitive measures, 0.072 (95% Cl: 0.048, 0.095) for global measures, 0.049 (95% CI: 0.023, 0.075) for memory, and 0.032 (95% CI: 0.011, 0.052) for executive function. Results for social network yielded effect sizes of 0.072 (95% CI: 0.032, 0.112) for all cognitive measures, 0.067 (95% CI: 0.026, 0.108) for global measures, and 0.107 (95% CI: -0.041, 0.250) for memory. Results for a combination of social activity and social networks included effect sizes of 0.036 (95% CI: 0.024, 0.049) for all cognitive measures, 0.036 (95% CI: 0.020, 0.052) for global measures, and 0.046 (95% CI: 0.021, 0.070) for memory. Study findings for all social measures and all cognitive measures were stratified by gender. Sub-analysiss results demonstrated effect sizes of 0.048 (95% CI: 0.021, 0.074) for men and 0.059 (95% CI: 0.028, 0.090) for women. Overall, the study authors conclude that "in later life larger social networks and engagement in social activity are associated with better cognitive function. The reported association was small, which may be attributed to the methodological issues associated with assessing social concepts and the fact that social connections is only one of many factors that influence cognitive function over time" (p. S139) (Evans et al., 2019).

Wu et al. (2020) conducted a systematic review, which was previously described in greater detail, to determine predictors of cognitive trajectories during late life in study participants with a mean age of 60 to 93.4 years. Classes of trajectory profiles that were observed include stable-high, minor-decline, stable-medium, and rapid-decline. Results from this review demonstrate that social engagement, and volunteer activity are frequently reported to be positively predictive of the best class.

4.3.6.3 Education and occupation

Wu et al. (2020) demonstrate that higher education is frequently reported to be positively predictive of the best class of cognitive trajectory.

Chapko et al. (2018) conducted a systematic review to determine life-course factors that prevent cognitive decline in study participants with a mean age greater than 60 years. Three bibliographic databases were searched, including MEDLINE (1946 – 06/09/13), EMBASE (1947 – 06/09/13), and PsycheInfo (1967 – 06/09/13). In total, 34 studies were eligible for inclusion, where 7 were on education, and 2 were on occupation as determinants of cognitive reserve (CR). No meta-analysis was conducted. In conclusion, the study authors report that "[w]ithin healthy population suitable to inform preventative interventions, our findings suggest that education has a protective effect on general cognition in the face of multiple brain burden measures, while occupation as a potential CR determinant presented inconclusive results" (p. 294).

4.3.6.4 Psychological working conditions

The review by Nexo et al. (2016) evaluated the association of psychological working conditions with the magnitude of and changes in cognitive function. Four bibliographic databases, including MEDLINE, PsycNET, Web of Science, and OSH UPDATE, were searched to identify references published up to August 1st, 2014. To supplement the search, studies identified through hand-searching of reference lists and recommendation by colleagues were also considered for inclusion. In total, 11 studies were eligible for inclusion, where 4 were on mental work demands, 2 were on work complexity, and 5 were on work environmental factors. No meta-analysis was conducted. Study findings from this review demonstrate that "high levels of mental work demands, occupational complexity or job control at one point in time were prospectively associated with higher levels of cognitive function in midlife or late life. However, the evidence to clarify whether these psychosocial factors also affected cognitive decline was insufficient, conflicting or weak. It remains speculative whether job control, job demands or occupational complexity can protect against cognitive decline" (p. 487).

4.3.6.5 Retirement

The review by Meng et al. (2017) evaluated the association of retirement with cognitive functioning and age-related cognitive decline in people aged 40 years or older, using longitudinal studies. Four bibliographic databases consisting of MEDLINE, PsycNET, Web of Science, and OSH UPDATE were searched for references published up to August 1st 2014. Following an update of the search in December 2016, a total of 7 studies were selected for inclusion. No Meta-analyses were conducted. Overall, the review authors observed "weak and contradicting evidence for an association between retirement and age-related cognitive decline . . . [and that] there is a major research gap in this field" (p. 9).

4.3.6.6 Evidence Synthesis

Only one review was identified for each of the following factors: retirement, stereotype threat, and volunteer activity (B. Armstrong et al., 2017; Meng et al., 2017; Wu et al., 2020). Evidence on the relationship between retirement and age-related cognitive decline was weak and conflicting (Meng et al., 2017). An adverse effect of negative age-based stereotypes on episodic and working memory was also observed (B. Armstrong et al., 2017). In addition, volunteer activity was identified as a protective factor that is positively predictive of having greater odds of being in a better cognitive trajectory class (Wu et al., 2020).

Two reviews on education were identified and reported a positive impact on general cognition (Chapko et al., 2018), as well as an increased odds of being in a better trajectory class (Wu et al., 2020). Occupation-related factors were reported in two reviews, where one identified research findings that were inconclusive for occupation as determinant of CR (Chapko et al., 2018; Nexo et al., 2016). Although the other review reported a positive association of job control, job demands, and occupational complexity with cognitive function, evidence was inadequate to conclude on the effect of these factors on cognitive decline (Nexo et al., 2016).

Of the reviews included in the RSI report, three reported on social engagement-related factors (Evans et al., 2019; Kelly et al., 2017; Wu et al., 2020). One review reported a weak association of social networks and activities with enhanced cognitive function, and suggests that the review results may be due to methodological issues (Evans et al., 2019). Similarly, findings from the review by Kelly et al. (2017) identified an association between social relationship and cognitive functioning; however, the review authors also report that the nature of the association is unclear. Finally, in contrast to the two prior studies, evidence reported by Wu et al. (2020) supports social engagement as a protective factor that positively predictive of an elevated odds of being in a better cognitive trajectory class.

5 Evidence for question 4: Studies of physicians

5.1 What is the association between age-related cognitive decline and physician performance?

The search strategy resulted in the retrieval of 1,781 records from five bibliographic databases. Electronic and manual de-duplication resulted in the removal of 247 records, leaving 1534 records for title and abstract screening (level 1). After excluding 1410 irrelevant records, 124 articles remained for full text examination (level 2). This examination led to the exclusion of 119 for not matching the inclusion/exclusion criteria. Five articles were retained for further analysis.

A PRISMA flow diagram (Moher et al., 2009) detailing the selection process for articles relevant to question 5 is shown in Figure 2.

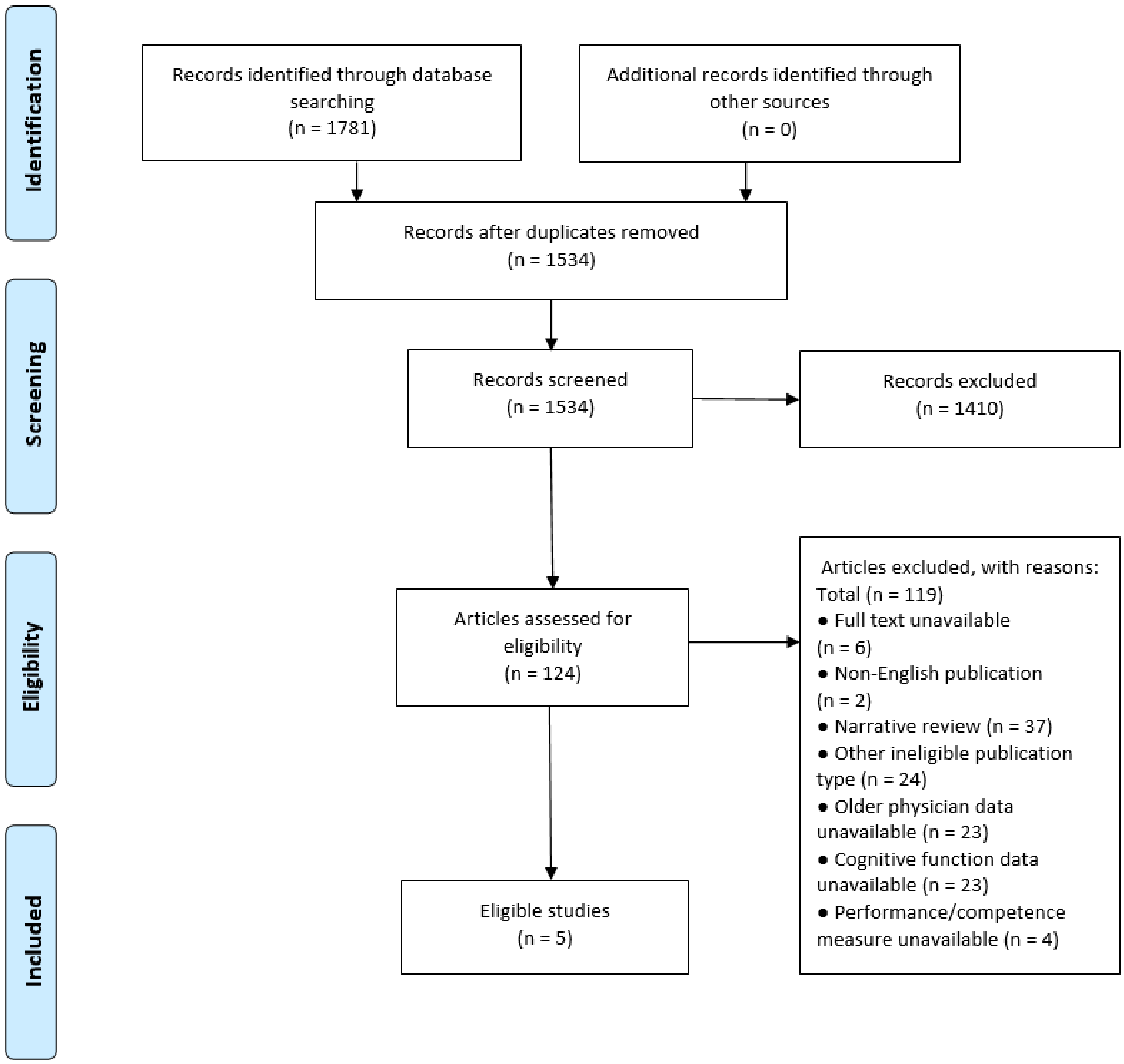

Figure 2: PRISMA flow diagram for question 4

Several studies were identified comparing cognitive functioning of physicians referred for assessment due to clinical competency or performance concerns, to cognitive functioning of control physicians with no performance problems, or to normative reference data (Table 3). These studies are summarized below, and more details are provided in Appendix 4.

Table 3: Studies of cognitive functioning of physicians referred for assessment due to clinical competency or performance concerns

	Population	Cognitive function measure	Clinical performance or competence measure	Findings
Del Bene and Brandt (2020)	**Referred group** • 30 physicians of different specialties referred for neuropsychological evaluations. • Mean age 64.27 (SD 12.53) years **Comparison group** • 39 practicing community urologists with no known or suspected neurological, psychiatric, or cognitive disorders. Mean age 48.51 (SD 8.71) years	Nine variables derived from seven cognitive and motor tests	Referral for assessment due to quality-of-care infractions or deficiencies, or concern of their healthcare professionals about their neurocognitive wellbeing	• "Impaired" test score was defined as that below the 5th percentile of the control physicians' performance. • An impaired score on more than five of the nine key variables was suggested as a cut-off to identify impaired physicians. • Using this cut-off, 14 referred physicians were categorized as "impaired" and 16 as "ambiguous." • The referred group performed below the comparison group on the neuropsychological test battery as a whole and on each of the nine variables • The neurocognitive scores of "impaired" physicians were inferior to those of physicians categorized as "ambiguous". • The "impaired physicians were older, more often suspected of having a neurodegenerative disorder, and more likely discontinued practicing medicine.
Korinek, Thompson, McRae, and Korinek (2009)	**Competency group** • 267 physicians of different specialties referred for competency evaluation	MicroCog scores for five specific cognitive domains and three summary scores	Referral for competency evaluations; no details provided	• Scores of the competency group were significantly lower than those of the control group on three MicroCog summary measures and on four of the five neuropsychological domains

	Population	Cognitive function measure	Clinical performance or competence measure	Findings
	• Age 30-80, mean 51.5 (SD 9.1) years **Comparison group** • 68 physicians of similar age with no competency concerns • Age 31-74, mean 49.4 (SD 12.5) years			• More physicians in the study group (24% vs. 0% in the comparison group; p<0.001) had cognitive difficulty defined as a cognitive proficiency score more than 1 SD below the mean, or any two index scores more than 1 SD below the mean
Perry and Crean (2005)	**Study Group** • 148 physicians of different specialties whose primary language was English referred to the Physician Assessment and Clinical Education (PACE) program for assessment **Comparison group** • Normative reference samples.	24 subsets derived from four neuropsychological test batteries	Referral to PACE due to various infractions	• The referred group of physicians performed in the average range on most of the neuropsychological measures. • 61% scored 1 SD below the normative reference sample on at least three neuropsychological measures • 14 (9%) scored in the average range or greater on all measures. • The referred physicians performed lower than expected on tests of sequential processing, attention, logical analysis, eye–hand coordination, verbal and non-verbal learning.
Turnbull et al. (2000)	**Study group** • 27 physicians referred to the Physician Review Program (PREP) **Comparison group**	Neuropsychological screening battery to assess problem solving (verbal and visual/spatial), concept formation, reasoning, learning, memory,	Performance in the PREP program.	• Of the eight physicians who performed well in the PREP assessment, seven had no, minimal, or mild cognitive impairment. • Of the 19 physicians who scored poorly at PREP, six had moderate or severe cognitive impairment.

	Population	Cognitive function measure	Clinical performance or competence measure	Findings
	• Internal comparisons by level of performance in the PREP	attention, complex mental tracking, and verbal productivity (fluency)		
Turnbull, Cunnington, Unsal, Norman, and Ferguson (2006)	**Study group** • 45 physicians referred to the PREP **Comparison group** • Internal comparisons by level of performance in the PREP	13 tasks covering five cognitive domains	Performance in the PREP program.	• Of the 14 physicians scoring well at PREP, 12 had no, minimal, or mild cognitive impairment using age-adjusted reference norms • Of the 31 physicians scoring poorly at PREP, 12 (38%) had cognitive impairment: moderate (7 physicians) or severe (5 physicians).

Del Bene and Brandt (2020) compared scores on a battery of neuropsychological tests of 30 physicians referred for neuropsychological assessment and 39 control community-practicing urologists. The reasons for referral were quality-of-care infractions or deficiencies, or concern of their healthcare professionals about their neurocognitive wellbeing. The referred group was significantly older than the control group and performed significantly less well on the neuropsychological tests. More details on this study are provided in section below.

Perry and Crean (2005) administered a battery of neuropsychological tests to 148 physicians referred for assessment by the California Medical Board (CMB). Reasons for referral included medical malpractice claims; four physicians were self-referred. Performance of the referred physicians was compared with normative reference samples. The referred group of physicians performed in the average range on most of the 24 neuropsychological measures. Sixty one percent of the participants scored one standard deviation below the normative reference sample on at least three neuropsychological measures, and only 14 (9%) scored in the average range or greater on all measures. The referred physicians performed lower than expected on tests of sequential processing, attention, logical analysis, eye–hand coordination, verbal and non-verbal learning. The authors hypothesized that, based on the neuropsychological profile of the physicians referred for assessment, they may be at risk of poor problem solving and attention to critical detail and, therefore, prone to errors when faced with complex and novel situations requiring a quick decision. However, the authors acknowledged that their hypothesis should be tested by comparing the referred physicians with a matched sample of physicians with no performance concerns. When interpreting the results of this study, it should be noted that low scores on cognitive tests are common among cognitively healthy populations (Tanner-Eggen, Balzer, Perrig, & Gutbrod, 2015). As shown by Schretlen, Testa, Winicki, Pearlson, and Gordon (2008), the likelihood of normal healthy individuals having two or more "abnormal" scores on test batteries increases with increasing the number of tests administered. In test batteries with at least 20 measures, most "normative" participants exhibit one or more abnormalities defined as a score more than one standard deviation below the mean (Binder, Iverson, & Brooks, 2009). On the other hand, physicians' performance within the normative ranges for the general population may represent considerably lower than expected performance given physicians' level of intelligence and education.

Using the MicroCog tool, Korinek et al. (2009) assessed cognition of 267 physicians referred for competency evaluation and 68 control physicians of similar age with no competency concerns. The scores of the competency group were significantly lower than those of the control group on three MicroCog summary measures (processing speed, processing accuracy, cognitive proficiency) and on four of the five neuropsychological domains (Attention/Mental Control; Reasoning/Calculation; Memory; Spatial Abilities). No significant group differences were seen for Reaction time. More physicians in the study group (24% vs. 0% in the comparison group; $p<0.001$) had cognitive difficulty defined as a cognitive proficiency score more than 1 SD below the mean, or any two index scores more than 1 SD below the mean. The authors believe that the comparison group could have comprised higher-functioning physicians than the general physician population, thus the differences between the groups could have been accentuated. The authors also acknowledge that the two groups of physicians were tested under different circumstances. Because evaluation results could have an impact on careers of the physicians in the study group, anxiety and pressure could have negatively impacted their performance. On the other hand, motivation to perform well may have been higher in the study group.

Turnbull et al. (2000) administered a battery of neuropsychological tests to 27 physicians referred to the Physician Review Program (PREP) for assessment due to competence concerns. All these physicians were currently practicing. Specialties of these physicians are not reported. The PREP assessment included multiple-choice questions, simulated patients, and chart-stimulated recall. Two criteria were applied during selection of neuropsychological tests: sensitivity to cognitive functions relevant to professional competence and availability of age and education norms. Several tests were selected to assess each cognitive domain. the Raw scores for each test were converted to z scores using data from age-and education-matched controls. Domain-specific scores were obtained by combining converted scores of all relevant tests for each of the following domains: verbal problem solving, visual–spatial problem solving, memory, tracking/concentration, fluency, and mood. These domain-specific scores ranged from 0 to 4, indicating no, minimal, mild, moderate, or severe cognitive difficulty, respectively. A summary cognitive score also ranging from 0 to 4 was assigned to each physician. Of the eight physicians who scored well at the PREP assessment, seven had no, minimal, or mild cognitive difficulties. Of the 19 physicians who scored poorly at the PREP, six had moderate or severe cognitive difficulties. Four of the nine physicians who were older than 60 years (44%) received global cognitive scores of 3 or 4, whereas only three of the 18 physicians under 60 years (16%) received these global scores suggesting moderate, or severe cognitive difficulty. The authors acknowledge several limitations of their study, including age-adjustment of test scores because "such adjustments may be less helpful in assuring the quality of physicians". Their neurocognitive assessment was not comprehensive.

Turnbull et al. (2006) extended their observations to include 45 physicians and obtained similar results. Of the 14 physicians scoring well on the PREP, 12 had no or minimal or mild cognitive difficulties. Of the 31 physicians scoring poorly at the PREP assessment, seven had moderate and five had severe cognitive difficulties that were, in the authors' view, "sufficient to explain their poor performance".

Summary of evidence

In summary, the reviewed studies demonstrate that, on average, cognitive functioning of physicians with problematic clinical performance or competence, is poorer compared to cognitive functioning of physicians without such problems. These studies suggest that lower cognitive functioning may be a contributing factor to physicians' competence or performance problems.

5.2 Is there a threshold that represents a level of cognitive decline sufficient to render a physician no longer fit to practice?

5.2.1 Definitions of fitness to practice

In their systematic review, Serra et al. (2007) defined fitness for work as "a worker's capacity to work without risk to self or others."

Physicians' fitness for practice (professionalism) includes multiple components, such as knowledge and skills, ethical aspects, effective relationships with patients and colleagues, etc. For example, the Royal College of Physicians and Surgeons of Canada (2022) defines professionalism as follows:

> *"The Professional Role reflects contemporary society's expectations of physicians, which include clinical competence, a commitment to ongoing professional development, promotion of the public good, adherence to ethical standards, and values such as integrity, honesty, altruism, humility, respect for diversity, and transparency with respect to potential conflicts of interest. It is also recognized that, to provide optimal patient care, physicians must take responsibility for their own health and well-being and that of their colleagues."*

The skills, knowledge, and performance component of fitness for practice is defined in very general terms by some professional bodies, for example:

> *"Knowledge, skills and performance – doctors must develop and maintain their professional performance, must apply their knowledge and experience and practise within the limits of their competence and must record their work clearly, accurately and legibly. They must have the necessary knowledge of the English language to provide a good standard of practice and care …"* (General Medical Council (UK), 2021)

Specialty-specific requirements for physicians' knowledge and skills are determined by licencing/professional bodies in their respective fields:

> *"Licensing bodies ensure that only properly qualified doctors are allowed to practise medicine, and can remove any who cease to be fit to practise. They may be national, like the General Medical Council (GMC) in the UK, or they may be regional where the jurisdiction rests with a State or Province (as in the US and Canada respectively)."* (Irvine (2005) as cited by Chisholm, Askham, and Picker Institute Europe (2006)).

> *"Specialty-specific professional bodies decide the standards needed for practice in their respective fields and the training necessary to achieve those standards. Their grant of certification, which may or may not be within a statutory framework, marks the satisfactory completion of training and therefore eligibility to practice as an unsupervised specialist in the doctor's chosen field."* (Irvine (2005) as cited by Chisholm et al. (2006)).

5.2.2 Are there data that would support a derivation of a cognitive threshold for physicians' fitness to practice?

Del Bene and Brandt (2020) (see Table 3) conducted a cross-sectional study aimed to develop an approach for determining a cut-off to identify impaired physicians. A battery of neuropsychological tests was administered to 30 physicians referred for neuropsychological assessment to the Medical Psychology Clinic of the Johns Hopkins University School of Medicine, and to 39 control community-practicing urologists. The reasons for physicians' referral for assessment were quality-of-care infractions or deficiencies on ongoing performance reviews, or concern of their healthcare professionals about their neurocognitive wellbeing. Whereas all physicians in the control group were urologists, the referred group included physicians of different specialties, 23% were psychiatrists and 20% were general practitioners, family practitioners or internal medicine physicians. None of the control physicians had known or suspected neurological, psychiatric or cognitive disorders, whereas 33% of the referred physicians had known neurological disorders, 20% had known psychiatric disorders, and 27% had suspected cognitive disorder. All control urologists were currently practicing, whereas many of the referred physicians were not currently working but were on medical leave of absence, or suspended, or retired due to age or disability. The neuropsychological battery included seven cognitive and motor tests: Wonderlic personnel test (WPT) for general cognitive ability; Symbol digit modalities (SDMT) test for visual scanning, attention, processing speed, graphomotor control; Grooved pegboard test for manual speed and dexterity; Hopkins verbal learning test (HVLT)– revised; brief visuospatial memory test – revised; D-KEFS trail making test for multiple, simultaneous tracking and motor speed; D-KEFS tower test for planning and non-verbal problem solving. The WPT, the delayed recall trial of the HVLT and the oral trial of the SDMT test were considered motor-free. The referred group was significantly older than the control group and performed significantly less well on the neuropsychological test battery as a whole and on each test. Nine key variables were derived from the cognitive and motor tests. “Impaired” test score was defined as that below the 5th percentile of the control physicians’ performance. Using, as a cut-off, an impaired score on more than five of the nine key variables, 14 of the referred doctors were categorized as “impaired” and 16 as “ambiguous”. At least one of these “impaired” scores had to be on a motor-free test. The “impaired” and the “ambiguous” subgroups of the referred group differed in terms of proportions of physicians who were retired or permanently disabled, proportions of physicians with mild cognitive impairment (MCI), dementia, or Parkinson’s disease. These differences between the two subgroups, in the authors’ view, “provide some criterion validity” to their categorization. Because the cut-off of abnormal performance in five tests meets three criteria outlined *a priori* (1) occurs infrequently by chance, 2) separates those currently working from not working and 3) those with neurocognitive diagnosis from those without), the authors “recommend this criterion pending further studies”. The authors also recommend that physicians categorized as “impaired” using this cut-off, “not automatically lose their clinical privileges or license to practice” but be subjected to more comprehensive clinical assessment to determine whether their impairments are remediable. The authors acknowledge limitations of their study: small sample size, a possible non-representativeness of the control group, being composed entirely of urologists, and a retrospective nature of the study. The authors posit that, to be a useful predictor of cognitive impairment, “a prospective study of currently-practicing physicians - perhaps those at especially high risk, due to advanced age for example – would be required”. Also, the authors suggest that “additional research is needed to develop specialty-specific criteria for successful medical practice” because “the impairments that disable a pathologist, an emergency room physician, and a psychiatrist, for example, are likely to be very different”. In summary, a cut-off score to identify “impaired” physicians was derived in this study. However, this cut-off was derived based on physicians’ performance not only in cognitive but also in motor tests. Also, the reasons for referral of the physicians in the study group were mixed: many physicians were referred for assessment not because of their inferior clinical performance but because of known or suspected neurological, psychiatric or cognitive disorders. The study has other methodological limitations acknowledged by the authors. For these reasons, the usefulness of this approach to identify physicians no longer fit to practice is questionable.

5.2.3 Summary of evidence and discussion

Sataloff, Hawkshaw, Kutinsky, and Maitz (2020) acknowledged that there were no longitudinal data on cognitive functions in physicians over time correlating them with performance. No longitudinal studies of correlations between physicians' cognition and indicators of their competence or performance were identified for this review. Overall, no data that can be used to determine a level of cognitive decline that renders a physician unfit to practice have been identified for this review.

The complexity of relationships between the results of physicians' cognitive assessment and the quality of care they provide, as well as lack of cut-off cognitive scores, has been acknowledged over the years by many experts. Peisah and Wilhelm (2002) point out that there is "no known thresholds for decline below which practice is untenable", and the impact of cognitive deficits would "relate to the type of medicine practised and the precise domains of neuropsychological deficit". LoboPrabhu, Molinari, Hamilton, and Lomax (2009) note that cognitive assessment tools cannot "predict to what extent cognitive impairment translates into dysfunction in professional duties". The American Medical Association (2015) acknowledge that it is challenging to demonstrate an association between specific cognitive deficits and physician occupational performance. The Medical Board of Australia (2017) point to difficulties in relating the degree of cognitive deficits to physician competence "because the actual levels of cognitive impairment that preclude safe practice have not yet been determined". Garrett, Perry, Williams, Korinek, and Bazzo (2021) claim that, even if appropriate cutoff scores were available, they would have to be applied to the physician specialty area; cutoff scores would be misused if applied "to the diversity of cognitive skill sets required for different medical specialties" (Garrett et al., 2021). Katz (2016) also state that "[o]ne size does not fit all", and that the evaluation process should be "specific to the clinician's specialty and desired privileges". Hickson, Peabody, Hopkinson, and Reiter (2019) believe that "testing of cognitive skills alone rarely is adequate to make and enforce credentialing decisions."

5.3 Evidence on related considerations

5.3.1 Physicians' age and cognitive functioning

Bieliauskas et al. (2008) used the Cambridge Neuropsychological Test Automated Battery (CANTAB) to assess visual sustained attention and stress tolerance (rapid visual information processing [RVIP] task), reaction time (RTI task), visual learning and memory (paired associates learning [PAL] task). Three hundred and fifty-nine surgeons aged 45 to 86 years (mean 61.4 years) took part in this study between 2001 and 2005. Cognitive data of 62 surgeons who were already retired were excluded from these analyses. Ninety-four surgeons were retested in 2005 and 2006. As shown in the figure below, in the RVIP task, mean response latency significantly increased with increasing age ($p=0.002$). Age groups 70-74 and 75+ years were significantly ($p<0.05$) slower than younger age groups (45-49, 50-54, 55-59, 60-64, 65-69 years). The probability of a hit significantly decreased with increasing age ($p= 0.01$). It was substantially lower in age groups 65 to 69, 70 to 74, and 75+ years compared to the age group 45-49 years ($p<0.05$). Age had no significant effect on the probability of a false alarm ($p=0.64$).

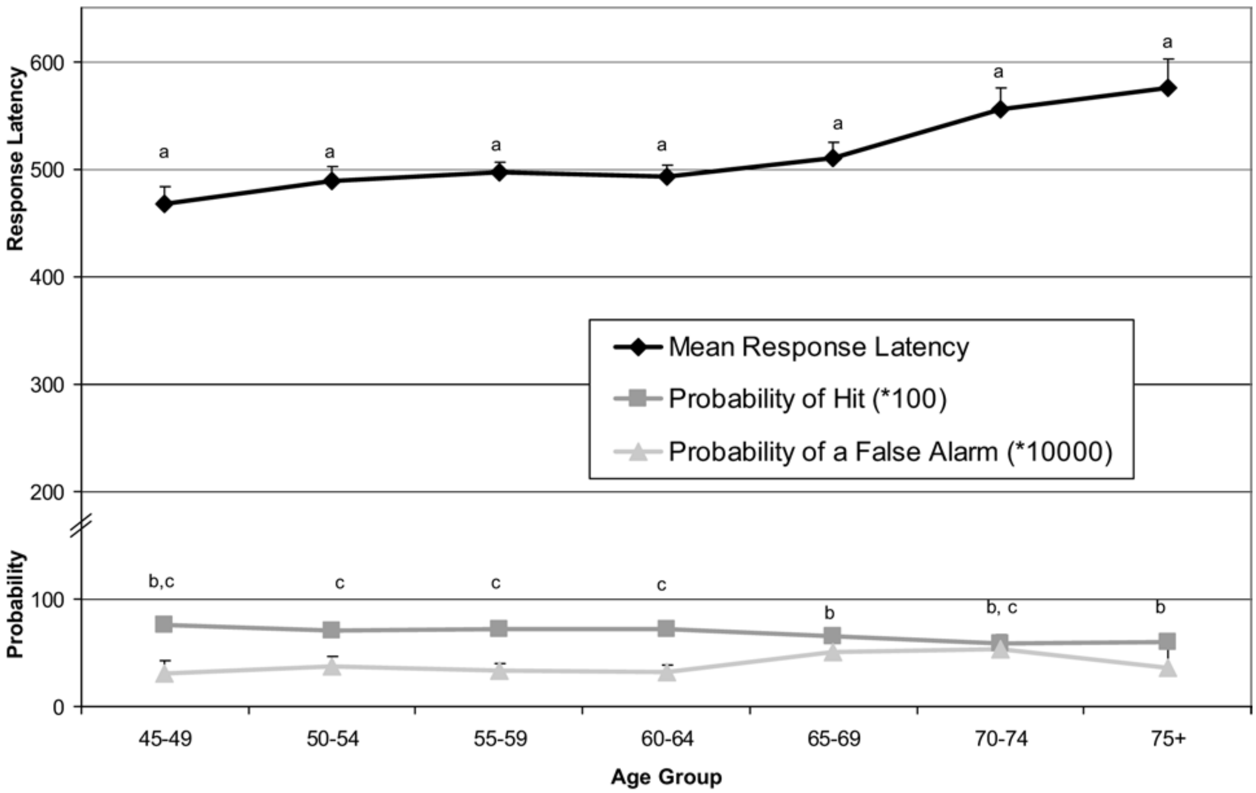

Figure from Bieliauskas et al. (2008). Performance in the rapid visual information processing (RVIP) task

In the RTI task (see figure below), five-choice reaction time significantly increased with age (p= 0.0001). Significant increases were seen in age groups 60-64, 65-69, 70-74, and 75+ years compared to 45-49 years of age (p<0.05); in age groups 65-69, 70-74, and 75+ years compared to 50-54 years (p<0.05); in age groups 70-74 and 75+ years compared to 60-64 years (p<0.05); in age group 75+ compared to 65-69 and 70-74 years (p<0.05). Five-choice movement time also significantly increased with age (p=0.0001). Significant increases were seen in age groups 60-64, 65-69, 70-74, 75+ years compared to 45-49 years age group (p<0.05); in 75+ age group compared to age group 50-54 years (p<0.05); in age groups 60-64, 70-74, and 75+ years compared to 55-59 years (p<0.05); in 75+ age group compared to 60-64 years (p<0.05).

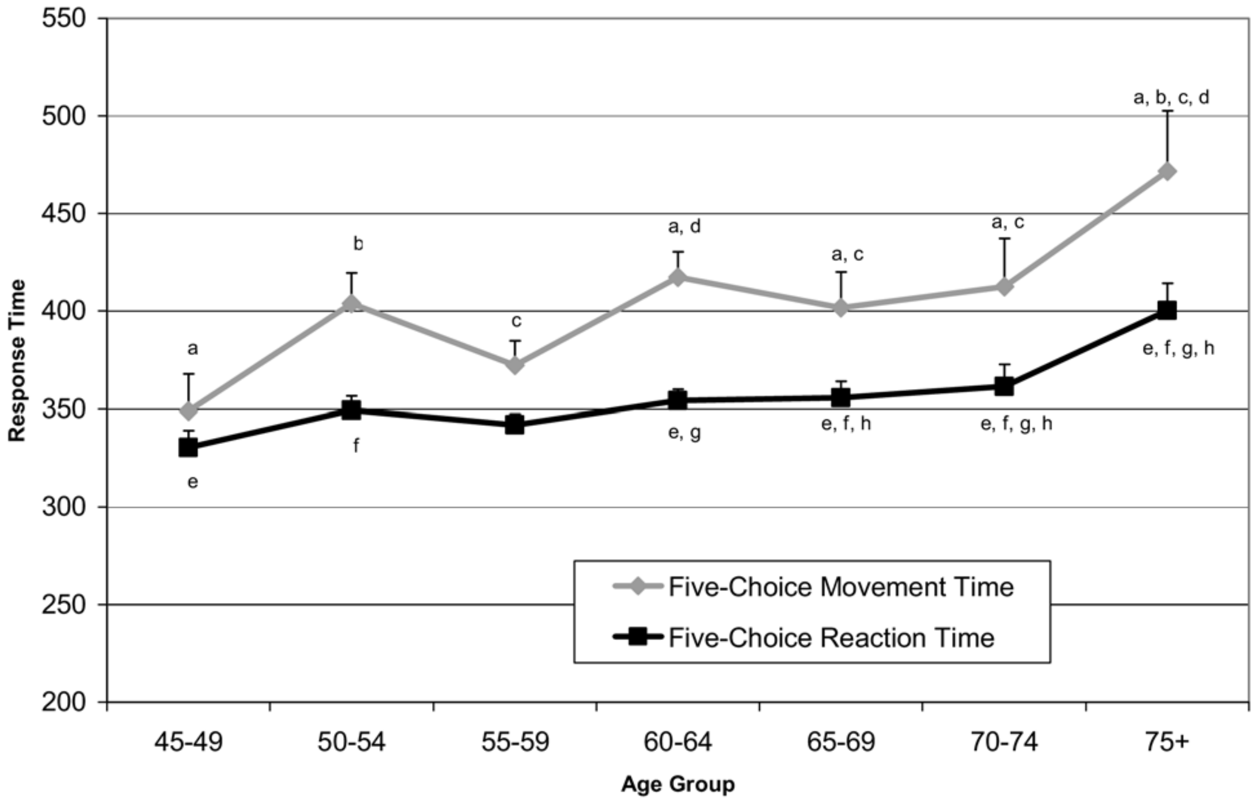

Figure from Bieliauskas et al. (2008). Performance in the Reaction time (RTI) task

As shown in the figure below, in the PAL task, the number of stages where the correct responses were made on the first trial significantly decreased with increasing age (p=0.0001). The 75+ age group had a significantly greater number of stages than 45-49, 50-54, 55-59, and 60-64 age groups (p<0.05). The mean number of errors in learning all stimulus locations significantly increased with age (p=0.0001). Age groups 60-64, 65-69, 70-74, and 75+ years had significantly more errors per trial (p<0.05) in comparison with the 45-49 and 50-54 years of age groups (p<0.05). Age groups 65-69, 70-74 and 75+ years had significantly more errors per trial than age group 55-59 years (p<0.05). Age groups 70-74 and 75+ years had significantly more errors per trial than 60 to 64 and 65 to 69 age groups (p<0.05).

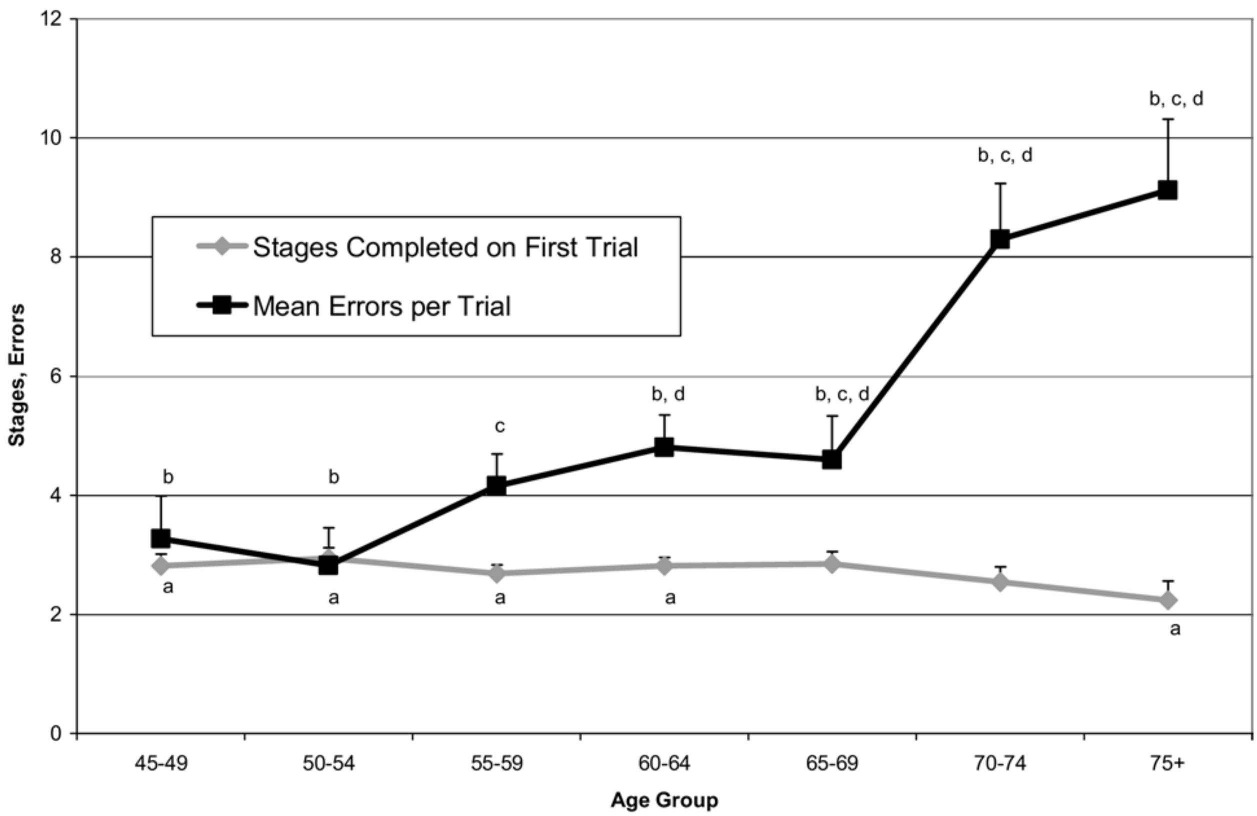

Figure from Bieliauskas et al. (2008). Performance in the paired associates learning (PAL) task

When surgeons were retested one to six years after the initial testing, an increase in mean latency of response on the RVIP task (p=0.001) was observed with no significant changes in the accuracy of responding (the probability of a hit (p=0.12) and the probability of a false alarm (p=0.35)). There was a decrease in mean number of errors per trial on the PAL task (p<0.05). No significant changes over time in performance on the other tasks were seen. The authors believe that the observed stability or improvement in some tests may be due to test familiarity or the practice effect. In summary, this study shows a significant age-related decline in most cognitive function tested; the decline is most pronounced at ages 70-74 and 75+ years; some functions showed a decline at ages 60+ years compared to younger age groups.

Boom-Saad et al. (2008) used a subset of data from Bieliauskas et al. (2008), specifically, data on 308 practicing surgeons tested between 2001 and 2004. These surgeons were divided into two age groups: 45 to 60 years (n = 139) and 61 to 75 years (n = 169). Their performance on the three tasks was compared with normative age-matched control and with performance of medical students entering a surgical field. The performance of senior surgeons (61-75 years) on all three neuropsychological tests was poorer compared to performance of mid-career surgeons (45-60 years) and of medical students (20-35 years). Senior surgeons outperformed the age-matched normative control only on one of the two parameters of the RTI test, whereas the performance of mid-career surgeons and medical students was significantly better than that of the age-matched normative control on both the RTI and RVIP tests. Normative data for the VPAL test were not available.

In a later study, Drag, Bieliauskas, Langenecker, and Greenfield (2010) analyzed cognitive status of these surgeons by retirement status. Cognitive performance of 168 senior surgeons (60 years of age and older) was compared with that of 126 younger surgeons (aged 45 to 59). Of the senior surgeons, 36% were retired, 33% were planning to retire within 5 years, and 30% had no imminent retirement plans. It was found that 55% of all senior surgeons, 49% of senior surgeons with no imminent plans to retire, 72% of senior surgeons planning to retire within the next 5 years, and 45% of retired surgeons performed within the range of the younger surgeons on all three cognitive tasks. No senior surgeon performed below the younger surgeons on all three tasks. This study shows that most senior surgeons performed at or near the level of younger surgeons on cognitive tasks, which suggests that older age does not necessarily affect cognition. The authors suggest that perceived cognitive decline, although it does not reflect true abilities, may be one of the factors that affect surgeons' decision to retire; therefore, findings from this study support formal measures of cognitive functioning. The authors believe that objective assessment of cognitive functioning can help senior surgeon to decide whether to retire, continue to practice, or modify their practice.

Using the computerized cognitive test MicroCog, D. H. Powell and Whitla (1994) assessed cognition of 1002 physicians (MDs) and 581 other subjects (referred to as "Normal" subjects). The study subjects ranged in age from 25 to 92 years. The MicroCog test measures reactivity, attention, numeric recall, verbal memory, visuospatial facility, reasoning, and mental calculation.

Analysis of the raw data demonstrated that, among physicians, the total MicroCog score gradually declined between 30 and 60 years of age. On average, a 60-year-old MD scored only 8% lower than a 30-year-old doctor. A more rapid decline was seen after 60 years of age: the differences with the younger groups almost doubled with each decade. Among the “Normal” subjects, the total MicroCog score declined more rapidly after age 50. In the two decades after 60, their scores were in about the same range as those of physicians ten years older. The gap between the two groups narrowed after age 75; however, at all ages, the “Normal” subjects scored lower than the MDs. The authors explain this difference by the lower education level of the “Normal” subjects (on average 14.13 years of education vs. 20+ years of the MDs). As to specific cognitive functions, similar patterns were seen for the MDs and the “Normal” subjects.

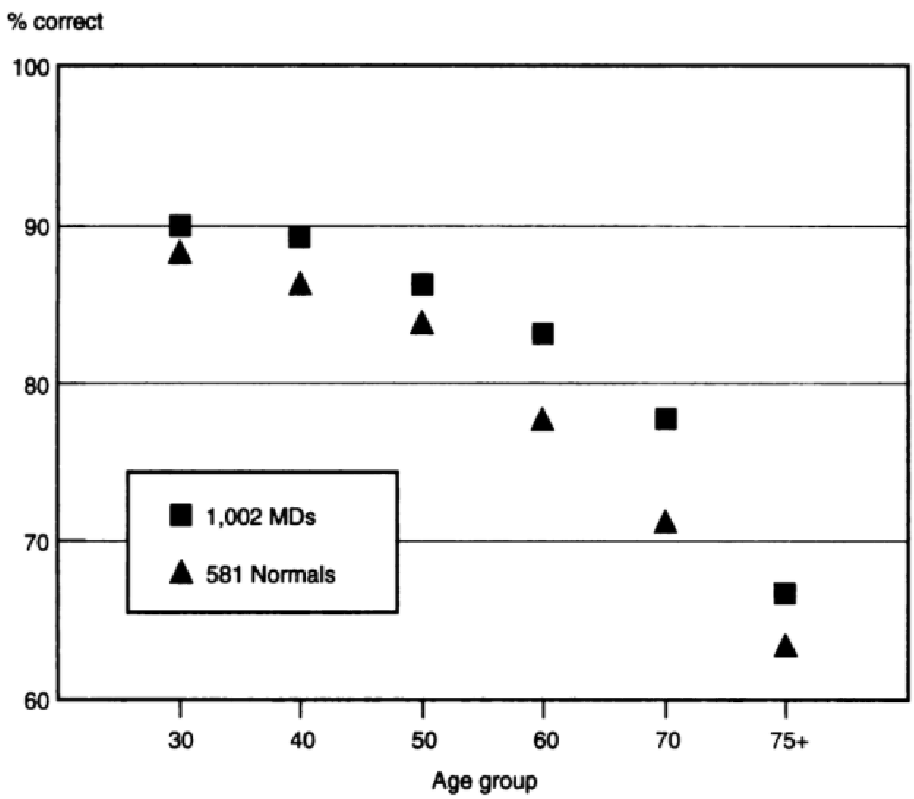

Figure: Age-related differences in MicroCog total score comparing physicians to "normals" (from D. H. Powell and Whitla (1994))

The steepest decline was seen for mean scores on visuospatial memory. Among the MDs, correct responses on the subtest for visuospatial abilities (Tictac) dropped by 24% between ages 30 and 50 years, by 10% between ages 50 and 60 years, and by 39% between 65-74 and 75+ years. The decline in visuospatial abilities in the "Normal" subjects was slower, likely due to lower initial scores. The second steepest decline was seen for reasoning scores (Analogies subtest); in the MDs, the decline occurred about a decade later than the decline in visuospatial scores. The rate of decline in verbal memory was in the third place. The rate of decline in these three functions was greater than that for the total MicroCog score. More resistant to aging were the math scores and attention. The Wordlist 1 scores for attention declined by 11% at age 65-74 years compared to the youngest age group of <35 years, and another 21% drop occurred beyond age 75 years. Attentiveness appeared not to be much influenced by education level, as the scores were nearly identical between the MDs and the "Normal" subjects across almost all testing points. The math scores (calculation) of the MDs were slightly above those of the "Normal" subjects in the oldest age groups (65-74 and 75+ years) but not in the younger age groups. As shown in figure 4.5 of the publication, scores on the Stories test for verbal memory (delayed recall) closely followed the total MicroCog score in the MDs and in the "Normal" subjects.

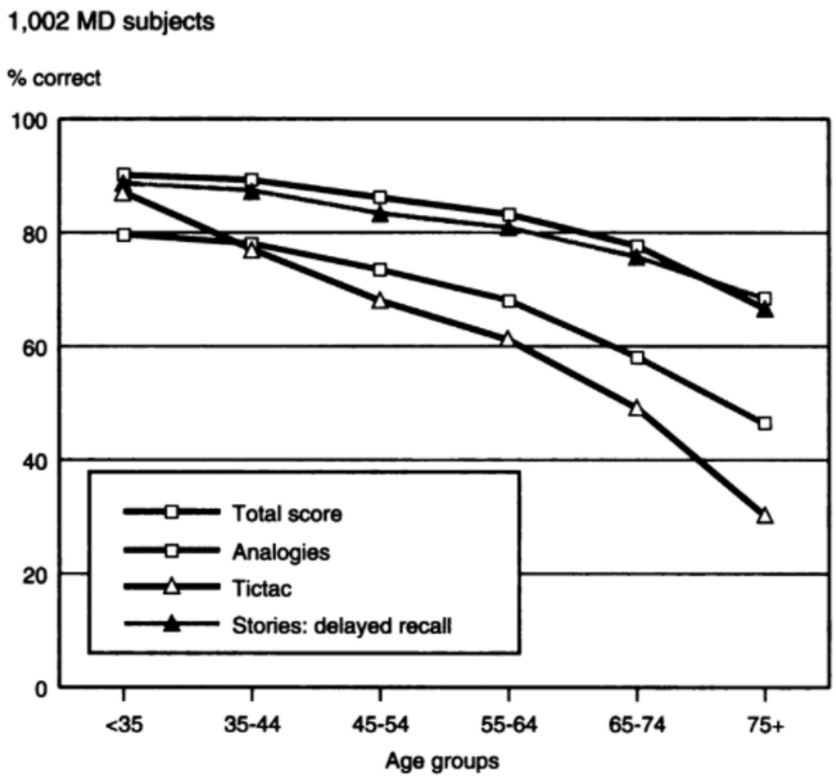

Figure: Age-related differences in MicroCog specific test scores comparing physicians to "normals" (from D. H. Powell and Whitla (1994))

In addition to analyzing the raw data, the authors conducted the effect size (ES) correlation analysis. For the MDs, four comparisons were made: the scores of those aged 35-44 years were compared with the scores of 25-34-year-olds, 45-54-year-olds were compared with 35-44-year-olds and so on. Because no significant differences were found between the two youngest age groups (35-44 vs. 25-34-year-olds), these results are not reported. Statistically significant results are reported in table 4.2 of the publication.

According to the authors, these results demonstrate diminished specific cognitive abilities early on. More greatly affected were visuospatial faculty, reasoning, and verbal memory after delay. The authors also noted a "flattening" in the magnitude of the decline "from ages 50-60 compared with the decades on either side of this age span", which suggests that "slowing of the decline in overall, and possibly many specific, cognitive functions does occur in late mid-life. Some cross-sectional as well as longitudinal evidence indicates that it happens in the 50-60 decade. But there are also data indicating that the flattening of the curve can occur in the first five to seven years of the sixties."

The timing of the decline was investigated more in depth by using finer (5-year) groupings of the MDs from age 60 onwards. Statistically significant results of these comparisons are reported in table 4.3 of the publication. Based on these results, the authors concluded that "the downward sloping of specific abilities as well as in global cognitive functioning is relatively mild until 70-74, with all but one ES estimate less than .20. At Comparison C, when the subjects aged 75-79 are measured against those five years younger, both the number of significant findings and the size of the correlations increased remarkably. … Those most greatly affected were the now familiar faces of visuospatial functioning and reasoning, as well as faculty with numbers and attention. At comparison D [75-80 vs. 80+], lower verbal memory, both immediate and delayed, along with attention as measured by Wordlist 1 and 2 distinguished the 80+ MDs from those five years their juniors."

No significant findings were seen for reaction times with either age grouping (5- or 10-year intervals). The authors pointed out that this finding was not consistent with most of the literature and explained the discrepancy by either relatively less demanding task used, or by the older participants in their study being not representative of their age group. A more likely explanation, in the authors' view, was that older subjects performed as well as younger ones on a simple reaction time test, but they responded much slower if the task requires both accuracy and a quick response.

The order of the decline. Based on their results the authors suggest that visuospatial abilities, reasoning, and verbal memory were affected earlier than other functions in the aging process, whereas attention and number abilities remain intact for much longer.

This study also demonstrated a significant variability in cognitive performance among individuals 65 years and older, with a substantial number of older subjects functioning at a level close to that of younger subjects.

Summary of evidence and discussion

In summary, four studies identified for this review show declines in cognitive functioning of older physicians, generally in age groups 60 or 65 years or older compared to younger age groups; the decline gets steeper at ages 75 and older. However, there is a substantial variability in older physicians' cognition, with many older physicians performing at or near the level of younger counterparts on cognitive tasks. It should be noted that all these studies are cross-sectional. Therefore, it is not certain to what extent the observed differences between the test scores are caused by age. These differences in cognitive performance may also be related to other unaccounted differences between the group. Although cross-sectional data are generally adequate to answer the question about age-related cognitive decline, they may overestimate both the magnitude of the decline and how early the decline occurs (D. H. Powell & Whitla, 1994). D. H. Powell and Whitla (1994) suggest using the term "age-related differences in abilities" rather than "age-related changes" when speaking of the relationship between age and cognition derived from cross-sectional studies.

5.3.2 Physicians' age and ability to practice competently and safely

This review refers to two different but related concepts, physician's competence, and performance. Competence reflects how physicians perform in a controlled environment, in testing situations such as at written examination. Physicians acquire competence on completing medical school and residency training, and on passing qualifying medical licensure examinations. Performance represents how physicians apply their attitudes, knowledge, and skills in practice that is multidimensional and is impacted by many factors. Competence is necessary but not sufficient for high-quality physician performance (Kain, Hodwitz, Yen, & Ashworth, 2019; Rethans et al., 2002). The relationship between competency examinations and behavior in actual practice is characterized by some researchers as "problematic", with studies showing high, moderate, and very weak correlations between competency test results and parameters of performance in actual practice (Rethans et al., 2002).

Whereas cognitive aging is a risk factor for deficits in physicians' competence and performance, it should not be interpreted in isolation from other contributing factors (Medical Board of Australia, 2017).

Because of the multidimensional nature of physicians' competence and performance, studies examining their associations with age were included in this review if analyses were adjusted for potential confounders. Also, to be included, studies had to have objective measures of performance/competence and sufficiently wide age range of participants. Specifically, in case of a categorical analysis, a study should include at least two age categories older than (approximately) 50 years and at least one category younger than 50 years. In case of a continuous analysis, a study should include physicians aged from less than (approximately) 50 years to (approximately) 70 years or older. Studies of physicians of any specialty, including surgeons, were considered[3]. Twenty-three articles meeting these criteria and reporting on results of original research were identified and summarized in Table 4. In this table, an association between physicians' age and their competence/performance is described as "negative" if a decline in competence/performance with age was observed; "positive" if superior performance of older physicians was seen. Two reviews described by their authors as systematic (Choudhry, Fletcher, & Soumerai, 2005; Eva, 2002) and a meta-analysis (Jung et al., 2022), address the relationship between physicians' years in practice or age, and indicators of health care quality.

[3] It should be noted that not only cognitive but also adequate psychomotor skills are essential for surgeons (Garrett et al., 2021)

Table 4: Summary of studies of the relationship between physicians age (or years in practice as a surrogate for age) and their competence/performance

Reference	Study location	Physicians' specialty	Type of outcome	Assessments	Covariates	Evidence of association with age
First author, year	*Country*		*Competence or Performance*	*Indicators of competence or performance used as study outcomes*	*Risk factors accounted for in the analyses*	*Negative (decline with age)* *Positive (superior performance of older physicians)* *No association*
B. R. Anderson et al. (2017)	USA	Surgeons	Performance	Patients' major morbidity, mortality, and a composite outcome (major morbidity or mortality) after congenital heart surgery	• Patient's characteristics (sex, prematurity, weight - for neonates and infants, year of surgery, noncardiac abnormalities or syndromes/chromosomal abnormalities, previous cardiothoracic operation, and preoperative mechanical ventilation, circulatory support, persistent shock, renal failure, any other preoperative risk factor) • STAT Mortality Category for the primary operative procedure. • Surgeon and center volume	• Negative association for patients' major morbidity and composite outcome. The odds of poorer patient's outcomes increased in category 35+ years in practice (approx. 60-80 years of age) vs. those <15 years in practice (<40 years old) • No association for patients' mortality
G. M. Anderson, Beers, and Kerluke (1997)	Canada	General practitioners Family practitioners Specialists	Performance	Inappropriate prescribing	• Physician's specialty (specialist, family practitioner, general practitioner) • Volume of prescriptions	Negative association. Physicians in age categories 45-64 years and 65+ years were more likely to prescribe potentially inappropriate drugs compared to physicians aged <45 years

Reference	Study location	Physicians' specialty	Type of outcome	Assessments	Covariates	Evidence of association with age
Brown et al. (2016)	USA	Primary care physicians	Performance	Diabetes glucose control	• Patient's characteristics (demographics, BMI, blood pressure, biomarkers, diabetes severity) • Physician's characteristics (internal medicine as primary specialty; number of patients with diabetes, proportion of patients with diabetes taking insulin)	No association
Gershon, Hwee, Croxford, Aaron, and To (2014)	Canada	Primary care physicians	Performance	Pulmonary function testing (PFT) for diagnosis of COPD	• Patient's characteristics: socio-demographic; rural/urban residence, long-term care, immigration status, year of COPD diagnosis, previous hospitalizations/ED visits; specialist care (yes/no); primary care physician visits in previous year; flu short in previous year; coexisting medical conditions Physician's characteristics: gender, foreign medical graduate (yes/no)	Negative association. Physicians in all older age categories (36-50, 51-65 and >65 years) were less likely to order PFT compared to physicians younger than 35 years.
Goulet et al. (2013)	Canada	Family practitioners	Performance	A composite score for three components of quality: clinical investigation, accuracy of diagnosis, and appropriateness of	Physician's characteristics (participation in continuing professional development, sex, country of graduation, primary place of practice, completion of a residency in family medicine)	Negative association. Physicians' age ranged from <40 to ≥70 years. A stepwise multiple linear regression analysis showed that physicians' age was a significant predictor of inferior quality of practice: β=-0.15; p=0.03

Reference	Study location	Physicians' specialty	Type of outcome	Assessments	Covariates	Evidence of association with age
				treatment plan and follow-up		
Grace, Wenghofer, and Korinek (2014)	USA	Physicians of various specialties	Competence	Competence assessment tailored to the physician's practice area and specialty	• Physician's characteristics: gender, years in practice, medical school, degree type, board certification, years of postgraduate training, training specialty • Practice characteristics: practice-to-training match, solo practice, rural practice, practice status • Referral source (board, hospital, self, other), previous board action affecting license status, Drug Enforcement Administration revocation	Negative association. Physicians' age ranged from 32 to 84 (mean 53.1) years. A multivariate logistic regression showed that physicians' age was a significant predictor of inferior assessment outcome: OR [for each year of increasing age] =1.07 (95% CI: 1.03-1.10); p<0.01
Marco et al. (2018)	USA	Emergency medicine residency–trained physicians	Competence	Score on the American Board of Emergency Medicine (ABEM) ConCert examination	Physician's characteristics (number of years since residency graduation, diplomate status at time of examination, gender, ethnicity)	Negative association: "…gradual decline, with some perturbations" from age 35 to 72 years
Markar, Mackenzie, Lagergren, and Lagergren (2018)	Sweden	Surgeons	Performance	Patients' 90-day all cause mortality; 5-year all cause mortality; 5-year disease-specific (esophageal cancer) mortality after esophageal cancer resection	• Patient's characteristics: demographics, comorbidity, tumor stage and histology, use of neoadjuvant therapy • Surgeon volume of esophagectomies, calendar period of surgery	Negative association. Deterioration in patients' mortality rates was seen in the highest surgeons' age category studied (>=56 years)

Reference	Study location	Physicians' specialty	Type of outcome	Assessments	Covariates	Evidence of association with age
Mehrotra et al. (2018)	USA	Endoscopists	Performance	Adenoma detection rate (ADR)	• Patients' characteristics: age, sex, and colonoscopy indication • Physician's characteristics: gender, primary specialty (gastroenterology or other); volume of colonoscopies performed	Negative association. ADR was lower in the highest category of years in practice since residency (27-51 years) relative to the lowest category of years in practice (≤9 years).
Meier, Valeri, Senn, Rosemann, and Chmiel (2020)	Switzerland	General practitioners	Performance	Quality of diabetes care (process indicators, outcome indicators and cumulative indicators)	• Patient's characteristics (age, sex, number of comorbidities, number of consultations, number of consulted GPs) • Physician's characteristics (gender, physician's network participation) • Practice characteristics (location, type)	No association
Meltzer, Connolly, Schneider, and Sedrakyan (2017)	USA	Surgeons (vascular)	Performance	Outcomes of abdominal aortic aneurysm repair: 30-day mortality and 1-year mortality.	• Patients' characteristics: age, gender, race, insurance status, comorbidities • Surgeon's annual volume and facility's annual volume	No association
O'Neill, Lanska, and Hartz (2000)	USA	Surgeons	Performance	In-hospital mortality; in-hospital overall bad outcome (mortality or morbidity) following carotid endarterectomy	• Patient's characteristics (age, gender, source of admission, carotid endarterectomy procedure, payer, Medis-Groups severity score • Surgeon's characteristics (gender; specialty, years of experience, board certified, surgical volume)	• Negative association for patients' mortality (p=0.04). Mortality rate 0.61%, 0.59%, 0.68%, 1.22% and 2.53% among patients of surgeons' aged groups: 30-39, 40-49, 50-59, 60-64 and 65+ years, respectively. • No significant association between surgeons' age and the rate of overall bad outcome: 4.46%, 3.53%, 3.58%, 4.40% and 5.49% among patients of

Reference	Study location	Physicians' specialty	Type of outcome	Assessments	Covariates	Evidence of association with age
						surgeons' aged groups: 30-39, 40-49, 50-59, 60-64 and 65+ years, respectively.
Pentzek et al. (2009)	Germany	General practitioners	Competence	Dementia knowledge assessed using a questionnaire with 37 multiple-choice questions.	• Physician's characteristics (gender, years of surgery practice, location of surgery - rural vs. urban, estimated prevalence of dementia, personal views on dementia). • An additional covariate (care facility knowledge score) was used in the analysis of the teaching GP sub-sample.	Negative association between physicians' age and the knowledge test score. In a stepwise linear regression analysis, β=-0.255; p=0.003. Similar results were obtained in the sub-sample of teaching GPs: β=-0.246, p=0.005
Poulin de Courval, Saroyan, Joseph, and Gauthier (1996)	Canada	Family physicians	Competence	Knowledge and skills with respect to patients with dementia assessed using a questionnaire with 47 multiple-choice questions	• Physician's characteristics (gender, percentage of time spent with patients aged 65 or over, years in practice, certification from the College of Family Physicians of Canada – yes or no) • Practice characteristics (solo office, group or local community service center, short-term hospital, long-term hospital, method of remuneration, practice settings - urban, semi-urban, rural)	Negative association. Gradual decline over age intervals 32-44, 45-54, 55-64 and >=65 years of age compared to those 25-34 years of age.
Prystowsky (2005)	USA	Surgeons	Performance	Patients' mortality, morbidity, and hospital length of stay (LOS) after	• Patient's characteristics (age, admission type - emergency or nonemergency, severity of illness) • Surgeon volume	• Negative association for hospital length of stay ["… when it comes to LOS, the newer surgeons tend to get their patients out faster. I am assuming that that might be a bias of older more

Reference	Study location	Physicians' specialty	Type of outcome	Assessments	Covariates	Evidence of association with age
				alimentary tract surgery		experienced surgeons who might hang onto their patients a little bit longer …"] • No association for patient's mortality and morbidity
Reid, Friedberg, Adams, McGlynn, and Mehrotra (2010)	USA	Physicians of various specialties	Performance	Overall performance scores on 124 indicators of quality of care for 22 acute and chronic conditions, as well as preventive care, from RAND's Quality Assessment Tools.	Physician's characteristics (gender, board certification status, medical school location - domestic or international, medical school ranking, malpractice claims and disciplinary actions by the board in the past 10 years)	• Negative association for acute care and male-specific care. Gradual decline over age categories 10-19, 20-29, 30-39, 40-49 and 50+ years in practice compared to <10 years in practice. • No association for chronic care, female-specific care, and all measures • Positive association for preventive care. Gradually increasing score over the age categories
Satkunasivam et al. (2020)	Canada	Surgeons	Performance	30-day postoperative outcomes of 25 common procedures performed by surgeons of various subspecialties: deaths; complications; hospital readmission; a composite outcome including the presence of any of death, complications, or hospital readmission in the 30 days after	• Patient's characteristics (age, gender, income, rurality, comorbidity - Johns Hopkins Aggregated Diagnosis Group, year of surgery) • Surgeon's characteristics (gender, surgical volume, specialty) • Practice setting (academic or community) • Stratified analyses by several variables were conducted, including type of surgery (emergent or elective) and case complexity	Positive association for most outcomes. Surgeons' age: 29–80 years. Each 10-year increase in surgeon's age was associated with decreased odds of the composite outcome comprising death, readmission or complication within 30 days (OR=0.95; 95% CI: 0.92–0.98), death (OR=0.95; 95% CI: 0.91–0.998), hospital readmission (OR=0.98; 95% CI: 0.97–0.99) and complications (OR=0.94; 95% CI: 0.89–0.98) Dichotomized surgeons' age: patients treated by older surgeons (≥ 65 years) were significantly less likely to have the composite outcome (OR=0.93; 95% CI: 0.88–0.97) Older surgeon age (≥65 years) was associated with lower odds of the

Reference	Study location	Physicians' specialty	Type of outcome	Assessments	Covariates	Evidence of association with age
				surgery; hospital length of stay		composite outcomes after emergent (OR=0.97; 95% CI: 0.94–0.99) and elective procedures (OR=0.96; 95% CI: 0.93–0.99); readmission within 30 d after elective surgery (OR=0.98 (0.97–0.99); complications within 30 days after emergent (OR=0.94; 95% CI: 0.91–0.98) and elective surgery (OR=0.94; 95% CI: 0.89–0.999). No significant differences between older (≥65 years) and younger (<65 years) surgeons in patients' mortality after emergent or elective surgery, readmission after emergent surgery (ORs 0.96 to 1.00) No significant association between surgeons' age and hospital length of stay in the continuous analysis (OR=1.01; 95% CI: 0.99-1.02 per 10-year increase in surgeon's age) and a negative association in dichotomized analysis after emergent surgery (OR=1.01; 95% CI: 1.01-1.02 for older surgeons vs. younger surgeons).
Smith-Bindman et al. (2005)	USA	Physicians who interpret mammograms (radiologists?)	Performance	Accuracy of screening mammogram interpretation: sensitivity, specificity, overall accuracy	• Patient's characteristics (age, breast density, whether examination was a first or a subsequent) • Physician's characteristics (annual volume of mammogram interpretations, ratio of screening to diagnostic mammographic interpretations)	• Positive association for specificity and overall accuracy. Physicians' age from <40 to ≥70 years. Specificity [the OR (95% CI) for a correct mammogram interpretation by years since receipt of medical degree]: 1.0 (reference); 1.16 (0.88 to 1.54); 1.22 (0.92 to 1.64); 1.18 (0.88 to 1.59); 1.54 (1.14 to 2.08); 1.67 (1.25 to 2.22); 1.59 (1.12 to 2.22) for <10; 10-14; 15-19; 20-24; 25-29; 30-34 and >34 years, respectively.

Reference	Study location	Physicians' specialty	Type of outcome	Assessments	Covariates	Evidence of association with age
						Overall accuracy [the OR (95% CI) for a correct mammogram interpretation by years since receipt of medical degree]: 1.0 (reference); 1.14 (0.73 to 1.78); 1.31 (0.92 to 1.87); 1.14 (0.78 to 1.64); 1.54 (1.05 to 2.26); 1.44 (0.99 to 2.12); 1.20 (0.82 to 1.73) for <10; 10-14; 15-19; 20-24; 25-29; 30-34 and >34 years, respectively • No association for sensitivity [the OR (95% CI) for a correct mammogram interpretation by years since receipt of medical degree]: 1.0 (reference); 0.98 (0.68 to 1.43); 1.07 (0.79 to 1.46); 0.96 (0.70 to 1.33); 1.00 (0.72 to 1.40); 0.86 (0.63 to 1.19); 0.76 (0.55 to 1.04) for <10; 10-14; 15-19; 20-24; 25-29; 30-34 and >34 years, respectively
Tsugawa et al. (2018)	USA	Surgeons	Performance	Operative mortality, defined as death during hospital admission or within 30 days of non-elective surgeries (emergency or urgent admissions and admissions from a trauma center)	• Patient's characteristics (age, gender, race/ethnicity, median household income estimated from residential zip code, Medicaid status, comorbidities) • Surgeon's characteristics (gender, credentials – allopathic (MD) vs. osteopathic (DO), number of non-elective surgeries) • Adjustment for hospital where patient was treated by using hospital fixed effects	Positive association Adjusted OR (95% CI) for patients' mortality vs. surgeons' age group <40 years (reference category): 0.98 (0.96-1.01), p=0.25; 0.97 (0.94-0.99), p=0.02; 0.95 (0.92-0.99), p=0.02) among patients of surgeons aged 40-49, 50-59 and 60+ years, respectively.
Tsugawa, Newhouse,	USA	Hospitalist physicians	Performance	Patients' mortality within 30 days of	• Patient's characteristics: age, gender, race/ethnicity, primary diagnosis, comorbidities,	• Negative association for 30-day mortality. Increased patients' mortality in physicians' age categories 40-49, 50-

Reference	Study location	Physicians' specialty	Type of outcome	Assessments	Covariates	Evidence of association with age
Zaslavsky, Blumenthal, and Jena (2017)		("general internists who filed at least 90% of their total evaluation and management billings in an inpatient setting")		admission; 30-day readmission rates; costs of care	median household income estimated from residential zip code, Medicare/Medicaid coverage, day of the week of admission, and year indicators. • Surgeon's characteristics: gender, medical school (foreign vs. domestic); credentials (allopathic -MD vs. osteopathic -DO) • Adjustment for hospital where patient was treated by using hospital fixed effects	59 and 60+ years relative to age category <40 years; the increase was greater in the age category 60+ years • No association for 30-day readmission and costs of care
Waljee, Greenfield, Dimick, and Birkmeyer (2006)	USA	Surgeons	Performance	"Operative mortality, defined as death before hospital discharge or within 30 days of the operative procedure"	• Patient's characteristics: age, gender, race, admission acuity - elective or nonelective, pre-existing conditions • Surgeon's characteristics: procedure volume, • Hospital volume and teaching status	• Performance of surgeons aged <40 years and 60+ years was compared with surgeons aged 41-50 years. • Negative association for 3 of 8 surgical procedures analyzed. Compared with surgeons aged 41-50 years, surgeons aged 60+ years had higher mortality rates after pancreatectomy (OR=1.67; 95% CI: 1.12–2.49), coronary artery bypass grafting (OR=1.17; 95% CI: 1.05–1.29) and carotid endarterectomy (OR=1.21; 95% CI: 1.04 –1.40). The effect was largely restricted to surgeons with low procedure volumes. • No association for 5 of 8 surgical procedures analyzed (elective repair of an abdominal aortic aneurysm; aortic valve replacement; lung resection; esophagectomy; cystectomy)

Reference	Study location	Physicians' specialty	Type of outcome	Assessments	Covariates	Evidence of association with age
Wenghofer, Williams, and Klass (2009)	Canada	General/family practitioners	Performance	Acute care, chronic care, continuity of care, well care ("providing patients with well care and health maintenance"), managing patient records	• Physician's factors (age; gender, years in practice, medical school - North American vs. other, CFPC certification, years in current practice, previous peer assessment by the CPSO) • Organizational factors: (solo practice, episodic care practice/walk-in clinic, number of clinical and administrative staff, hours worked per week in primary practice, number of patient visits per week in primary practice, active hospital appointment - yes/no, teaching -yes/no, focused practice -yes/no) • Systemic factors: access to 911 services - yes/no, estimated minutes for access to emergency medical services, availability of four core diagnostic tests, physician per 1,000 population, northern practice locations -yes/no)	No association

Reference	Study location	Physicians' specialty	Type of outcome	Assessments	Covariates	Evidence of association with age
Weycker and Jensen (2000)	USA	All non-osteopathic physicians	Performance	Medical malpractice	• Physician's characteristics (gender, born US citizen, training credentials, previous litigation history) • Practice characteristics (medical research/teaching, direct patient care, solo practice, practice in Wayne County, general practice, medical specialty, surgical specialty)	Positive association: "… older physicians were generally less likely to incur malpractice". Physicians' age from <40 to 60+ years ORs from 0.342 to 0.679 (in different models) for physicians aged 60+ years compared to physicians younger than 40 years. "… no significant difference in the odds of an adverse record between physicians whose age was between 40–59 and physicians who were younger."

Jung et al. (2022) conducted a systematic review and meta-analysis of studies examining association between surgeons' age and postoperative complications/mortality. This meta-analysis included 10 retrospective cohort studies in which surgeons' age was expressed as a categorical variable. For the meta-analysis, surgeons' age was categorized into three groups: young, middle, and old. The authors acknowledge that, due to heterogenous classification of age among the included studies, they were unable to clearly define the ranges of the three age groups. The groupings for the meta-analysis were determined by discussion among the authors. Surgeons classified as "old" were 50 years or older in 5 studies, 55 years or older in 3 studies, 60 years or older in two studies. Outcomes of 29 different types of surgery were analyzed in the eligible studies. The meta-analysis showed a significantly higher postoperative mortality among patients of old-aged surgeons compared to patients of middle-aged surgeons (OR=1.14; 95% CI: 1.02-1.28; p=0.02). Post-operative mortality in patients of old-aged surgeons was also higher compared to patients of young-aged surgeons but the difference was not statistically significant (OR=1.23; 95% CI: 0.93-1.63; p=0.14). However, there was a significant heterogeneity among individual studies (I2=80% and I2=85% for the two comparisons, respectively). The postoperative major morbidity among patients of old-aged surgeons was not different from that among patients of middle-aged surgeons (OR=1.08; 95% CI: 0.92-1.27; p=0.34) or among patients of young-aged surgeons (OR=1.00; 95% CI: 0.83-1.21; p=0.99). Again, there was a significant heterogeneity among individual studies (I2=77% and I2=88% for the two comparisons, respectively). The postoperative major morbidity was analyzed by type of surgery: large organ surgeries were categorized as "major", and small-organ surgeries were categorized as "minor". There were no significant differences in major morbidity after minor or major surgeries according to surgeons' age. Major surgeries: OR=0.96 (95% CI: 0.81-1.13) for old-aged vs. middle-aged surgeons; OR=0.92 (95% CI: 0.74-1.16) for old-aged vs. young-aged surgeons. Minor surgeries: OR=1.20 (95% CI: 0.97-1.48 for old-aged vs. middle-aged surgeons; OR=1.15 (95% CI: 0.92-1.42) for old-aged vs. young-aged surgeons.

Choudhry et al. (2005) reviewed studies published between 1966 and June 2004 on the relationships between physicians' age or years in practice and their medical knowledge, guideline adherence, patients' mortality or some other quality of health care outcomes. Fifty-nine articles reporting on 62 groups of outcomes were eligible for inclusion in this review. Results of these studies were classified into six groups based on the nature of the reported association. A negative association between increasing physicians' age/years in practice and performance for all outcomes assessed was reported in 32 of the 62 evaluations (52%); a negative association for some outcomes but no association for others was reported in 13 (21%) evaluation; 2 (3%) reported initial increase in performance with increasing experience, a peak and a subsequent decrease (a concave relationship); 13 (21%) reported no association; 1 (2%) reported a positive association for some outcomes but not for others, and 1 (2%) reported a positive association for all outcomes assessed. These results did not change substantially when analyses were restricted to objective outcome measures (use of chart audits or administrative databases vs. self-reports) or to studies adjusted for other known predictors of health care quality, such as patient comorbidity, physician volume or specialization. The authors concluded that, although their review was based on heterogeneous studies, its results suggest that more experienced older physicians may be at risk for providing lower-quality care."

Eva (2002) systematically examined evidence regarding whether clinical performance improves or declines with aging. The findings of this review suggest that analytic capabilities decline with age, whereas nonanalytic processing remains intact and becomes increasingly dominant. Older physicians tend to rely more on their prior experience and to a lesser extent critically incorporate novel conflicting information. When faced with a new case, physicians generate hypotheses and then test these hypotheses against the data presented. Older physicians are more influenced by the information they encounter early in the case. While more experienced physicians may have more correct first impressions than less experienced physicians, there are cases when these initial hypotheses are incorrect, and there is a need to consider other possibilities. The failure to engage analytic processing in the decision-making process may result in medical errors. The author stressed, however, that "the competence problems induced as a result of declining analytic capabilities should not be viewed as evidence for the inadequacy of nonanalytic diagnostic strategies. On the contrary … nonanalytic approaches to problem solving can be superior to analytic approaches. The problem arises when these nonanalytic approaches are not tempered by additional analytic consideration of clinical cases". Also, the author pointed to the existence of strong inter-individual differences that tend to increase with age. Although, on the average, performance of older physicians tends to be lower, many older physicians perform at or above the level of their younger colleagues.

Summary of evidence and discussion

In summary, although many studies included in this review, as well as those reviewed by Choudhry et al. (2005), Eva (2002) and Jung et al. (2022), found evidence of age-related decline in physicians' performance, other studies detected no relationship with age, and still others reported superior performance of older physicians compared to younger counterparts. Possible reasons for these discrepancies include different medical specialties of study participants, different measures of competence/performance used, as well as different sets of potential confounders adjusted for in the analyses. Numerous factors other than cognitive aging may contribute to underperformance of older physicians.

Older physicians' training occurred decades ago and may not be updated regularly (Choudhry et al., 2005). For example, Day, Norcini, Webster, Viner, and Chirico (1988) demonstrated that, on recertification examinations, older physicians who were further out of training, performed less well compared to more recently trained physicians on items related to new or changing knowledge; at the same time, they performed as well as younger examinees on items testing stable knowledge. Older physicians may be less accepting to practice innovations (Choudhry et al., 2005).

Physicians' performance may be influenced by their individual characteristics (such as gender, medical school, certification status), organisational factors (for example, solo practice, support systems, hours worked, practice volume, appointment lengths), systems level factors (for example, community size, physician-to-population ratio) (American Medical Association, 2015; Kain et al., 2019; Wenghofer et al., 2009).

Physicians' physical and mental health, personality characteristics, attitudes and beliefs, life stressors and burnout also contribute to performance difficulties (Williams, Flanders, Welindt, & Williams, 2018). The type of physician's motivation (intrinsically motivated to serve patients or externally motivated to make a lot of money) is considered critical for quality of patient care (Kain et al., 2019).

Patients' factors, such as disease acuity and complexity, should also be taken into consideration (American Medical Association, 2015). For example, it has been suggested that older doctors tend to treat older and sicker patients (Samuels & Ropper, 2005).

Age-related physiological changes, such as reductions in manual dexterity, hearing, and visual acuity, may affect physicians' clinical competence and performance (American Medical Association, 2015; Moutier, Bazzo, & Norcross, 2013). For example, although intact cognition is important for optimal performance of surgeons, good eyesight and hand dexterity are also essential (Fortunato & Menkes, 2019; Yule, Flin, Paterson-Brown, & Maran, 2006).

Aging physicians who collaborate with their colleagues, engage in evidence-based discussions, receive performance feedback, use computerized reminder systems, may be in a better position than those who practice in isolation or in more traditional settings (Choudhry et al., 2005).

Lack of valid tools for measuring physician's competence or practice performance, and the variable nature of physician practices, are among challenges faced when assessing practicing physicians (American Medical Association, 2015). Quality of care in one domain may not predict quality of care in another. Therefore, caution is recommended when interpreting results of physicians' assessments based on narrow measures of performance (Parkerton, Smith, Belin, & Feldbau, 2003; Yen & Thakkar, 2019). For example, Parkerton et al. (2003) assessed primary care physicians on four measures of performance and found that, although 76% of the physicians ranked in the highest tertile for at least one measure, 81% of these high performing physicians were in the lower tertile for at least one other measure.

Reported improvements in outcomes for patients of older surgeons may be, at least partly, explained by self-selection of highly skilled surgeons to continue performing surgical procedures, whereas lower skilled surgeons may decide to quit (Satkunasivam et al., 2020; Tsugawa et al., 2018). Also, volume and complexity of surgical cases may decrease with increasing surgeon's age (Bieliauskas et al., 2008).

Postoperative mortality, as a measure of surgery outcome, is affected not only by technical quality of the operation itself, but also by other aspects of care, including postoperative inpatient care (R. J. Campbell et al., 2019). Also, post-operative mortality is specialty-specific and of a greater relevance in some surgical specialties than in others (Maruthappu et al., 2014). It should be noted that studies of surgeons summarized in this section either analyzed outcomes of a specific type of surgery, or accounted for surgeons' specialties and/or type of surgery (emergent vs. elective).

As to studies of physicians' knowledge and skills, there are some uncertainties regarding relevance and predictability of competence assessments in an assessment center for actual performance in clinical practice (American Medical Association, 2015).

5.3.3 Ability of physicians to self-assess

Davis et al. (2006) systematically reviewed studies comparing physicians' self-assessments with objective assessments using quantifiable and replicable measures. Studies conducted in the United Kingdom, Canada, United States, Australia, or New Zealand were eligible. Seventeen studies that included 20 comparisons were reviewed. Self-assessments in these studies were conducted using questionnaires, checklists, or surveys asking about learning needs, confidence in performing procedures, general clinical skills, medical and critical appraisal knowledge, and nonclinical competencies such as teaching skills and cultural competencies. External objective measures included performance in objective structured clinical examinations (OSCEs), in-training or other examinations, chart audit, standardized patients, simulations, the ability to explain concepts of evidence-based medicine to a blinded interviewer. Of the 20 comparisons, 13 found little, no, or even inverse association between self-assessment measures and external indicators; seven studies found positive associations. The authors concluded that, most of the evidence suggests limited ability of physicians to accurately self-assess.

Bieliauskas et al. (2008) administered a battery of computerized neuropsychological tests to 359 older surgeons, of whom 294 surgeons also completed a self-report survey asking about perceived difficulties in name recognition or memory recall. It was found that there was no notable relationship between surgeons' perception of cognitive difficulties and their performance on cognitive tests. Subjective cognitive problems were significantly related with surgeon's retirement status or decision to retire in the next five years, whereas no notable relationship was seen between measured cognitive status and retirement decision.

Summary of evidence

In summary, studies summarized in this review suggest that physicians may not be good at assessment of their own clinical performance and cognitive skills.

5.3.4 Are physicians willing to report their colleagues' cognitive problems?

E. G. Campbell et al. (2007) conducted a national survey in the USA, using a stratified random sample of physicians in three primary care specialties (general internal medicine, family practice, and pediatrics) and three non–primary care specialties (cardiology, anesthesiology, general surgery). Of the 3167 eligible physicians, 1662 (52%) completed a questionnaire. Ninety-six percent of the respondents agreed that physicians should report all instances of significantly impaired or incompetent colleagues. However, 45% of physicians who had personal knowledge of an impaired or incompetent colleague indicated that they had not reported that colleague at least once in the last three years. Forty-six percent of physicians with personal knowledge of serious medical error did not report that error at least once in the last three years.

In a nationally representative survey of physicians in the USA (2938 eligible physicians; 1891 responded), 1120 (64%) agreed it is their duty to report impaired or incompetent colleagues (DesRoches et al., 2010). Three hundred and nine physicians personally knew of a colleague who was incompetent to practice. Of these 309 physicians, 67% (n = 204) reported this colleague to the relevant authority. The authors concluded that, although physicians supported the professional commitment to report impaired or incompetent colleagues, many failed to do so when faced with these situations. Most frequently cited reasons for not acting were beliefs that someone else was taking care of the problem, that nothing would happen as a result of the report, and fear of retribution (DesRoches et al., 2010).

Weenink, Westert, Schoonhoven, Wollersheim, and Kool (2015) conducted a survey of legally regulated healthcare professions in the Netherlands: dentists, midwives, nurses, pharmacists, physicians, physiotherapists, psychologists, and psychotherapists. Of 4348 professionals who were invited, 1238 responded (28.5%). Of the 1238 participants, 390 (31.3%) had an experience with an impaired or incompetent colleague, but only 266 of them (68.6%) acted upon this experience. Reasons for not acting were beliefs that impairment/incompetence could not be proven, that it was the responsibility of others, or that others had already taken care of the problem; possible consequences for the team climate; no knowledge of what action to take. The authors of this study noted that their definition of "taking action" was broad and included "talking to the impaired/incompetent colleague" or "discussing the experience with colleagues". Only one fifth of the participants (20.7%) reported the impaired/incompetent colleague to relevant authorities: the board of the organisation (11.7%), the professional association (3.0%) or the Health Care Inspectorate (6.0%).

Summary of evidence

Although it is their duty to report their own and their colleagues' cognitive problems, physicians are generally reluctant to do so (Fortunato & Menkes, 2019).

6 Question 5: What are the important methodological considerations when assessing age-related cognitive decline?

6.1 Considerations regarding assessment of cognitive decline in physicians

Scientific evidence linking cognitive test results with physician performance is lacking (Steffany, 2022). It is not clear what cognitive assessments are best predictors of performance in real-life clinical situations (K. A. Armstrong & Reynolds, 2020). There are no standards on the level of cognitive decline at which a doctor is no longer fit to practice (Australian Medical Association, 2017; L. Lee & Weston, 2012; Medical Board of Australia, 2017). Data from prospective longitudinal studies analyzing results of physicians' cognitive assessments in conjunction with variables relevant to physicians' performance are necessary to support the criterion validity of cognitive testing (Gaudet & Del Bene, 2022). No such studies were identified by literature searches conducted for this review.

Sets of cognitive abilities required for different medical specialties are diverse, due to a diversity of skill sets required and the level of responsibility that each medical specialty involves (Garrett et al., 2021; Gaudet & Del Bene, 2022). For example, psychomotor impairment may weigh more heavily for surgeons, critical care, or emergency medicine specialists (Garrett et al., 2021); changes in processing speed may be particularly relevant for intensivists who rely on rapid decisions and responses (Skowronski & Peisah, 2012); visuospatial abilities are important for radiologists (Gaudet & Del Bene, 2022). If cognitive cut-off scores were available, they would have to be interpreted and applied to the physician specialty area (Garrett et al., 2021; Gaudet & Del Bene, 2022).

Ideally, neuropsychological test batteries should include specialty-specific modules that are not just theoretically but empirically linked to impaired physician performance (Saver, 2020). Fortunato and Menkes (2019) suggest that "[p]roper tools for assessment and subsequent validation of these tools must be formulated before using methods that might adversely affect a physician's career. A task force of experts … would be best suited to create an appropriate assessment". Likewise, according to Hoffman (2022), to develop a testing protocol, "experts must determine whether there are appropriate cognitive testing tools with which to screen physicians and other health care providers. … It is possible that entirely new tests that do not yet exist will need to be created. In addition, several alternative tests may need to be used or developed because of differences in the skills required for various types of practice. … Experts would also need to determine at which age testing should begin and how frequently it should be administered."

Outcomes of most currently available cognitive assessment tools are difficult to interpret due to lack of normative data for physicians. The committee of the American Medical Association (2015) stated: "With regard to measurement of cognitive dysfunction, it is uncertain whether and how physician results should be compared to the general population and whether their results should be age-matched for interpretation purposes. … The nature of physician decisions, in terms of their difficulty, acuity and gravity, suggests that even minor changes in cognitive function may be impactful in patient care situations. … Results for cognitive testing that are interpreted as normal based on comparison to an age-matched, non-physician population could potentially represent a significant decline in highly intelligent individuals….”

Although some cognitive assessment tools include normative data for physicians, there are limitations associated with inter-individual comparisons inherent to the use of normative data. Baseline cognitive testing would offset these limitations by comparing an individual’s current cognitive performance with prior performance. If longitudinal testing is done, reliable change indices should be used to determine whether the observed cognitive changes are clinically meaningful, or simply represent normal intra-individual variability (Gaudet & Del Bene, 2022).

As many practicing physicians are graduates from international medical schools, Gaudet and Del Bene (2022) stress the importance of ethnic, cultural and language factors that affect performance on cognitive testing. Failure to account for these factors may result in inaccurate interpretation of physicians’ test scores and conclusions regarding their competence; therefore, special efforts should be made to select tests appropriate fore foreign-born physicians and correctly interpret their results. For example, bilingual people are disadvantaged on verbal fluency tasks in their non-dominant language, and their lower-than-expected performance on such tasks may not be due to cognitive dysfunction but rather due to cultural or language differences. Gaudet and Del Bene (2022) acknowledge lack of research in this area.

Gaudet and Del Bene (2022) summarized important considerations in cognitive screening of physicians:

> *“… there are numerous limitations stemming from the use of cognitive screening in isolation. While results of a simple screen may provide a rough estimate of cognitive functioning, this is also a significant limitation. As underscored in the research literature, numerous variables exert an influence on physicians’ cognitive functioning. To comprehensively characterize a physicians’ cognitive functioning, and the extent to which it may or may not interfere with their job performance requires specialized knowledge and appreciation of contextual factors. Specialized knowledge includes but is not limited to: (1) test selection & administration; (2) normative sample selection and interpretive procedures; (3) integration of biopsychosocial factors (e.g., medical history; psychological stressors); (4) cultural competency; (5) understanding of demands associated with medical specialties; and (6) generating informed recommendations to preserve and optimize physician functioning.”*

6.2 Methodological considerations when assessing age-related cognitive studies

Selection bias. Samples commonly used in cognitive aging research are those conveniently accessible (convenience samples) and almost never fully representative of the general population. Differences observed in these samples may not accurately characterize the true age-related differences in the population (Salthouse, 2000).

Recruitment bias relates to which subjects are willing to participate in a study. Individuals who are ill, who have financial constrains or limited social support may find it difficult to participate. Because healthy or more advantaged individuals are more likely to participate, recruitment bias tends to underestimate the degree of age-related cognitive decline (Murman, 2015).

Misclassification bias occurs when subjects with early signs of dementia are classified as cognitive normal. These subjects' test scores overestimate the degree of cognitive decline attributed to normal aging (Murman, 2015).

Longitudinal vs. cross-sectional study design. Most studies on age-related cognitive decline are cross-sectional. These studies compare cognitive performance of different age groups at a single point in time. A limitation of cross-sectional studies is that they confound age and cohort effects. For example, a person whose age is currently 80 years grew up under different conditions than a person who is currently 20 years old. For example, they may have different nutrition, education experiences, exposure to social stressors and new technologies, and to other unmeasured factors. Therefore, it is not possible to determine whether observed group differences are due to aging or due to shared generational experiences. It has been demonstrated that cross-sectional studies tend to overestimate both the magnitude of age-related cognitive decline, and how early it occurs (MacDonald & Stawski, 2016; Murman, 2015; Nilsson, 2012; D. H. Powell & Whitla, 1994).

Longitudinal studies, in which a group of individuals is followed over time, would allow measuring cognitive changes within each subject as a function of age. The longer the follow-up, the more likely it is that reliable changes are discovered (Nilsson, 2012; D. H. Powell & Whitla, 1994). However, longitudinal studies have problems as well. One of these problems is attrition (MacDonald & Stawski, 2016; D. H. Powell & Whitla, 1994). Longitudinal studies may lose up to 80% of their subjects during follow-up**,** and those remaining may not be representative of the original cohort. Subjects remaining in the study may differ systematically from those lost to follow-up. Although subjects may decide to discontinue participation for a variety of reasons, such as relocation, lack of interest, dislike of the measurement protocols, those who stay tend to be healthier physically, better educated, more motivated and exhibiting better cognitive functioning (Ferrer & Ghisletta, 2011; MacDonald & Stawski, 2016; D. H. Powell & Whitla, 1994). Another problem of longitudinal studies is practice (retest) effect, which may mask aging-related declines. It is possible that repeated exposure to similar cognitive tasks improves performance on subsequent testing occasions due to a practice effect. This effect depends on the responsiveness of the measured function to practice, the number of repeated assessments, and the intervals between them (Ferrer & Ghisletta, 2011). It has been suggested that retest effect may also be seen in cross-sectional studies when large batteries of similar tasks are administered (Ferrer & Ghisletta, 2011).

It is thought that "even a longitudinal study with only two measurement points is better than only one time of cognitive assessment as in cross-sectional studies" (Nilsson, 2012). However, real cognitive decline can be characterized most effectively by analyzing changes over several assessments. Performance on cognitive tests can be affected by many factors, such as emotional and physical states, the testing environment, and measurement error. Thus, assessments at two time points provide limited ability to differentiate changes due to aging from changes due to other factors (Morris, Evans, Hebert, & Bienias, 1999).

Categorical vs. continuous variables. When analyzing two measurement points, cognitive decline is frequently modeled as a categorical variable, for example decline versus no decline, by applying a cut point to a continuous variable. Categorization based on reaching a specific cognitive score does not distinguish between small and large changes in scores over the study period. For example, for persons who initially scored low, much smaller cognitive decline would be required to fall below the cut point in subsequent evaluations compared to persons with higher initial scores (Morris et al., 1999).

Continuous vs. extreme age groups. Some cross-sectional studies in cognitive aging use extreme-group designs, comparing just young and old adults and not including middle aged adults, under an implicit assumption that middle-aged adults would perform at an intermediate level between the two extreme age groups (Salthouse, 2000). It has been suggested that the assumption of linearity may be reasonable as an approximation because, although there exists some evidence of a non-linear relationship between age and cognition, the nonlinear effects appear to be small, at least in the range of ages 18 to 70 years (Salthouse, 2000). A recent study (LaPlume, Anderson, McKetton, Levine, & Troyer, 2022) suggests that departure from a linear pattern occurs at an earlier age. These researchers measured performance in several validated tests for episodic memory and executive function in a sample of over 40,000 people aged 18–90 years. It has been demonstrated that cognitive performance declined slightly and gradually from age 18 until around 60 years, and more rapidly from age 60 until the end of measurement at age 90 years. Variability between people and within a person across tasks also increased gradually over early and middle adulthood and rapidly after age around 60 years.

Sample size and statistical power. To interpret a finding of “no age-related difference” in a cognitive variable, the power of the study to detect small or moderate effects needs to be considered. Even when a small study reports a statistically significant age-related decline, the confidence interval may be large and preclude an accurate estimate of the effect size (Salthouse, 2000).

Measures used for evaluation of cognitive domains. A variety of tests exist for evaluation of each cognitive domain, and there is a controversy regarding optimal tests for each domain and for each population of interest (Institute of Medicine, 2015).

Combining cognitive tests results. When combining tests that measure different components of cognitive functioning, information on specific cognitive domains is lost, and these domains may exhibit very different rates of decline (Morris et al., 1999).

The effect of stereotypes about aging. There are popular stereotypes about aging in society. For example, older adults are often viewed as slow, or forgetful. It has been demonstrated that negative stereotypes affect the performance of seniors in cognitive tests, and at least some of the observed age-related cognitive decrements may be explained by exposure to stereotypes about aging. If performance on cognitive tests can be affected by subtle modifications to the testing environment (such as language used by researchers, expectations that they set for their participants), these variables are important to consider in research of age-related cognitive changes (B. Armstrong et al., 2017; Horton, Baker, Pearce, & Deakin, 2008).

7 Question 6: Which screening instruments are preferred for assessing age-related cognitive decline in physicians?

There exists a distinction between cognitive screening and comprehensive cognitive assessment. The aim of screening is early identification of preclinical cases in population without any symptoms. Generally, screening is quick, non-invasive, and low cost. Screening is not a definitive indication of a condition or disorder; rather it can indicate a need for further evaluation. An important characteristic of a screening measure is its high sensitivity, i.e., the proportion of true positives that are identified as such. Comprehensive assessment confirms or rules out a suspected condition or disorder(American Psychological Association, 2014; Garrett et al., 2021). Cognitive screening tests can be administered in minutes to hours, whereas full neurocognitive assessment can take up to days (K. A. Armstrong & Reynolds, 2020). The focus of this review is on instruments for cognitive screening.

To identify cognitive screening instruments for use in physicians, an environmental scan was conducted of sources, including general grey literature searching (google) and a review of existing policy documents from various agencies. Key words for the internet search included terms for physician, clinician, cognitive decline, cognition, capacity, competence, measurement, instrument, and tool. The list of instruments summarized was not exhaustive - the final selection of instruments was based on several considerations, including: the instrument was noted as commonly used (or considered for use) for screening the physician workforce, the instrument had normative data on physicians, or the instrument was recommended in policy documents. For each instrument, a short summary is provided, as well as data on administration, validity, sensitivity, and presence of a ceiling effect.

Essential features of tools for cognitive screening of physicians, according to Garrett et al. (2021), include high ceiling for individuals with high cognitive reserve; measurements of processing speed across all tasks [processing speed, in the authors' view, is a "leading indicator of cognitive changes across the cognitive aging to dementia spectrum"]; availability of alternative forms to mitigate practice effect; availability of norms for physicians; breadth of cognitive skills assessed; good psychometrics such as sensitivity and strong criterion validity data. Definitions of terms are provided in Table 5**.**

Summary of characteristics and validity[4] data for each cognitive assessment tool described below can be found in Table 6.

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[4] The validity data of the cognitive assessment tools are based on comparisons between healthy subjects and subjects with cognitive impairment (i.e., MCI or dementia). Garrett et al. (2021) acknowledge: *"For each of the objective screening measures, we note that the best available criterion validity data (to determine sensitivity, specificity, etc.) involves comparisons between healthy aging and those diagnosed with MCI using standardized criteria. … We appreciate the conceptual leap from identifying those physicians at risk for unsafe practice and a clinical diagnosis of MCI. Also, we acknowledge that there are cognitively compromised physicians who may have age-related weaknesses that potentially impact their professional performance but do not have MCI, and high performing physicians who do have MCI. Make no mistake; there are gaps in the validity data."*

Table 5: Definitions of terms

Term	Definition	Reference
Ceiling	"Defined as a measurement limitation that occurs when the highest possible score on a test or measurement instrument is reached, thereby decreasing the likelihood that the testing instrument has accurately measured the intended domain."	(Garrett et al., 2021)
Criterion validity	"… an index of how well a test correlates with an established standard of comparison (i.e., a criterion). Criterion validity is divided into three types: predictive validity, concurrent validity, and retrospective validity. For example, if a measure of criminal behavior is valid, then it should be possible to use it to predict whether an individual (a) will be arrested in the future for a criminal violation, (b) is currently breaking the law, and (c) has a previous criminal record. Also called criterion-referenced validity; criterion-related validity."	(American Psychological Association, 2022)
Internal consistency	"Internal consistency refers to how well a survey, questionnaire, or test actually measures what you want it to measure. The higher the internal consistency, the more confident you can be that your survey is reliable. The most common way to measure internal consistency is by using a statistic known as Cronbach's Alpha, which calculates the pairwise correlations between items in a survey. The value for Cronbach's Alpha can range between negative infinity and one."	(Statology, 2020)
Inter-rater agreement/reliability	"… inter-rater reliability is a way to measure the level of agreement between multiple raters or judges." Two common ways of measure the inter-rater variability are 1) percent agreement that "ranges between 0 and 1 with 0 indicating no agreement between raters and 1 indicating perfect agreement between raters"; 2) Cohen's Kappa "which calculates the percentage of items that the raters agree on, while accounting for the fact that the raters may happen to agree on some items purely by chance. … Cohen's Kappa always ranges between 0 and 1, with 0 indicating no agreement between raters and 1 indicating perfect agreement between raters. … In general, an inter-	(Statology, 2021a)

	rater agreement of at least 75% is required in most fields for a test to be considered reliable."	
Predictive Value of Tests	"In screening and diagnostic tests, the probability that a person with a positive test is a true positive (i.e., has the disease), is referred to as the predictive value of a positive test; whereas, the predictive value of a negative test is the probability that the person with a negative test does not have the disease. Predictive value is related to the sensitivity and specificity of the test."	(National Center for Biotechnology Information, 1987)
Practice effect	"Practice effects are improvements in cognitive test performance due to repeated evaluation with the same or similar test materials."	(Duff, Callister, Dennett, & Tometich, 2012)
Sensitivity	"Sensitivity or recall rate is the proportion of true positives."	(National Center for Biotechnology Information, 1991)
Specificity	"Specificity is the probability of correctly determining the absence of a condition."	
Test-retest reliability	"Test-retest reliability is a specific way to measure reliability of a test and it refers to the extent that a test produces similar results over time." Test-retest reliability can be calculated as the Pearson Correlation Coefficient, which takes on values between -1 (indicating a perfect negative linear correlation between two scores) and 1 (indicates a perfect positive correlation); 0 indicates no correlation	(Statology, 2021b)

7.1 MicroCog: Assessment of Cognitive Functioning Screening Test

MicroCog, formerly known as the Assessment of Cognitive Skills (ACS), was originally developed to screen older physicians for cognitive impairment and the risk of malpractice (Wild, Howieson, Webbe, Seelye, & Kaye, 2008). This computer-administered neuropsychological battery includes 18 subtests that generate composite scores across five cognitive domains: attention/mental control, memory, reasoning/calculation, spatial processing, and reaction time. Indices for information processing speed and information processing accuracy are derived from the speed and accuracy scores of the subtests for the cognitive domains. These indices are then used to generate a General Cognitive Functioning index and a General Cognitive Proficiency index. The former gives equal weight to speed and accuracy of processing, whereas the latter gives preferential weight to accuracy (Raymond, Hinton-Bayre, Radel, Ray, & Marsh, 2006). A neuropsychologist is needed to interpret and summarize test results and to provide recommendations (Garrett et al., 2021). MicroCog is commercially available (D. Powell et al., 2004). This self-administered test battery is available in two forms: a standard form that includes 18 subtests and takes 60 to 90 minutes to complete, and a short form that includes 12 subtests and takes 30 to 45 min to complete (D. Powell et al., 2004; Wild et al., 2008). Normative data were based on a representative sample of 810 adults ages 18-89. Age-specific norms are available for nine age groups, and education level adjusted norms are also available (D. Powell et al., 2004). Physician norms were collected for the original version of the MicroCog; revised physician norms are not adequately described in the manual and are not "native to the computer scoring software" (Garrett et al., 2021). The MicroCog has a very high ceiling, which allows better assessment of highly educated individuals; the tool is not widely used by physicians in their clinical practice, and therefore is not familiar to them (Garrett et al., 2021). Raymond et al. (2006) found significant practice effects when MicroCog test battery was administered two weeks apart and three months apart; the magnitude of practice effect was somewhat smaller at three-month interval. Alternate forms to minimize the practice effects are not available (Garrett et al., 2021).

7.2 Montreal Cognitive Assessment Tests (MoCA)

MoCA was developed for early detection of MCI. MoCA assesses short-term memory, visuospatial abilities, executive functions, attention, concentration, working memory, language, orientation in time and place. It can be administered as a paper test and as a digital tool; versions adapted for administration by telephone or videoconference are also available (MoCA Cognitive Assessment, 2022a). In September 2019, MoCA became proprietary; users must register, obtain consent, and enter selected patient data and test responses for centralized scoring (Borson, Sehgal, & Chodosh, 2019). Test results are be interpreted by healthcare professionals with an expertise in the cognitive field (for example, by neurologists, neuropsychologists, occupational therapists, or psychiatrists) after training and certification that can be obtained online (MoCA Cognitive Assessment, 2022b; Nasreddine, 2020). There is a fee for training and certification, and recertification is required every 2 years (Borson et al., 2019). Limitations of this test also include lack of normative data for physicians (the normative data do not distinguish beyond greater than high school education); lack of novelty for physicians (due to its widespread use in primary care, many physicians know the answers); lack of measures of processing speed (Garrett et al., 2021).

7.3 Saint Louis University Mental Status (SLUMS) Examination

SLUMS is a paper questionnaire developed by Saint Louis University in partnership with the Geriatrics Research, Education and Clinical Center at the St. Louis Veterans Administration Medical Center. The purpose of the SLUMS exam is to screen for presence of cognitive deficits and to identify changes in cognition over time (Saint Louis University School of Medicine, 2022). The questionnaire includes 11 questions to assess attention, immediate recall, and orientation (questions 1 to 3); delayed recall with interference (questions 4 and 7); numeric calculation and registration (question 5); memory: immediate recall with interference (time constraint) (question 6); registration and digit spam (question 8); visual spatial function (question 9); visual spatial and executive function (question 10); executive function plus extrapolation (question 11). The questionnaire is available in multiple languages. It is free of charge, can be downloaded from the Saint Louis University website, and should be used by qualified health care professionals trained by viewing online videos (Saint Louis University School of Medicine, 2022). It takes approximately 7 min (4 to 10 minutes) to complete the questionnaire. The maximum score is 30, and cut-off scores for MCI and dementia depend on the level of education (high school and above or less than high school) (Shirley Ryan AbilityLab).

SLUMS was developed for the US veteran population, which is more likely to be older, poorer, unemployed, and with poorer physical and mental health. Limitations of this test include lack of data on inter-rater reliability, test-retest validity and internal consistency; familiarity to physicians due to its use in primary care, neurology, psychiatry (Garrett et al., 2021). Garrett et al. (2021) believe this test is not desirable for cognitive screening of late-career physicians despite it was cited by the California Public Protection and Physician Health.as "commonly used" for this purpose.

7.4 Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)

This test battery was developed to measure cognitive decline or improvement; its updated version is marketed by Pearson Inc. The measure is available in more than 20 languages and assesses five cognitive functions: immediate memory, visuospatial/constructional, language, attention, and delayed memory (Randolph, 2012). Initially, the measure was developed as a pen-paper test that took less than 30 minutes to complete (Randolph, Tierney, Mohr, & Chase, 1998). Later, Pearson Inc. has introduced a digital version. Four parallel forms are available, of which form A offers norms based on age, gender, race, education, and geographic region (Randolph, 2012). This test has many strengths, including high internal consistency, inter-rater and test-retest reliability; it is less familiar to physicians because it is used mainly by neuropsychologists and rehabilitation specialists. However, normative and validation data for physicians are unavailable, and, in the paper-and-pencil test setup, processing speed is measured only in one task rather than across all cognitive domains assessed (Garrett et al., 2021). Although Duff et al. (2005) found no practice effect over a one-year retest interval, alternative forms of this test are available (Garrett et al., 2021).

7.5 Automated Neurophysiological Assessment Metrics (ANAM)

The Automated Neurophysiological Assessment Metrics was originally developed by the US the Department of Defense for routine cognitive testing of active-duty service members (Meyers & Vincent, 2020). This computer-based test library has been used in a variety of circumstances, including for measurements of subtle cognitive changes (Vincent, Roebuck-Spencer, Fuenzalida, & Gilliland, 2018). Currently, ANAM is marketed by Vista Life Science and includes 22 cognitive and behavioral assessments that can be grouped into flexible or standardized batteries highly sensitive to cognitive changes. These batteries assess a variety of cognitive domains including attention, concentration, reaction time, memory, processing speed, and decision-making. ANAM can be administered by trained individuals under the supervision of qualified professionals trained in psychological testing. The time necessary to complete the testing varies depending on the number of tests included in the battery. For example, it takes about 20-25 minutes to complete the standard ANAM battery used by the U.S. Department of Defense. ANAM assessment results should be interpreted by qualified medical professionals, such as clinical psychologists, neuropsychologists, or physicians trained in psychological testing. ANAM software provides numerous alternative forms and combinations to minimize practice effect (Vista Life Science, 2022). This tool has a very high ceiling and includes processing speed measurements across all tasks; normative data are available from a variety of samples, including physicians. However, this tool does not include tests for language and delayed memory, which are essential for physicians (Garrett et al., 2021).

7.6 National Institutes of Health ToolBox (NIHTB)

The NIH toolbox was recommended for cognitive testing of physicians by Devi, Gitelman, Press, and Daffner (2021). The NIH Toolbox® was developed by a team of more than 300 scientists from about 100 institutions. It is a comprehensive set of measurements to assess cognitive, emotional, sensory, and motor functions (HealthMeasures, 2022d). The NIH Toolbox Cognition Battery is a set of computer-based tests of cognitive functions most important for daily functioning, independence, educational and professional success: executive function, episodic memory, language, processing speed, working memory and attention (Scott, Sorrell, & Benitez, 2019; Weintraub et al., 2013). Seven measures were designed to assess constructs in these domains (HealthMeasures, 2022a; NIH Toolbox and PROMIS iPad apps, 2021; Weintraub et al., 2013):

- NIH-TB Flanker Inhibitory Control and Attention Test is a measure of executive function and attention. It assesses the ability to inhibit visual attention to irrelevant task dimensions, which are considered a fluid ability.
- NIH-TB Dimensional Change Card Sort Test (DCCS) is a measure of executive function. This test is used to assess the set-shifting component of executive function, which is considered a fluid ability.
- NIH-TB List Sorting Working Memory Test assesses information storage and processing and is a measure of fluid ability.
- NIH-TB Picture Sequence Memory Test is a measure of episodic memory, which involves acquisition, storage, and recall of new information. It is a fluid ability measure.
- NIH-TB Oral Reading Recognition Test (language) measures the ability to pronounce single printed words and/or to recognize letters. This test assesses reading decoding skills and is a measure of crystallized abilities.
- NIH-TB Picture Vocabulary Test (language). The task is to pick the picture that matches the spoken word. This test assesses general vocabulary knowledge and is a measure of crystallized abilities.
- NIH-TB Pattern Comparison Processing Speed Test assesses speed of information processing and is a measure of fluid ability.

There are also two Cognition Supplemental Measures in the NIH Toolbox (HealthMeasures, 2022a):

- Auditory Verbal Learning Test (Rey) is a measure of memory (immediate recall).
- Oral Symbol Digit Test is a measure of processing speed.

This test battery is computerized and includes automatic scoring (Weintraub et al., 2013). It takes about 30 min to complete the Cognition test battery(HealthMeasures, 2022b). Normative scores are available for each year of age from 3 through 17, as well as for ages 18-29, 30-39, 40-49, 50-59, 60-69, 70-79, and 80-85 years (HealthMeasures, 2022c) for three levels of education: <high school, high school, college+ (Weintraub et al., 2013). Cognition measures are available for free to professionals trained to administer, score, and interpret psychological tests. To request permission, one must complete an online form. Eligibility is determined based on experience, education, and training (HealthMeasures, 2022e).

More information about each test included in the NIH toolbox, about scoring and interpretation of test results, can be found in the NIH Toolbox Scoring and Interpretation Guide for the iPad (NIH Toolbox and PROMIS iPad apps, 2021).

7.7 Cambridge Neuropsychological Test Automated Battery (CANTAB)

CANTAB was recommended by Greenfield (2002) for cognitive assessment of surgeons because, in the author's view, this tool is superior in detecting subtle cognitive changes. The tool was originally developed at the University of Cambridge and currently is marketed by Cambridge Cognition. The test battery is designed for use on digital devices, is quick and easy to administer. Automatic test delivery and rating ensures assessments consistency, allows non-specialists to administer the tests, and rules out rater variance. Because CANTAB uses non-verbal visual stimuli, it is language-independent and culturally neutral (Cambridge Cognition, 2022b). The CANTAB battery can be used to assess working memory, learning and executive function; visual, verbal and episodic memory; attention, information processing and reaction time; social and emotion recognition, decision making and response control (Cambridge Cognition, 2022a). Normative data are available for ages from four to 90 years (Greenfield, 2002). Education-adjusted norms were recently developed (R .A. Abbott et al., 2015; R. A. Abbott et al., 2019); it appears that the highest educational category was 14+ years (R. A. Abbott et al., 2019). Based on data reported by Greenfield (2002), norms controlled for IQ are available. No information regarding availability of norms for physicians was found; most likely, such norms are unavailable.

7.8 Addenbrooke's Cognitive Examination (ACE)

ACE is a tool to screen for cognitive impairment. This test was initially developed as a modification of the MMSE by including additional tasks. The first version was published in 2000, and since then two additional versions have become available: a revised (ACE-R) and a third version (ACE-III); the letter is the currently recommended version. ACE-R and ACE-III are similar, but items belonging to the MMSE were removed from ACE-III and replaced by other items to limit copyright restrictions. A short version, Mini-ACE, is also available (Matias-Guiu, 2020).

ACE-R and ACE-III provide a total score (maximum 100 points), for which a cut-off could be applied, as well as scores for individual cognitive domains: attention/orientation, memory, verbal fluency, language, and visuospatial abilities. This instrument does not sufficiently examine executive functioning and does not examine social cognition (Matias-Guiu, 2020).

The Addenbrooke's Cognitive Examination-Revised (ACE-R) was used for cognitive assessment of physicians by Kataria, Brown, McAvoy, Majeed, and Rhodes (2014). Their selection of this instrument was based on a review of 39 tests that take less than 20 minutes to complete.

The ACE-III is free of charge. It is administered by healthcare professionals, such as nurses, psychologists, doctors, occupational therapist (Say & O'Driscoll, 2022).

Say and O'Driscoll (2022) found considerable inter-rater scoring variability in the English version of ACE-III. These authors note that test–retest accuracy may also be an issue[5].

[5] In contrast, using ACE-III translated and adapted to Japanese, (Takenoshita et al., 2019) found "excellent" internal consistency (Cronbach's coefficient α=0.870), test-retest reliability (intraclass correlation coefficient (ICC) = 0.918), and inter-rater reliability (ICC= 0.996) in detecting MCI and dementia. (Yoshida et al., 2012) found "excellent" reliability parameters of the Japanese version of ACE-R: internal consistency (Cronbach's α = 0.903), test-retest reliability (ICC = 0.883), and inter-rater reliability (ICC = 0.999). Relevance of data on the Japanese version of the tool is unclear.

Table 6: Summary characteristics of cognitive assessment tools that have been used or considered for cognitive assessment of physicians (Based on Garrett et al. 2021, with additional information from other sources)

Features	MicroCog	MoCA	SLUMS	RBANS	ANAM	NIH Toolbox	CANTAB	ACE
Mode of administration	Computerized	Paper or digital	Paper	Paper or digital	Computerized	Computerized	Computerized	Paper
Response speed recorded	Yes	No	No	No	Yes	Yes	Yes (e.g., (Fray, Robbins, & Sahakian, 1996))	No (pen and paper test)
Inter-rater reliability	n/a	0.12-0.31	No information	0.85	n/a	n/a [automated scoring]	n/a [automated scoring]	Considerable inter-rater variability for the English version (Say & O'Driscoll, 2022)[6]
Test-retest reliability	0.73-0.99	0.92 (over 18 days)	No information	0.81 (over 1-7 days)	0.64-0.92 (over 30 days)	0.86–0.92 over 7 to 21 days (Heaton et al., 2014) 0.73-0.92 over 15.03±3.11 months (Scott, Sorrell, et al., 2019) 0.72-0.94 over 7-21 days (Weintraub et al., 2013)	0.09 to 0.86 for different tests (Lowe and Rabbitt 1998)	No information found for English-language version[7]

[6] "Excellent" parameters for the Japanese versions (Takenoshita et al., 2019; Yoshida et al., 2012)

[7] Japanese version of ACE-III: ICC = 0.918 (Takenoshita et al., 2019); Japanese version of ACE-R: ICC = 0.883 (Yoshida et al., 2012)

Features	MicroCog	MoCA	SLUMS	RBANS	ANAM	NIH Toolbox	CANTAB	ACE
Internal consistency	0.76-0.95	0.83	No information	0.93	n/r	Cronbach's alpha: 0.84 (crystallized); 0.83 (fluid); 0.77 (total) (Heaton et al., 2014)	0.73-0.95 in children (Luciana, 2003); information for adults not found	No information found for the English-language version[8]
Sensitivity	0.83	0.90-0.93	0.81	0.64	0.81	No information found	E.g., 72% for the episodic memory test to detect amnestic MCI (Juncos-Rabadan, Pereiro, Facal, Reboredo, & Lojo-Seoane, 2014); 70.7-82.8% for detection of MCI in patients with atrial fibrillation (Wang et al., 2022)	ACE-R: 0.94 using a cut-off score of 88, and 0.84 using cut-off score 82 for dementia (Mioshi, Dawson, Mitchell, Arnold, & Hodges, 2006)
Specificity	0.96	0.47-0.87	0.68	0.90	0.89	No information found	E.g., 83% for the episodic memory test to detect amnestic MCI	ACE-R: 0.89 using a cut-off score of 88, and 1.00 using cut-off score

[8] Japanese version of ACE-III: α= 0.870 (Takenoshita et al., 2019); Japanese version of ACE-R: α = 0.903 (Yoshida et al., 2012)

Features	MicroCog	MoCA	SLUMS	RBANS	ANAM	NIH Toolbox	CANTAB	ACE
							(Juncos-Rabadan et al., 2014); 57.4%-85.8% for detection of MCI in patients with atrial fibrillation (Wang et al., 2022)	82 for dementia (Mioshi et al., 2006)
Positive predictive value	0.70	0.49-0.89	0.88	0.87	0.57	No information found	E.g., 79.7% for the episodic memory test to detect amnestic MCI (Juncos-Rabadan et al., 2014)	ACE-R: 100% at the cut-off of 82 (Mioshi et al., 2006) ACE (original): 0.63, 0.71 and 0.83 at the cut-off of 88, 83 and 75, respectively (Larner, 2007)
Negative predictive value	0.96	0.91-0.93	0.55	0.72	NR	No information found	E.g., 76.3% for the episodic memory test to detect amnestic MCI (Juncos-Rabadan et al., 2014)	ACE (original): 1.0, 0.95 and 0.85 at the cut-off of 88, 83 and 75, respectively (Larner, 2007)
Ceiling effect	Excellent	Poor	Poor	Good	Excellent	No information found	No information found	Poor in the naming component of the original ACE.

Features	MicroCog	MoCA	SLUMS	RBANS	ANAM	NIH Toolbox	CANTAB	ACE
								Modifications in ACE-R included changing pictures for the naming test to reduce the ceiling effect (Mioshi et al., 2006)
Normative data for age and advanced education	Yes	No	Age ranges 18-64 (adult), 65+ (elderly adult) (Shirley Ryan AbilityLab) High school/less than high school education (Shirley Ryan AbilityLab, 2022)	Yes	Yes	Yes	Yes The highest education category 14+ years (R. A. Abbott et al., 2019) Norms controlled for IQ are available (Greenfield, 2002)	Yes (Kataria et al., 2014)
Normative data for physicians	Yes	No	No	No	Yes	No	No information found (likely "No")	No information found (likely "No")
Practice effect	Yes	Yes [e.g., (Costa et al.,	Unknown, likely "Yes"	No (Duff et al., 2005)	No	Little or no (Heaton et al., 2014; Scott, Sorrell, et al., 2019)	Variable depending on task difficulty and levels of ability of the	Yes (Mioshi et al., 2006)

Features	MicroCog	MoCA	SLUMS	RBANS	ANAM	NIH Toolbox	CANTAB	ACE
		2012), page 380					individuals assessed (Lowe & Rabbitt, 1998) (Mioshi et al., 2006)	
Alternate forms to minimize practice effects	No	Yes	No	Yes	Yes	No information found, likely "No"	No information found	Yes (Mioshi et al., 2006)
Novelty for physicians	Yes	No	No	Yes	Yes	No information found	No information found	No information found
Duration	60-90 min (standard form) 30-45 min (short form)	10-15 min	4-10 min	30 min	Varies depending on the number of (20-25 min to complete the standard ANAM battery)	30 min (HealthMeasures, 2022b)	From 2-3 min to 7-10 min for different modules, to a total of 40-45 min (CDC, 2022)	15-20 min
Availability in languages other than English	No	Yes	Yes(Saint Louis University School of Medicine, 2022)	Yes	No	Yes (Spanish) (Fox, Manly, Slotkin, Devin Peipert, & Gershon, 2021)	Language-independent tool	Yes (Matias-Guiu, 2020)

7.9 Tests suggested for assessment of specific cognitive functions in physicians

Devi et al. (2021) highlighted critical features of cognitive screening and suggested potential tests for cognitive testing of physicians. The critical features of cognitive screening tools include assessment of critical cognitive domains (executive functioning, processing speed, memory, semantic access/fluency[9]; visuospatial abilities and motor dexterity); availability of established norms that allow identification of very poorly performing physicians; relatively short time to complete the test. The authors suggest selecting one test for each cognitive domain from the list provided in table 3 of their publication and reproduced in Table 7 below. All these tests have age norms, and take several minutes to administer; however, not all have sex-specific or education norms. Moreover, some studies [Devi et al. (2021), Del Bene & Brant (2021) and Cooney et al. (2020)] considered the use of customized battery or set of tests as opposed to cognitive screening instruments. The table of tests in which selected batteries and screening tools within the corresponding cognitive domains can be found in **Appendix 7**.

Table 7: Potential cognitive tests for cognitive functions critical to physicians (adapted from table 3 of Devi et al. (2021))

Test	Education norms	Sex norms
Processing Speed/Executive Function		
Trail Making	Yes	No
Stroop	No	No
Delis–Kaplan Executive Function System (D-KEFS) Color Word Interference	No	No
Digit Symbol Coding, Wechsler Adult Intelligence Scale 4th edition (WAIS-IV)	Yes	Yes
Letter-Number Sequencing	Yes	Yes
Digit Span	Yes	Yes
Language/Executive Function/Processing Speed		
Animals	Yes	No
Fruits	No	No
Vegetables	No	No

[9] Semantics: The relationships between symbols and their meanings. https://www.ncbi.nlm.nih.gov/mesh?term=Semantics

C F L form of verbal fluency[10]	Yes	Yes
F A S form of verbal fluency	Yes	No
Rey Auditory Verbal Learning Test	No	Yes
The Consortium to establish a registry for Alzheimer's disease (CERAD) Word List	Yes	Yes
6-Trial Selective Reminding Test (SRT)	Yes	Yes
California Verbal Learning Test (CVLT) 2nd edition, Short Form	Yes	Yes
Visuospatial Function		
Rey-Osterrieth Complex Figure	No	No
Clock Drawing	No	Yes
Benton Visual Form Discrimination	Yes	Yes

Devi et al. (2021) suggest that, to identify seriously impaired physicians, those scoring at ≥2 SD below the mean for age on any test be subjected to a more extensive cognitive evaluation; physicians who scored within 1 SD would be rescreened in 5 years, and those who scored between 1 and 2 SD below the mean would be rescreened more frequently, for example every 2 years.

The following alternative approaches are suggested by Devi et al. (2021):

- A more sensitive and less specific cut-off of 1 SD can be selected.
- Norms for 60-year-olds could be applied to all physicians.
- Maintaining a longitudinal record of scores for each physician to identify a "worrisome" decline in cognitive functioning over time rather than detecting scores below an arbitrary cut-off.

Devi et al. (2021) acknowledge that screening tests are imperfect tools; good test scores do not guarantee acceptable performance as a physician, and poor test scores do not mean an unsafe physician. The authors stress that "failing cognitive screening would start, not end, the evaluation process".

Whalley (2021) commented on Devi et al. (2021), stating that the cut-off suggested by Devi et al. (2021) may not provide sufficient protection for patients for the following reasons:

> *"… it would miss some physicians with milder forms of cognitive impairment whose clinical practice is unsafe. Second, it would not identify the early phase of those uncommon dementia syndromes with loss of insight and poor interpersonal judgment who retain most other cognitive functions. Third, reliance on a cutoff score on 1 or more cognitive tests may be misplaced in some physicians with underlying health problems such as disturbances of mood."*

Whalley (2021) suggests to consider the proposals by Devi et al. (2021) "as interim measures that aim in a limited way to win acceptance by older physicians of regular cognitive screening."

[10] "The Controlled Oral Word Association (COWA) Test is a brief and sensitive measure of executive cognitive dysfunction. There are two commonly used forms of the test, one using the letters F, A, and S, and the other using C, F, and L." (Barry D, Bates ME, Labouvie E. FAS and CFL forms of verbal fluency differ in difficulty: a meta-analytic study. Appl Neuropsychol. 2008;15(2):97-106. https://pubmed.ncbi.nlm.nih.gov/18568601/)

7.10 Summary of evidence

Information on tools that have been used or considered for use to assess physicians' cognition was identified by conducting an environmental scan. General grey literature (via google) and existing policy documents from various agencies were screened for relevant information. Information on eight tools was found that either have been used or considered for use in cognitive assessment of physicians. Five of these tools (MicroCog, MoCA, SLUMS, RBANS, and ANAM) were reviewed in considerable details by Garrett et al. (2021). Three tools, NIH toolbox, CANTAB and ASE, were identified from articles authored by Devi et al. (2021), Greenfield (2002), and Kataria et al. (2014), respectively. Devi et al. (2021) recommend a set of tests for assessment of each individual cognitive function critical to physicians, acknowledging that screening tests are not perfect and do not predict acceptable performance or "unsafe" physicians.

Although no perfect screening tool exists (Devi et al., 2021; Garrett et al., 2021), it appears that MicroCog and ANAM tools may be more suitable for testing physicians[11]. Both tools are computerized, are not familiar to physicians, have a very high ceiling, include normative data for physicians, and measure processing speed; however, neither of these tests is available in languages other than English. Other tools appear to be less suited for testing highly educated individuals (lower ceiling) and have no norms for physicians. The NIH toolbox has norms for a wide range of ages and for three levels of education, of which the highest is college+; however, it appears that normative data for physicians are not available.

Some experts suggest using tests for individual cognitive function critical to physicians, rather than cognitive screening tools.

[11] "Indeed, there is no perfect screening measure, but given the structure, content, and psychometrics of ANAM and MicroCog, we could do a lot worse." (**Garrett et al. 2021**)

8 Opinions on the issue of age-based cognitive screening of physicians

Devi et al. (2021) recommend that physicians undergo cognitive screening at age 65 years but acknowledge that earlier (at age 60 years), or later screening (at age 70 years) may be more suitable for some health systems.

Gaudet and Del Bene (2022) acknowledge that "although existing evidence is insufficient relative to the determination of a specific age, or career stage, to mandate cognitive testing, age 60 has been suggested as an entry point to establish a baseline for future comparison.".

Cwiek, Vick, Osterhout, and Maher (2021) recommend that "there should be mandatory testing of cognitive skills, physical dexterity, and eye/hand coordination for all surgeons beginning at age 65, and this should continue thereafter as part of ongoing professional practice evaluation at least every two years".

Bundy and Williams (2021) believe that, although physician age is an important risk factor for clinical performance issues, it is not the only factor and may not be the most important. Health problems, independent of age, may compromise effectiveness of the medical care provided by a physician across the career span. The authors suggest considering the merits of routine compulsory health screening, including cognitive screening, for all physicians regardless of age. Cognitive testing early in a physician's career would provide a baseline for evaluating cognitive changes over time. The authors anticipate, however, that "the prospect of mandatory health screening over the career span is likely to be met with resistance". Challenges that would complicate screening are similar regardless of whether only senior physicians, or all physicians, are screened. These challenges include "when to begin screening, what screening tests should be implemented, who should conduct the screening, what happens when a screen is positive, and how confidential health information obtained during screening or follow-up evaluation will be protected from employers, credentialing entities or regulatory agencies".

According to Hoffman (2022), "[p]reliminary screening should not be cumbersome. Whichever test or tests is selected and validated for health care providers could be administered online with appropriate safeguards to prevent testing misconduct and maintain confidentiality. If initial testing scores raise concerns, further investigation would need to follow. This could consist of more comprehensive cognitive testing, review of clinical performance, interviews with colleagues, and other measures."

Moutier et al. (2013) summarized data from a conference on the issue of physician aging and its potential impact on clinical performance and quality of care. The conference was held in November 2011 by the Coalition for Physician Enhancement (CPE) and the University of California, San Diego, Physician Assessment and Clinical Education (PACE) Program. Experts in medicine, law and public policy from the United States and Canada discussed the issue and were surveyed on their opinions regarding whether age-based physician screening should be implemented, and if so, what methods are optimal, at what age and interval the screening should be implemented. Of the 110 attendees for the conference, 71 responded to the survey. Fifty-two percent of responders were physicians or other healthcare professionals, 13% were state medical board members, 26% were judges or attorneys, six percent were researchers, 1% were administrator, and 1% self-identified as "other." Not all participants answered all questions. Sixty-two percent of participants responded "yes" to the question about the need for age-based physician screening; 18% responded "Maybe", and 20% responded "No". The numbers of "yes" responses were similar for men and women, for physicians and non-physicians, but were much grater among participants aged 60 years and younger compared to those older than 60 years. Canadians were more likely to respond "yes" (70%) than Americans (58%), and primary care physicians were somewhat more likely to respond "yes" (67%) than specialists (62%). Participants believed that an assessment battery should include assessment of mental and physical health, and a cognitive screen. As to the age at which age-based assessment should begin, 1% believed it should start at age 85 years, 1% - at age 80 years, 8% -at age 75, 45% -at age 70 years, 25% - at age 65 years, 16% - at age 60 years. The authors acknowledged the following limitations of their survey: 1) data were collected after presentations in didactic sessions, which may have influenced responses; 2) predominance of participants from California compared to other regions of the US. A strength of this survey was its bi-national representation.

Waters and Williams (2021) administered questionnaires on later career surgeon performance assessment to an expert panel of 20 experts from thirteen US pediatric institutions. Among the 20 panel members there were 14 division chiefs, a surgical chief responsible for hospital bylaws-medical peer review, three chief legal counsels, and two nurse operating room manager. Of the 15 surgical chiefs, five were under 55 years, six between 56 and 65 years, and four over 65 years. The experts were asked when the assessment should occur, what should be evaluated, by whom, and who should decide regarding actions to be taken based on the result of the assessment. Consensus was reached that age-based assessment should automatically be initiated at age 65 years (>85% support). However, respondents commented that, to address the variability in decline, assessments may need to begin earlier than 65 years. Assessments should also be initiated at a surgeon's self-request (100% support), at the request of a concerned health care professional (90% support), at the request of the chief surgeon (90% support), after an adverse physical or mental health event before return to work (>90% support). Consensus was not reached that assessment should be automatically included as part of any recredentialing cycle (35% support), following an adverse clinical event in a patient (35%), or every 5-10 years following initial certification (50%). Regarding elements of assessment, 90% respondents supported "general evaluation of mental capacity". The questionnaires appear to not include questions regarding what aspects of "mental capacity" should be evaluated. Other elements of assessment for which consensus was reached were surgeons' behavioral health, surgical performance, physical health, peer feedback, surgical mortality, and readmission rates. Consensus was reached that the assessment process should be managed, and a decision regarding actions should be made by a department chief in collaboration with a surgeon-in-chief. The authors of this study acknowledge the following limitations of their study: the panel represents urban hospitals and not rural possibly underserved hospitals with more limited resources; the evaluators (department chiefs and surgeons-in-chief) may be older than 65 years themselves.

9 Grey literature on various topics

9.1 Overview of policies, programs and recommendations concerning cognitive assessment

9.1.1 Components of physician assessment

There are many domains to be assessed to capture a fulsome picture of physician competency. The existing and proposed age-based screening programs of physicians detailed the importance of a broad screening program that included a cognitive assessment alongside an evaluation of personal and family health history, hearing, vision, mental health, emotional wellness and resources, substance abuse/addiction, problem-solving skills, rates of physician error, and peer assessment (American Medical Association, 2018; California Public Protection and Physician Health, 2015; Medical Board of Australia, 2017).

The cognitive function assessment was consistently a deciding factor in physician scoring on existing age-based screening programs. The Driscoll Children's Hospital, the Lifebridge Health Aging Surgeon Program, the UC San Diego Physician Assessment and Clinical Education (PACE) program, the Stanford Health Late Career Practitioner Policy, the Hartford Healthcare Late Career Practitioner Policy and the Yale New Haven Hospital program all include cognitive competency as a core screening criterion of physician competency (Norcross, Perry, Bazzo, & Miller, 2014).

9.1.2 Commonalities across cognitive assessment guidance, including domains of assessment

California Public Protection and Physician Health (CPPPH), an organization formed by the California Society of Addiction Medicine, the California Psychiatric Association, the California Medical Association, and the California Hospital Association, recommend that age-based cognitive assessment programs use a screening instrument such as the MicroCog, the St. Louis University Mental Status (SLUMS) Examination, or the Montreal Cognitive Assessment (California Public Protection and Physician Health, 2015). Should a cognitive assessment program not rely on a screening instrument, California Public Protection and Physician Health has proposed alternative methods of cognitive assessment which should be used in various combinations. This could include peer evaluations at regular intervals, peer observation, and physical tests or examinations at a regular interval (California Public Protection and Physician Health, 2015). The Medical Board of Australia (2017) mentioned that cognitive domains such as processing speed, problem-solving abilities and fluid intelligence may be particularly vulnerable to age-based cognitive decline. The American Medical Association (2015) listed cognitive factors associated with aging that may impact the non-analytical approaches and the analytical processing abilities of practising physicians. These factors should be assessed on a cognitive screening, including:

- Decreasing ability to store and process information,
- Decreasing working memory,
- Decreasing processing speed,
- Decreasing ability to disregard irrelevant information and inhibit inappropriate responses,

- Increasing order bias, and the
- Increasing tendency to be biased by personal experience.

9.2 Rationale and justification for age-based screening provided by professional organizations

The American Medical Association (American Medical Association, 2018, 2021) describes mandated retirement age for physicians in Russia and China ((60 years for men and 55 years for women); however, the AMA states that there is no mandatory retirement for physicians in most countries. The American Medical Association (2015) and California Public Protection and Physician Health (2015) refer to the mandatory screening programs and/or mandatory retirement policies in many industries outside of healthcare, including law enforcement, aviation and public transportation. Age-based mandatory retirement exists in many career fields in the United States of America. Pilots must retire at age 65, age 56 for air traffic controllers, and 57 for FBI agents (American Medical Association, 2015). These industries, like healthcare, have a direct correlation between employee ability and public health and safety (California Public Protection and Physician Health, 2015). California Public Protection and Physician Health (2015) posits that healthcare is similar to fields where mandatory retirement ages currently exist in that employee competency directly impacts public health and safety. California Public Protection and Physician Health (2015) proposes that the appropriate application of age-based testing would provide an additional layer of protection for safe and comprehensive patient care.

The American Medical Association (American Medical Association, 2015, 2018), the Medical Board of Australia (2017), and California Public Protection and Physician Health (2015) pose that age-related cognitive decline may mirror its affects in the general population in the physician population (Medical Board of Australia, 2017). The Medical Board of Australia (2017) went on to clarify that while crystallized intelligence[12] tends to remain stable, fluid intelligence[13] normally declines in mid-adulthood. The American Medical Association (2015) stated that after age 60, performance differences on knowledge examinations may become more apparent. The American Medical Association (2015) went on to explain that most physicians over age 60 will score significantly lower than their younger colleagues on knowledge examinations, however, some physicians over the age of 60 may perform as well as those younger than 40 due to the higher variability among older test-takers.

The American Medical Association included mention of the Ontario Peer Assessment Program which found that "gross deficiencies" in cognitive abilities increase alongside age in physicians, with rates of 9%, 16% and 22% in physicians aged under 49, 50 to 74, and over 75, respectively (American Medical Association, 2015). The Expert Advisory Group on Revalidation by the Medical Board of Australia (2017) included mention of a study by Drag et al. that found 78% of surgeons aged 60-64 performed at equivalent standard to younger colleagues, while only 38% of those 70 and older were able to do so.

The American Medical Association (2015) found that older physicians that are assessed following a referral from a United States physician licensing authority were significantly more likely to be found unsafe for clinical

[12] "Crystallized intelligence, or crystallized abilities, reflects a person's knowledge, such as language skills or knowledge about a particular topic …" (Institute of Medicine, 2015)

[13] "… fluid intelligence, or fluid abilities, is involved in processing current or new information, such as learning to play chess. Fluid abilities reflect a person's capacity to think logically and solve problems in novel situations, and they aid in skill acquisition and learning." (Institute of Medicine, 2015)

practice. The American Medical Association (2015) also found that an analysis of physicians who were in receipt of discipline or license restrictions were found to have deficits in "attention, sequential processing, logical analysis, eye-hand coordination, and verbal and non-verbal learning". The Medical Board of Australia (2017) found that many studies suggest that there is moderate to severe cognitive impairment in over a third of physicians with identified competency concerns. This serves to underscore the importance of screening programs to identify cognitive decline and provide supports in earlier stages of decline (American Medical Association, 2015). The American Medical Association (2015) details that peer reporting of physician incompetency and/or referral to a licensing authority for remediation or assessment often occurred when cognitive decline had already negatively impacted patient safety after the fact. The Medical Board of Australia (2017) reiterates concern for cognitive impairment being discovered only in the more severe stages and calls for increased surveillance and vigilance of cognitive impairment in physicians. The American Medical Association Council on Medical Education states that screening for cognitive decline may help guide the respectful provision of appropriate supports to aging physicians, as well as facilitate physician self-identifying the appropriate time to retire before competency is endangered (American Medical Association, 2015). The American Medical Association states in *Report 5: Competency and the Aging Physician* by the Council on Medical Education Working Group of the AMA that: *"It is the opinion of the Council on Medical Education that physicians should be allowed to remain in practice as long as patient safety is not endangered and that, if needed, remediation should be a supportive, ongoing and proactive process. Self-regulation is an important aspect of medical professionalism, and helping colleagues recognize their declining skills is an important part of self-regulation. Therefore, physicians must develop guidelines/standards for monitoring and assessing both their own and their colleagues' competency. Formal guidelines on the timing and content of testing of competence may be appropriate and may head off a call for mandatory retirement ages or imposition of guidelines by others"* (American Medical Association, 2015)

The American College of Surgeons (ACS) Physician Competency and Health Workgroup 2016 recognized that surgeons are susceptible to age-related decline in cognitive skill. At the same time, surgeons may not be able to recognize deterioration of their cognitive functions and clinical skills with age. The ACS recommended that surgeons should "voluntarily assess their neurocognitive function using confidential online tools" starting at ages 65 to 70. ACS assertion that surgeons have a professional obligation to self-disclose any concerning finding, and limitation of activities may be appropriate (American College of Surgeons, 2016).

Studies reviewed by the American Medical Association (2021) suggest that many physicians "were not clear on their obligation to report a colleague who is impaired or incompetent", and many who are aware of an impaired or incompetent colleague do not report this colleague.

9.3 Screening instruments

In the Final Report of the National Forum on Reducing Risk of Suicide in the Medical Profession organized by the Australian Medical Association, it is stated that the key concepts of cognition in physicians (executive function and judgement) are difficult to assess because current cognitive assessment tools "are benchmarked against general population and we do not have validated instruments for doctors" (Australian Medical Association, 2017).

The CPPPH states that the physician's ability to perform their position adequately is evaluated by the cognitive function assessment (California Public Protection and Physician Health, 2015). The CPPPH states that it is of critical importance that:

1. the cognitive screening is accurately applied to the physician being assessed,
2. the screening instrument used is appropriate for the population,
3. the individual or committee conducting the screening (referred to as the evaluator) is well-versed in the application of the instrument to the population, and
4. the hospital or jurisdictional procedure being followed is appropriate (California Public Protection and Physician Health, 2015).

CPPPH states that the ideal screening instrument used would have published studies conducted with it used on a population of, or similar to, healthcare practitioners (California Public Protection and Physician Health, 2015). The CPPPH elaborates that published studies of the MicroCog were conducted on the general population, which is not comparable to the "*education level, characteristics and abilities to physicians. Therefore, we rely on the evaluator to interpret the results of the testing in a way that takes these factors into consideration rather than using only the norms from the general population*" (California Public Protection and Physician Health, 2015). The CPPPH concludes that as the studied populations are not equivocal to those in which the instrument is being applied to, the evaluator must consider these factors when interpreting the test results, hence the preference for experienced evaluators (California Public Protection and Physician Health, 2015).

Greenfield, the CPPPH, the AMA, and the Medical Board of Australia describe some of the screening instruments that have and are being used in physician assessment, which includes:

- the MicroCog,
- St. Louis University Mental Status (SLUMS) Examination,
- Montreal Cognitive Assessment,
- Cambridge Neuropsychological Test Automated Battery (CANTAB), and the
- Addenbrooke's Cognitive Examination-Revised (ACE-R) (California Public Protection and Physician Health, 2015; Greenfield, 2002; Medical Board of Australia, 2017).

The CPPPH states that the MicroCog screening instrument is used frequently as it is well-known compared to the other instruments and is quick to administer (California Public Protection and Physician Health, 2015). In an opinion piece by Greenfield (2002) in a bulletin for American College of Surgeons, they state that the CANTAB was developed to have increased sensitivity over the MicroCog test, and it can detect subtle cognitive changes. Greenfield states that a normative database of research studies using the CANTAB has been used and validated in over 3,000 individuals aged 4 to 90 (Greenfield, 2002).

9.4 Threshold for decline

The Medical Board of Australia (2017) came to the conclusion that no levels of physician cognitive impairment have been determined at which patient safety is at risk. They elaborate that there are no established guidelines for degree of cognitive impairment that determine a physician to be precluded from the safe practice of medicine (Medical Board of Australia, 2017). There is no threshold for cognitive impairment where a physician is no longer fit to practice medicine in any of the reviewed literature from professional organizations.

Similar conclusions can be found in the Final Report of the Australian National Forum on Reducing Risk of Suicide in the Medical Profession (Australian Medical Association, 2017):

- "There is no evidence to tell us what level of cognitive decline indicates an inability to continue practising medicine."
- "Impact depends on speciality and scope of current practice, including the types of tasks performed versus the type of functional decline."

9.5 Reception of age-based screening policies

The reception of age-based policies for physicians has generally been negative. In 2015, the proposed age-based policy enacted by Stanford received a negative response and was ultimately rejected by the senior faculty members working at the Stanford Hospital and Clinic due to concerns of age-based discrimination (Kaups, 2016). Other cited concerns included a lack of practical, comprehensive and easily used screening tools for testing, and there were additional concerns about the expenses associated with travelling to sites that could provide neurocognitive testing (Kaups, 2016).

The American Medical Association provided the suggestion that physicians 70 and older should have to undergo testing; however, it recanted this statement in 2018 following the Stanford protests (American Medical Association, 2015). The AMA then stated that "*the effect of age on any individual physician's competence can be highly variable. While age is one factor in predicting potential competence, other factors such as practice setting, clinical volume, specialty, and stress also can contribute*" (American Medical Association, 2015).

In 2016, the Yale-New Haven hospital enacted a screen policy asking physicians aged 69 and older to participate in cognitive testing, causing 18 of the 141 clinicians in the hospital to retire or practice under a proctored environment (Khine, 2020). This policy was targeted by a lawsuit from the Equal Employment Opportunity Commission in early 2020, who stated that testing was not "job related and consistent with business necessity", and suggested that other non-discriminatory methods already existed for ensuring competence (T. Powell, 2020).

The Committee on Occupational Health of the American Society of Anesthesiologists (2018) acknowledged that "there is no universally accepted agreement on the role of cognitive testing to assess professional competency among late career physicians". The Committee believes that policies and interventions regarding individual anesthesiologists are more appropriate than "blanket mandatory" testing.

9.6 Physicians' duty to report impaired or incompetent colleagues

Collège des Médecins du Québec (n.d.)

- Clause 119 of the "Code of Ethics of Physicians" of the COLLÈGE DES MÉDECINS DU QUÉBEC: "A physician must report to the Collège any physician, medical student, resident, medical fellow or any person authorized to practise medicine whom he believes to be unfit to practise, incompetent or dishonest, or who has performed acts in contravention of the Professional Code (R.S.Q., c. C-26), Medical Act (R.S.Q., c. M-9) or regulations ensuing therefrom."

College of Physicians and Surgeons of Nova Scotia (2019)

- "When a physician has reasonable grounds to believe that another physician is impaired, incompetent or unethical, there is a professional obligation to report this concern to the College. The obligation arises regardless of whether the physician in question is a patient or a colleague."
- "Physicians must immediately notify the College upon becoming aware that their own health may be affecting their ability to safely practice medicine."
- Evidence of cognitive defects or signs of dementia are listed among other situations that could place patients at risk and that are to be reported.

American College of Surgeons (2016)

- "Colleagues and staff must be able to bring forward and freely express legitimate concerns about a surgeon's performance and apparent age-related decline to group practice, departmental and medical staff, or hospital leadership without fear of retribution."

American Medical Association (2021)

- "AMA policy urges members of the profession to discover and rehabilitate if possible or exclude if necessary, physicians whose practices are incompetent and to fulfill their responsibility to the public and to their profession by reporting to the appropriate authority those physicians who, by being impaired, are in need of help or whose practices are incompetent …"

9.7 Description of established hospital-specific age-based screening programs

Several policies or programs implemented at individual hospitals or health care organizations which involve cognitive assessments of older physicians were identified in the grey literature search. All identified cognitive screening or assessment programs, described below, are based in the United States.

9.7.1 Driscoll Children's Hospital

According to a report by the UC San Diego "PACE" (Physician Assessment and Clinical Education) program entitled "Organizational Portfolio on the Topic of Physician Aging", it is the policy of Driscoll Children's Hospital (a pediatric hospital located in Corpus Christi, Texas) that any practitioner aged 70 years or older requesting clinical privileges be required to undergo a comprehensive examination of physical health and cognitive/technical competencies relevant to their clinical duties (Norcross et al., 2014). No further details were provided regarding the cognitive screening; however, if a practitioner is assessed to be incompetent, then clinical privileges may be modified or reduced (Norcross et al., 2014).

9.7.2 Hartford Healthcare

The Late Career Practitioner Policy at Hartford Healthcare—a healthcare organization based in Hartford, Connecticut—applies to all staff with clinical privileges after the age of 70 (Hartford Healthcare, n.d.). When a Hartford healthcare practitioner reaches age 70, and for each subsequent year thereafter, they must complete an extensive assessment (Hartford Healthcare, n.d.). The assessment includes a comprehensive medical examination (annual physical, neurological, ophthalmological, and neuropsychological examination), as well as a performance evaluation (Ongoing Professional Practice Evaluation) (Hartford Healthcare, n.d.). The neurological examination includes a sensory and motor exam—which tests for both fine motor skills and strength (Hartford Healthcare, n.d.). The neuropsychological/cognitive screening tool used is the MicroCog: Assessment of Cognitive Functioning, one of the few cognitive screening tools that has been specifically studied among aging physicians and is both valid and reliable (Hartford Healthcare, n.d.). If a practitioner screens positive for cognitive abnormalities, more extensive cognitive testing is required, and depending on the severity of the test results, recommendations regarding modifications to clinical practice will be provided to the practitioner (Hartford Healthcare, n.d.).

9.7.3 Lifebridge Health

The Aging Surgeon Program, implemented at Lifebridge Health (a regional health care organization based in northwest Baltimore city and Baltimore County), is a series of assessments that evaluates general health, eyesight, neurocognitive faculties, visual-spatial and fine motor capability of older surgeons over a two-day period (LifeBridge Health, n.d.; Whitehead, 2015). There is no evaluation of medical knowledge, specific surgical skills, or medical interviewing and documentation skills (LifeBridge Health, n.d.).

The program was initiated in 2014 by Dr. Mark Kaltic, a thoracic surgeon at Sinai Hospital (a hospital within the LifeBridge Health organization), after growing concerns of how aging may affect surgeons' abilities to practice medicine effectively and safely (Whitehead, 2015). The program aims to support individualized screening and treatment of physicians, as many can operate well into their seventies (Relias Media, 2020). Further, this program was put into place to avoid an arbitrary age used for screening criterion (LifeBridge Health, n.d.). Simply using an age cut-off could force many surgeons into retirement prior to performance deficiencies, while neglecting to catch early symptoms of aging in physicians that are younger than the required screening age (LifeBridge Health, n.d.). Although the program is intended to evaluate the aging surgeon, there is no specific age limit; however, exclusions include substance abuse and known psychiatric illness (Relias Media, 2020). Surgeons of any sub-specialty are candidates, and the surgeon must understand and speak English (LifeBridge Health, n.d.).

Testing is entirely voluntary, and evaluations may be requested by surgeons themselves, hospitals, or licensing bodies (Relias Media, 2020; Whitehead, 2015). Assessment results, and any accompanying recommendations from the assessors, are provided to the individual who requested the assessment, but are otherwise kept confidential (Whitehead, 2015). Results of the examinations can initiate several outcomes: all privileges may be granted or revoked in full; operating privileges may be granted if assisted by another surgeon; the evaluated surgeon may only be allowed to assist other lead surgeons; operating privileges may be revoked, but other responsibilities (such as mentoring, teaching) may be allowed; privileges may be granted for routine cases only; the evaluated surgeon may undergo a peer review of cases; or, the surgeon may be asked to reduce their work hours (Relias Media, 2020).

9.7.4 Stanford Health

Stanford Health—based at Stanford University in Stanford, California—adopted the Late Career Practitioner Policy in 2012 (Sanford, 2012; Whitehead, 2015). This policy requires older physicians practicing at Stanford Health hospitals and clinics or Lucile Packard Children's Hospital to undergo evaluations every 2 years

(Sanford, 2012; Whitehead, 2015). More specifically, practitioners (including allied health professionals, such as clinical psychologists) aged 74 and half or older must receive a health exam, physical and cognitive screening, and peer assessment of their clinical performance when applying for medical privileges at the hospitals/clinics (Sanford, 2012). After initial examination, subsequent evaluations are to be completed every two years (Sanford, 2012).

According to the Stanford Medicine News Center, The Late Career Practitioner Policy was developed by a medical centre task force, and the intention was to objectively assess competency of aging health care practitioners, as opposed to relying on practitioners' self-assessments (Sanford, 2012). It was also developed in order to replace a similar policy that was enacted one year previously, which applied only to physicians practicing at Packard Children's Hospital (Sanford, 2012). The reasoning behind the task force's decision to require that evaluations begin at age 75 specifically was due to incidence data for Alzheimer's disease—which significantly increases after age 75 (Sanford, 2012).

9.7.5 University of Virginia Health System

A policy at the University of Virginia Health System in Charlottesville, Virginia, requires older clinical staff to undergo tests of competency (Norcross et al., 2014). When a practitioner first applies for clinical privileges after the age of 70, they undergo an initial physical and mental screening, and starting at age 75, these capacity tests occur yearly (Norcross et al., 2014). The assessment consists of comprehensive examination of physical and mental capacity under the Physician Wellness Program; clinical performance is not assessed (Frazer & Tanzer, 2021).

9.7.6 Yale New Haven Hospital

Physicians over the age of 70 years are required to undergo neuropsychological assessment when reapplying for medical credentials at Yale New Haven Hospital in New Haven, Connecticut (Frost, 2020). The neurological screening test was developed by two senior physicians on the hospital's Medical Executive Committee, along with a colleague neuropsychologist in the Department of Psychiatry (Frost, 2020). The test is approximately 45 minutes long, resembles an IQ test, and primarily evaluates problem-solving and decision-making skills, as well as identifying cognitive abnormalities (Frost, 2020). Test results are reviewed and if necessary, recommendations are made by the committee (Frost, 2020). Poor screening results could lead to further testing, proctored medical practice, or resignation and/or retirement (Relias Media, 2020).

Initial results of the new screening program at Yale New Haven Hospital indicated that nearly one in eight of the physicians tests showed cognitive deficits that could potentially affect clinical performance, and therefore patient outcomes (Relias Media, 2020). Of the 141 health care practitioners who were screened when reapplying for credentials, a slight majority (57%) demonstrated no cause for concern (Relias Media, 2020). The remaining practitioners were asked to complete further testing or reapply for credentials on a more regular basis (Relias Media, 2020). Most concerning, however, is that 12.8% of the clinicians tested showed severe cognitive deficits—enough to raise concerns over their ability to practice independently (Relias Media, 2020). As of April 2020, these clinicians with concerning test results were subjected neither to any consequences (i.e., resignation), nor any peer or committee review regarding their abilities (Relias Media, 2020). Finally, in February 2020, the U.S. Equal Employment Opportunity Commission (EEOC) filed a lawsuit against the hospital for the screening policy on the grounds that it was "discriminatory" (Relias Media, 2020).

9.7.7 Scripps Health system

Since 2019, Scripps Health system in San Diego has required screening for cognitive impairment for all physicians aged 70 years or older. This screening is a condition for recredentialing every two years. Physicians take the MicroCog test, after which physical and mental health screens are performed, including tests for hearing and vision, and reviewing issues such as substance use. Physicians fill out a questionnaire asking about their sleep patterns, continuing medical education, patient load, and typical work hours. The screening is done by PAPA, the University of California, San Diego's PACE Aging Physician Assessment program. The testing process takes three to four hours. Poor performance on the MicroCog does not automatically end a physician's credentialing at Scripps but flag them for further evaluation (Kotula, 2019; Steffany, 2022).

9.7.8 Legacy Health

Since April 2017, Legacy Health has required late career practitioners who are age 70 and above to undergo the following examinations (Frazer & Tanzer, 2021; Legacy Health, 2017):

- Assessment of physical capacity by an occupational medicine specialist or a practitioner with similar qualifications, for example a primary care physician.
- Assessment of mental capacity for the privileges requested. This assessment is to be done by a neuropsychologist, or a practitioner with similar qualifications, and includes completion of the MicroCog online testing tool with a follow-up assessment by a Neuropsychologist.

These examinations are required every 2 years after the initial evaluation at age 70 (Frazer & Tanzer, 2021; Legacy Health, 2017). This policy can be utilized for practitioners younger than 70 years for reasonable cause (Legacy Health, 2017).

Practitioners may be required to undergo a focused review of their clinical performance. Such review may be required in the absence of any performance concerns (Legacy Health, 2017).

Findings that may interfere with the provision of safe and effective care under the privileges requested are assessed by the Credentials Committee (Legacy Health, 2017).

9.7.9 Tahoe Forest Health System

In 2017, Tahoe Forest Health System implemented a policy requiring practitioners aged 70 or older who apply for initial appointment to the Medical Staff to complete a physical and mental health evaluation at the U.C. San Diego PACE Aging Physician Assessment (PAPA) (Tahoe Forest Health System, 2017). Physicians who are 70 years or older and who are currently on the Medical Staff are required to complete these assessments every 2 year. The PAPA assessments include review of self-reported health questionnaire, a comprehensive physical examination, MicroCog cognitive screening examination, psychological screening, and, for proceduralists, also dexterity testing. If the PAPA report identifies potential concerns, consultations with a department chair or the Medical Executive Committee are held. If accommodations are required, the practitioner may voluntarily adjust their practice; otherwise, the Corrective Action provisions of the Medical Staff Bylaws may be invoked (Tahoe Forest Health System, 2017).

9.7.10 Other hospital-based programs

Other hospitals or healthcare organizations that have implemented mandatory cognitive screening programs for older physicians that were briefly mentioned in various grey literature sources, but were not described in detail, include Intermountain Healthcare based in Salt Lake City, Utah (T. Powell, 2020); the University of Pittsburgh Medical Center in Pittsburgh, Pennsylvania (Span, 2019); hospitals associated with the University of Pennsylvania (T. Powell, 2020), Nebraska's Children's Hospital (Devi et al., 2021); Cooper University Health Care (Devi et al., 2021); and Temple University Hospital in Philadelphia, Pennsylvania (Span, 2019).

In 2008, Virtua Health in New Jersey implemented a policy requiring cognitive and physical examination of all physicians who reached 70 years, by their own primary care physicians. These assessments must be conducted every two years thereafter. A similar late-career policy was adopted in 2015 by Cooper University Health Care in Camden, New Jersey for physicians aged 72 years or older (Steffany, 2022).

9.8 Description of provincial programs

Overall, the available information on age-based screening for physicians in Canada is sparse. Provinces such as British Columbia, Ontario, Manitoba, Quebec, and Newfoundland and Labrador have implemented age-based screening, however, very little, if any of this screening specifically tests cognitive ability, although specific information on the testing methods used to assess physicians is lacking.

9.8.1 British Columbia

In British Columbia, the College of Physicians and Surgeons of British Columbia (CPSBC) uses risk-based selection to determine which physicians to assess. Physicians under 70 years old may be periodically assessed every one to ten years, while physicians over the age of 70 may be assessed every 3-5 years (CPSBC, n.d.).

The assessment takes place in four parts. The first is the Multi Source Feedback section, which is administered by the Medical Council of Canada and is used to gather data on a physician's ability to act as a communicator, collaborator, and professional. Survey forms are sent to colleagues, non-physician co-workers, and patients to gather data. The second part of the assessment reviews the prescription practices of the physicians based and flags areas of concern such as large dispenses and lack of pharmacovigilance. The third part of the assessment is a review of a sample of the physician's medical records to evaluate recordkeeping and patient care. The fourth and final part of the assessment is a direct interview with the physician to gather further information on their practice, allow for time to address any physician concerns, and highlight opportunities for improvement. After evaluations, physicians are provided with action plans for quality improvement, opportunities for continued professional development, or may be referred to the CPSBC's Inquiry Committee if there are serious concerns in practice (CPSBC, n.d.).

9.8.2 Manitoba

The College of Physicians and Surgeons of Manitoba (CPSM, 2020) describes the protocol for older physician assessment in Manitoba. Physicians over the age of 75 years have routine chart audits every 5 years. The current evidence base for this age triggered quality audit is described in a study, *which was not retrievable*

("The Epidemiology of Competence: Aging as a Risk to Competence in Practising Physicians") and gives six domains affected by aging:

- Physical performance
- Cognitive performance
- Psychological wellness
- Clinical knowledge or performance
- Patient safety
- Medico-legal implications/repercussions

The conclusion of the study is that increasing age has a negative effect on the ability of a physician to practice safely and that age should be considered a risk factor to physician competence and patient safety (CPSM, 2020).

It is planned to decrease the applicable age for the Age Triggered Quality Audit to 70 years no later than 2030 (CPSM, 2020).

9.8.3 Newfoundland and Labrador

The College of Physicians and Surgeons of Newfoundland and Labrador uses a similar process to the CPSO to screen older physicians. All physicians older than 70 will undergo a targeted peer review that can be used to coordinate additional training for these physicians if found necessary (Pong, Lemire, & Tepper, 2007).

9.8.4 Ontario

In Ontario, the College of Physicians and Surgeons of Ontario (CPSO) conducts peer review on all physicians who are older than 70. This is done every five years. If deficiencies in practice are found, specific educational recommendations are made, along with a mentoring program and a targeted peer review subsequently Ontario (CPSO, n.d.-a).

The assessment consists of a review of the quality of patient care, where assessors gain insight into a physician's patient management, taking into account the ability of a physician to take adequate patient history, conduct an examination, order the necessary diagnostic tests, identify a course of action, and monitor the patient. The medical records of patients are also evaluated to determine the quality of care provided by the physician being assessed (CPSO, n.d.-b).

In Ontario, 22% of physicians in the group over 75 years old had gross deficiencies in their practice, 16% in the 50-to-74 year-old group had deficiencies, and 9% of physicians under the age of 49 had deficiencies. 55-and-older physicians had poorer performance than physicians under age 55. There was close to no difference in physicians' performance outcomes between the 55- to-69 year-old group and the group over 70 years old (Bazzo, 2015).

9.8.5 Québec

On January 1, 2019, the Regulation on compulsory continuing education of physicians was implemented in Quebec. All physicians registered by the Collège des Médecins du Québec must meet the requirements of the Regulation that includes an obligation to participate in at least 10 hours of performance evaluation activities during the reference period of five years; the first reference period being from January 1, 2019 to December 31, 2023. This allows the doctor to evaluate his performance through an external review accompanied by feedback, or through a self-assessment activity carried out on an individual or group basis. Several options are available to physicians to accumulate, during a reference period, the required minimum of 10 hours of participation in performance evaluation activities. Performance evaluation activities organized by the College may be via a professional inspection visit or a structured oral interview. Performance assessment activities recognized by a College-accredited body may include: simulation activities with feedback; electronic medical record evaluation; 360° evaluations with feedback; direct observation activities with feedback; annual performance evaluations with feedback; any other assessment activity recognized by an accredited body (Collège des Médecins du Québec, 2022).

In 1999, the College established the Program of administrative follow-up for physicians with physical or mental health problems likely to compromise the professional practice of medicine. The Program consists of increased monitoring of the fitness to practice of these physicians to ensure the protection of the public. A physician's fitness to practice is assessed based on their health status, skill level, clinical effectiveness, and efficiency. The administrative follow-up program is intended for physicians presenting a condition likely to have an impact on the quality of their professional practice, in particular: a mental health problem; certain physical conditions; drug addiction, including alcoholism; a risk of transmission of a blood-borne infection. The follow-up lasts on average two years, but it can be adapted to the evolution of the medical condition. Before any process is initiated, the doctor who is subject to administrative follow-up signs a consent to authorize the College to ask his therapist(s) for periodic reports on his state of health. If necessary, a meeting can be held to decide on the supervision required for his maintenance or his return to the practice of medicine (Collège des Médecins du Québec, 2005).

Given difficulties in establishing the acceptable level of performance for the practice of medicine, a working group was created by the College to develop guidelines for the assessment of cognitive disorders in physicians. The objective is to define the course of action regarding doctors experiencing a reduction in their cognitive functions, in particular by specifying the choice of examinations to be carried out and by setting out guidelines that will allow the professionals who will examine them to decide on their ability to practice medicine (Collège des Médecins du Québec, 2015)[14].

[14] No documents issued by this Working Group have been found.

10 Conclusion

The underlying question for this review was based on whether there is any evidence to suggest an advantage in mandating cognitive assessment for aging physicians. And if so, at what age.

Overall, the scientific findings summarized in the review provide some support both for and against cognitive testing of older physicians.

Implementation of cognitive assessments is a policy decision based on scientific, ethical, legal, and financial considerations. Our review focuses on scientific evidence that may assist in making this decision. Ethical, legal, and financial considerations were beyond the scope of this review. As discussed in earlier sections, cognitive aging is a process of gradual changes in cognition with age. This process is highly variable. The trajectory of change varies for different cognitive functions and domains. Inter-individual variability is explained by factors, such as physical and mental health, lifestyle, diet, socioeconomic factors, and education. Crystallized cognitive abilities that are more dependent on acquired knowledge tend to remain stable whereas fluid cognition that reflects the ability to process new information and solve problems in novel situations, declines with age.

Studies identified for this review provide evidence which is suggestive that cognitive testing of late-career physicians may be useful. Literature collected for this review demonstrates that physicians, despite high education levels and careers that require constant and involved mental aptitude, are not immune to age-related changes in cognitive functioning. On average, cognitive abilities of physicians decline with increasing age, although this occurs about a decade later than in the general population. Decline in physicians' cognitive functioning is seen in age groups 60-65 years or older compared to younger age groups; the decline is most pronounced in age groups 70 years and older. The rate of decline in different functions is variable. Many studies suggest that physicians' competence and performance also decline with age. Cognitive test scores are lower in physicians referred for assessment because of clinical performance or competence concerns than in control physicians with no such concerns. Cognitive functioning and clinical performance among older physicians are highly variable, and it appears that, generally, physicians are not able to accurately self-assess. On the one hand, physicians may continue to practice despite a significant decline in the quality of care provided by them. On the other hand, perceived cognitive decline, although it does not reflect true abilities, may accelerate physicians' decision to retire. Physicians are reluctant to report their colleagues' cognitive problems.

However, there are complex factors that will need to be weighed in the decision-making process for implementing cognitive-based assessment of physicians. Few cognitive assessment tools include normative data for physicians. Ability to practice medicine is driven by complex cognitive aptitudes that may vary across specialties. Specialty-specific modules that are empirically linked to impaired clinical performance are lacking. No longitudinal studies were identified that correlated cognitive function of physicians with their clinical performance, nor were any that determined a level of cognitive decline sufficient to render a physician unfit to practice. Cultural and language factors affect performance on cognitive testing, which should be accounted for because many practicing physicians are graduates from international medical schools.

Methodological issues in studies of age-related cognitive decline include possible biases related to selection and recruitment of study subjects, measures used for cognitive evaluation and possible misclassification of subjects' cognitive status, sample size and statistical power, the effect of using categorical vs. continuous variables, continuous vs. extreme age groups, and possible effect of negative age stereotypes on performance of older adults on cognitive tests.

Several cognitive screening tools have been used, or considered for use, in physicians. Among these tools, MicroCog and ANAM appeared to be more suitable for testing physicians. Most cognitive assessment tools considered in this review were designed to identify progression to dementia or detect MCI. Some experts suggest using tests for individual cognitive function critical to physicians, rather than cognitive screening tools.

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12 APPENDIX 1: Literature search strategy

12.1 Questions 1 to 3

12.1.1 Medline

#	Search terms
1	Intelligence.mp.
2	Intelligence/
3	Intellectual.mp.
4	Mental function*.mp.
5	Mental process*.mp.
6	Mental Processes/
7	Mental abilit*.mp.
8	Cognit*.mp.
9	Cognition/
10	Attention*.mp.
11	exp Attention/
12	Vigilance.mp.
13	Learning.mp.
14	Learning/
15	Memor*.mp.
16	exp Memory/
17	Mental recall.mp.
18	Free recall.mp.
19	Free recall.mp.
20	Problem solving.mp.
21	Problem Solving/
22	Inhibitory control.mp.
23	Inhibition, Psychological/
24	(Inhibition adj2 psychological).mp.
25	Perception.mp.
26	Perception/
27	Executive function*.mp.
28	Executive Function/
29	Executive control*.mp.
30	Reasoning.mp.
31	Neuropsychological.mp.
32	exp Neuropsychological Tests/
33	Neurocognitive.mp.
34	Verbal.mp.
35	Nonverbal.mp.
36	Non-verbal.mp.
37	(Processing adj2 speed).mp.

38	(Information adj2 processing).mp.
39	(Sensory adj2 processing).mp.
40	(Language adj2 processing).mp.
41	Language skill*.mp.
42	(Speech adj2 processing).mp.
43	Visuospatial.mp.
44	Visuo-spatial.mp.
45	Visual-spatial.mp.
46	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45
47	Cognitive aging.mp.
48	Cognitive Aging/
49	(Age-related adj5 function*).mp.
50	(Age-related adj5 declin*).mp.
51	(Age-related adj5 deficit*).mp.
52	(Age-related adj5 change*).mp.
53	(Age-related adj5 impair*).mp.
54	(Age-related adj5 deteriorat*).mp.
55	(Age-related adj5 decrement*).mp.
56	(Age-related adj5 dysfunction*).mp.
57	(Age-related adj5 loss*).mp.
58	(Age-associated adj5 function*).mp.
59	(Age-associated adj5 declin*).mp.
60	(Age-associated adj5 deficit*).mp.
61	(Age-associated adj5 change*).mp.
62	(Age-associated adj5 impair*).mp.
63	(Age-associated adj5 deteriorat*).mp
64	(Age-associated adj5 decrement*).mp.
65	(Age-associated adj5 dysfunction*).mp.
66	(Age-associated adj5 loss*).mp.
67	(Age-dependent adj5 function*).mp.
68	(Age-dependent adj5 declin*).mp.
69	(Age-dependent adj5 deficit*).mp.
70	(Age-dependent adj5 change*).mp.
71	(Age-dependent adj5 impair*).mp.
72	(Age-dependent adj5 deteriorat*).mp.
73	(Age-dependent adj5 decrement*).mp.
74	(Age-dependent adj5 dysfunction*).mp.
75	(Age-dependent adj5 loss*).mp.
76	(Ag?ing adj5 function*).mp.
77	(Ag?ing adj5 declin*).mp.
78	(Ag?ing adj5 deficit*).mp.
79	(Ag?ing adj5 change*).mp.
80	(Ag?ing adj5 impair*).mp.
81	(Ag?ing adj5 deteriorat*).mp.

82	(Ag?ing adj5 decrement*).mp.
83	(Ag?ing adj5 dysfunction*).mp.
84	(Ag?ing adj5 loss*).mp.
85	(Older adj5 function*).mp.
86	(Older adj5 declin*).mp.
87	(Older adj5 deficit*).mp.
88	(Older adj5 change*).mp.
89	(Older adj5 impair*).mp.
90	(Older adj5 deteriorat*).mp.
91	(Older adj5 decrement*).mp.
92	(Older adj5 dysfunction*).mp.
93	(Older adj5 loss*).mp.
94	(Senior* adj5 function*).mp.
95	(Senior* adj5 declin*).mp.
96	(Senior* adj5 deficit*).mp.
97	(Senior* adj5 change*).mp.
98	(Senior* adj5 impair*).mp.
99	(Senior* adj5 deteriorat*).mp.
100	(Senior* adj5 decrement*).mp.
101	(Senior* adj5 dysfunction*).mp.
102	(Senior* adj5 loss*).mp.
103	(Later life adj5 function*).mp.
104	(Later life adj5 declin*).mp.
105	(Later life adj5 deficit*).mp.
106	(Later life adj5 change*).mp.
107	(Later life adj5 impair*).mp.
108	(Later life adj5 deteriorat*).mp.
109	(Later life adj5 decrement*).mp.
110	(Later life adj5 dysfunction*).mp.
111	(Later life adj5 loss*).mp.
112	(Elder* adj5 function*).mp.
113	(Elder* adj5 declin*).mp.
114	(Elder* adj5 deficit*).mp.
115	(Elder* adj5 change*).mp.
116	(Elder* adj5 impair*).mp.
117	(Elder* adj5 deteriorat*).mp.
118	(Elder* adj5 decrement*).mp.
119	(Elder* adj5 dysfunction*).mp.
120	(Elder* adj5 loss*).mp.
121	(Cognit* adj5 trajector*).mp.
122	(Aging/ or Aged/) and (Cognition Disorders/ or Cognitive Dysfunction/ or Dementia/)
123	47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 or 94 or 95 or 96 or 97 or 98 or 99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or

	107 or 108 or 109 or 110 or 111 or 112 or 113 or 114 or 115 or 116 or 117 or 118 or 119 or 120 or 121 or 122
124	46 and 123
125	(Systematic* adj2 review*).mp.
126	"Systematic Review"/
127	Meta-analy*.mp.
128	Metaanaly*.mp.
129	Meta-Analysis/
130	125 or 126 or 127 or 128 or 129
131	124 and 130

12.1.2 Embase

#	**Search terms**
1	Intelligence.mp.
2	Intelligence/
3	Intellectual.mp.
4	Mental process*.mp.
5	Mental function*.mp.
6	mental function/
7	Mental abilit*.mp.
8	Cognit*.mp.
9	cognition/
10	Attention*.mp.
11	exp attention/
12	Vigilance.mp.
13	Learning.mp.
14	learning/
15	Memor*.mp.
16	exp memory/
17	Mental recall.mp.
18	Free recall.mp.
19	Cued recall.mp.
20	Problem solving.mp.
21	problem solving/
22	Inhibitory control.mp.
23	"inhibition (psychology)"/
24	(Inhibition adj2 psycholog*).mp.
25	Perception.mp.
26	perception/
27	Executive function*.mp.
28	executive function/
29	Executive control*.mp.
30	Reasoning.mp.
31	reasoning/
32	Neuropsychological.mp.

33	exp neuropsychological test/
34	Neurocognitive.mp.
35	Verbal.mp.
36	Nonverbal.mp.
37	Non-verbal.mp.
38	(Processing adj2 speed).mp.
39	(Information adj2 processing).mp.
40	(Sensory adj2 processing).mp.
41	(Language adj2 processing).mp.
42	Language skill*.mp.
43	(Speech adj2 processing).mp.
44	Visuospatial.mp.
45	Visuo-spatial.mp.
46	Visual-spatial.mp.
47	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46
48	Cognitive aging.mp.
49	cognitive aging/
50	(Age-related adj5 function*).mp.
51	(Age-related adj5 declin*).mp.
52	(Age-related adj5 deficit*).mp.
53	(Age-related adj5 change*).mp.
54	(Age-related adj5 impair*).mp.
55	(Age-related adj5 deteriorat*).mp.
56	(Age-related adj5 decrement*).mp.
57	(Age-related adj5 dysfunction*).mp.
58	(Age-related adj5 loss*).mp.
59	(Age-associated adj5 function*).mp.
60	(Age-associated adj5 declin*).mp.
61	(Age-associated adj5 deficit*).mp.
62	(Age-associated adj5 change*).mp.
63	(Age-associated adj5 impair*).mp.
64	(Age-associated adj5 deteriorat*).mp
65	(Age-associated adj5 decrement*).mp.
66	(Age-associated adj5 dysfunction*).mp.
67	(Age-associated adj5 loss*).mp.
68	(Age-dependent adj5 function*).mp.
69	(Age-dependent adj5 declin*).mp.
70	(Age-dependent adj5 deficit*).mp.
71	(Age-dependent adj5 change*).mp.
72	(Age-dependent adj5 impair*).mp.
73	(Age-dependent adj5 deteriorat*).mp.
74	(Age-dependent adj5 decrement*).mp.
75	(Age-dependent adj5 dysfunction*).mp.
76	(Age-dependent adj5 loss*).mp.

77	(Ag?ing adj5 function*).mp.
78	(Ag?ing adj5 declin*).mp.
79	(Ag?ing adj5 deficit*).mp.
80	(Ag?ing adj5 change*).mp.
81	(Ag?ing adj5 impair*).mp.
82	(Ag?ing adj5 deteriorat*).mp.
83	(Ag?ing adj5 decrement*).mp.
84	(Ag?ing adj5 dysfunction*).mp.
85	(Ag?ing adj5 loss*).mp.
86	(Older adj5 function*).mp.
87	(Older adj5 declin*).mp.
88	(Older adj5 deficit*).mp.
89	(Older adj5 change*).mp.
90	(Older adj5 impair*).mp.
91	(Older adj5 deteriorat*).mp.
92	(Older adj5 decrement*).mp.
93	(Older adj5 dysfunction*).mp.
94	(Older adj5 loss*).mp.
95	(Senior* adj5 function*).mp.
96	(Senior* adj5 declin*).mp.
97	(Senior* adj5 deficit*).mp.
98	(Senior* adj5 change*).mp.
99	(Senior* adj5 impair*).mp.
100	(Senior* adj5 deteriorat*).mp.
101	(Senior* adj5 decrement*).mp.
102	(Senior* adj5 dysfunction*).mp.
103	(Senior* adj5 loss*).mp.
104	(Later life adj5 function*).mp.
105	(Later life adj5 declin*).mp.
106	(Later life adj5 deficit*).mp.
107	(Later life adj5 change*).mp.
108	(Later life adj5 impair*).mp.
109	(Later life adj5 deteriorat*).mp.
110	(Later life adj5 decrement*).mp.
111	(Later life adj5 dysfunction*).mp.
112	(Later life adj5 loss*).mp.
113	(Elder* adj5 function*).mp.
114	(Elder* adj5 declin*).mp.
115	(Elder* adj5 deficit*).mp.
116	(Elder* adj5 change*).mp.
117	(Elder* adj5 impair*).mp.
118	(Elder* adj5 deteriorat*).mp.
119	(Elder* adj5 decrement*).mp.
120	(Elder* adj5 dysfunction*).mp.
121	(Elder* adj5 loss*).mp.
122	(Cognit* adj5 trajector*).mp.

123	(Aging/ or Aged/) and (cognitive defect/ or mild cognitive impairment/ or dementia/)
124	48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 or 94 or 95 or 96 or 97 or 98 or 99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or 107 or 108 or 109 or 110 or 111 or 112 or 113 or 114 or 115 or 116 or 117 or 118 or 119 or 120 or 121 or 122 or 123
125	47 and 124
126	(Systematic* adj2 review*).mp.
127	"Systematic Review"/
128	Meta-analy*.mp.
129	Metaanaly*.mp.
130	meta analysis/
131	126 or 127 or 128 or 129 or 130
132	125 and 131
133	limit 132 to conference abstracts
134	132 not 133

12.1.3 PsycInfo

#	Search terms
1	Intelligence.mp.
2	Intelligence/
3	fluid intelligence/
4	Intellectual.mp.
5	Mental process*.mp.
6	Cognitive Processes/
7	Cognit*.mp.
8	Cognition/
9	cognitive ability/
10	cognitive flexibility/
11	cognitive assessment/
12	Attention*.mp.
13	exp Attention/
14	Vigilance.mp.
15	Learning.mp.
16	Learning/
17	Memor*.mp.
18	exp memory/
19	Mental recall.mp.
20	Free recall.mp.
21	Cued recall.mp.
22	Problem solving.mp.
23	Problem Solving/
24	Inhibitory control.mp.
25	Response Inhibition/

26	(Inhibition adj2 psychological).mp.
27	Perception.mp.
28	Perception/
29	Executive function*.mp.
30	exp executive function/
31	Executive control*.mp.
32	Reasoning.mp.
33	reasoning/
34	Neuropsychological.mp.
35	exp Neuropsychological Assessment/
36	Neurocognitive.mp.
37	Neurocognition/
38	Verbal.mp.
39	Nonverbal.mp.
40	Non-verbal.mp.
41	(Processing adj2 speed).mp.
42	Cognitive Processing Speed/
43	(Information adj2 processing).mp.
44	(Sensory adj2 processing).mp.
45	(Language adj2 processing).mp.
46	Language skill*.mp.
47	Language skill*.mp.
48	(Speech adj2 processing).mp.
49	Visuospatial.mp.
50	Visuospatial Ability/
51	Visuo-spatial.mp.
52	Visual-spatial.mp.
53	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52
54	Cognitive aging.mp.
55	Cognitive Aging/
56	(Age-related adj5 function*).mp.
57	(Age-related adj5 declin*).mp.
58	(Age-related adj5 deficit*).mp.
59	(Age-related adj5 change*).mp.
60	(Age-related adj5 impair*).mp.
61	(Age-related adj5 deteriorat*).mp.
62	(Age-related adj5 decrement*).mp.
63	(Age-related adj5 dysfunction*).mp.
64	(Age-related adj5 loss*).mp.
65	(Age-associated adj5 function*).mp.
66	(Age-associated adj5 declin*).mp.
67	(Age-associated adj5 deficit*).mp.
68	(Age-associated adj5 change*).mp.

69	(Age-associated adj5 impair*).mp.
70	(Age-associated adj5 deteriorat*).mp
71	(Age-associated adj5 decrement*).mp.
72	(Age-associated adj5 dysfunction*).mp.
73	(Age-associated adj5 loss*).mp.
74	(Age-dependent adj5 function*).mp.
75	(Age-dependent adj5 declin*).mp.
76	(Age-dependent adj5 deficit*).mp.
77	(Age-dependent adj5 change*).mp.
78	(Age-dependent adj5 impair*).mp.
79	(Age-dependent adj5 deteriorat*).mp.
80	(Age-dependent adj5 decrement*).mp.
81	(Age-dependent adj5 dysfunction*).mp.
82	(Age-dependent adj5 loss*).mp.
83	(Ag?ing adj5 function*).mp.
84	(Ag?ing adj5 declin*).mp.
85	(Ag?ing adj5 deficit*).mp.
86	(Ag?ing adj5 change*).mp.
87	(Ag?ing adj5 impair*).mp.
88	(Ag?ing adj5 deteriorat*).mp.
89	(Ag?ing adj5 decrement*).mp.
90	(Ag?ing adj5 dysfunction*).mp.
91	(Ag?ing adj5 loss*).mp.
92	(Older adj5 function*).mp.
93	(Older adj5 declin*).mp.
94	(Older adj5 deficit*).mp.
95	(Older adj5 change*).mp.
96	(Older adj5 impair*).mp.
97	(Older adj5 deteriorat*).mp.
98	(Older adj5 decrement*).mp.
99	(Older adj5 dysfunction*).mp.
100	(Older adj5 loss*).mp.
101	(Senior* adj5 function*).mp.
102	(Senior* adj5 declin*).mp.
103	(Senior* adj5 deficit*).mp.
104	(Senior* adj5 change*).mp.
105	(Senior* adj5 impair*).mp.
106	(Senior* adj5 deteriorat*).mp.
107	(Senior* adj5 decrement*).mp.
108	(Senior* adj5 dysfunction*).mp.
109	(Senior* adj5 loss*).mp.
110	(Later life adj5 function*).mp.
111	(Later life adj5 declin*).mp.
112	(Later life adj5 deficit*).mp.
113	(Later life adj5 change*).mp.
114	(Later life adj5 impair*).mp.

115	(Later life adj5 deteriorat*).mp.
116	(Later life adj5 decrement*).mp.
117	(Later life adj5 dysfunction*).mp.
118	(Later life adj5 loss*).mp.
119	(Elder* adj5 function*).mp.
120	(Elder* adj5 declin*).mp.
121	(Elder* adj5 deficit*).mp.
122	(Elder* adj5 change*).mp.
123	(Elder* adj5 impair*).mp.
124	(Elder* adj5 deteriorat*).mp.
125	(Elder* adj5 decrement*).mp.
126	(Elder* adj5 dysfunction*).mp.
127	(Elder* adj5 loss*).mp.
128	(Cognit* adj5 trajector*).mp.
129	(Aging/ or Older Adulthood/) and (Cognitive Impairment/ or Mild Cognitive Impairment/ or Dementia/)
130	54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 or 94 or 95 or 96 or 97 or 98 or 99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or 107 or 108 or 109 or 110 or 111 or 112 or 113 or 114 or 115 or 116 or 117 or 118 or 119 or 120 or 121 or 122 or 123 or 124 or 125 or 126 or 127 or 128 or 129
131	53 and 130
132	(Systematic* adj2 review*).mp.
133	"Systematic Review"/
134	Meta-analy*.mp.
135	Metaanaly*.mp.
136	meta analysis/
137	132 or 133 or 134 or 135 or 136
138	131 and 137

12.1.4 ERIC

#	**Search terms**
1	Intelligence.mp.
2	Intelligence/
3	Intellectual.mp.
4	Mental process*.mp.
5	Mental function*.mp.
6	Mental abilit*.mp.
7	Cognit*.mp.
8	Cognitive Processes/
9	Attention*.mp.
10	attention/
11	Attention Control/
12	Attention Span/

13	Vigilance.mp.
14	Learning.mp.
15	learning/
16	Memor*.mp.
17	exp memory/
18	Mental recall.mp.
19	"Recall (Psychology)"/
20	Free recall.mp.
21	Cued recall.mp.
22	Problem solving.mp.
23	Problem Solving/
24	Inhibitory control.mp.
25	inhibition/
26	(Inhibition adj2 psychological).mp.
27	Perception.mp.
28	perception/
29	Executive function*.mp.
30	executive function/
31	Executive control*.mp.
32	Reasoning.mp.
33	Abstract Reasoning/
34	Neuropsychological.mp.
35	Neurocognitive.mp.
36	Verbal.mp.
37	Nonverbal.mp.
38	Non-verbal.mp.
39	(Processing adj2 speed).mp.
40	Reaction Time/
41	(Information adj2 processing).mp.
42	(Sensory adj2 processing).mp.
43	sensory integration/
44	(Language adj2 processing).mp.
45	exp language processing/
46	Language skill*.mp.
47	language skills/
48	(Speech adj2 processing).mp.
49	Visuospatial.mp.
50	spatial ability/
51	Visuo-spatial.mp.
52	Visual-spatial.mp.
53	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52
54	Cognitive aging.mp.
55	(Age-related adj5 function*).mp.

56	(Age-related adj5 declin*).mp.
57	(Age-related adj5 deficit*).mp.
58	(Age-related adj5 change*).mp.
59	(Age-related adj5 impair*).mp.
60	(Age-related adj5 deteriorat*).mp.
61	(Age-related adj5 decrement*).mp.
62	(Age-related adj5 dysfunction*).mp.
63	(Age-related adj5 loss*).mp.
64	(Age-associated adj5 function*).mp.
65	(Age-associated adj5 declin*).mp.
66	(Age-associated adj5 deficit*).mp.
67	(Age-associated adj5 change*).mp.
68	(Age-associated adj5 impair*).mp.
69	(Age-associated adj5 deteriorat*).mp
70	(Age-associated adj5 decrement*).mp.
71	(Age-associated adj5 dysfunction*).mp.
72	(Age-associated adj5 loss*).mp.
73	(Age-dependent adj5 function*).mp.
74	(Age-dependent adj5 declin*).mp.
75	(Age-dependent adj5 deficit*).mp.
76	(Age-dependent adj5 change*).mp.
77	(Age-dependent adj5 impair*).mp.
78	(Age-dependent adj5 deteriorat*).mp.
79	(Age-dependent adj5 decrement*).mp.
80	(Age-dependent adj5 dysfunction*).mp.
81	(Age-dependent adj5 loss*).mp.
82	(Ag?ing adj5 function*).mp.
83	(Ag?ing adj5 declin*).mp.
84	(Ag?ing adj5 deficit*).mp.
85	(Ag?ing adj5 change*).mp.
86	(Ag?ing adj5 impair*).mp.
87	(Ag?ing adj5 deteriorat*).mp.
88	(Ag?ing adj5 decrement*).mp.
89	(Ag?ing adj5 dysfunction*).mp.
90	(Ag?ing adj5 loss*).mp.
91	(Older adj5 function*).mp.
92	(Older adj5 declin*).mp.
93	(Older adj5 deficit*).mp.
94	(Older adj5 change*).mp.
95	(Older adj5 impair*).mp.
96	(Older adj5 deteriorat*).mp.
97	(Older adj5 decrement*).mp.
98	(Older adj5 dysfunction*).mp.
99	(Older adj5 loss*).mp.
100	(Senior* adj5 function*).mp.
101	(Senior* adj5 declin*).mp.

102	(Senior* adj5 deficit*).mp.
103	(Senior* adj5 change*).mp.
104	(Senior* adj5 impair*).mp.
105	(Senior* adj5 deteriorat*).mp.
106	(Senior* adj5 decrement*).mp.
107	(Senior* adj5 dysfunction*).mp.
108	(Senior* adj5 loss*).mp.
109	(Later life adj5 function*).mp.
110	(Later life adj5 declin*).mp.
111	(Later life adj5 deficit*).mp.
112	(Later life adj5 change*).mp.
113	(Later life adj5 impair*).mp.
114	(Later life adj5 deteriorat*).mp.
115	(Later life adj5 decrement*).mp.
116	(Later life adj5 dysfunction*).mp.
117	(Later life adj5 loss*).mp.
118	(Elder* adj5 function*).mp.
119	(Elder* adj5 declin*).mp.
120	(Elder* adj5 deficit*).mp.
121	(Elder* adj5 change*).mp.
122	(Elder* adj5 impair*).mp.
123	(Elder* adj5 deteriorat*).mp.
124	(Elder* adj5 decrement*).mp.
125	(Elder* adj5 dysfunction*).mp.
126	(Elder* adj5 loss*).mp.
127	(Cognit* adj5 trajector*).mp.
128	54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 or 94 or 95 or 96 or 97 or 98 or 99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or 107 or 108 or 109 or 110 or 111 or 112 or 113 or 114 or 115 or 116 or 117 or 118 or 119 or 120 or 121 or 122 or 123 or 124 or 125 or 126 or 127
129	53 and 128
130	(Systematic* adj2 review*).mp.
131	Meta-analy*.mp.
132	Metaanaly*.mp.
133	Meta Analysis/
134	130 or 131 or 132 or 133
135	129 and 134

12.1.5 Cochrane

#	**Search terms**
1	Intelligence.mp.
2	Intellectual.mp.
3	Mental process*.mp.

4	Mental function*.mp.
5	Mental abilit*.mp.
6	Cognit*.mp.
7	Attention*.mp.
8	Vigilance.mp.
9	Learning.mp.
10	Memor*.mp.
11	Mental recall.mp.
12	Free recall.mp.
13	Cued recall.mp.
14	Problem solving.mp.
15	Inhibitory control.mp.
16	(Inhibition adj2 psychological).mp.
17	Perception.mp.
18	Executive function*.mp.
19	Executive control*.mp.
20	Reasoning.mp.
21	Neuropsychological.mp.
22	Neurocognitive.mp.
23	Verbal.mp.
24	Nonverbal.mp.
25	Non-verbal.mp.
26	(Processing adj2 speed).mp.
27	Information adj2 processing).mp.
28	(Sensory adj2 processing).mp.
29	(Language adj2 processing).mp.
30	Language skill*.mp.
31	(Speech adj2 processing).mp.
32	Visuospatial.mp.
33	Visuo-spatial.mp.
34	Visual-spatial.mp.
35	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34
36	Cognitive aging.mp.
37	(Age-related adj5 function*).mp.
38	(Age-related adj5 declin*).mp.
39	(Age-related adj5 deficit*).mp.
40	(Age-related adj5 change*).mp.
41	(Age-related adj5 impair*).mp.
42	(Age-related adj5 deteriorat*).mp.
43	(Age-related adj5 decrement*).mp.
44	(Age-related adj5 dysfunction*).mp.
45	(Age-related adj5 loss*).mp.
46	(Age-associated adj5 function*).mp.
47	(Age-associated adj5 declin*).mp.

48	(Age-associated adj5 deficit*).mp.
49	(Age-associated adj5 change*).mp.
50	(Age-associated adj5 impair*).mp.
51	(Age-associated adj5 deteriorat*).mp
52	(Age-associated adj5 decrement*).mp.
53	(Age-associated adj5 dysfunction*).mp.
54	(Age-associated adj5 loss*).mp.
55	(Age-dependent adj5 function*).mp.
56	(Age-dependent adj5 declin*).mp.
57	(Age-dependent adj5 deficit*).mp.
58	(Age-dependent adj5 change*).mp.
59	(Age-dependent adj5 impair*).mp.
60	(Age-dependent adj5 deteriorat*).mp.
61	(Age-dependent adj5 decrement*).mp.
62	(Age-dependent adj5 dysfunction*).mp.
63	(Age-dependent adj5 loss*).mp.
64	(Ag?ing adj5 function*).mp.
65	(Ag?ing adj5 declin*).mp.
66	(Ag?ing adj5 deficit*).mp.
67	(Ag?ing adj5 change*).mp.
68	(Ag?ing adj5 impair*).mp.
69	(Ag?ing adj5 deteriorat*).mp.
70	(Ag?ing adj5 decrement*).mp.
71	(Ag?ing adj5 dysfunction*).mp.
72	(Ag?ing adj5 loss*).mp.
73	(Older adj5 function*).mp.
74	(Older adj5 declin*).mp.
75	(Older adj5 deficit*).mp.
76	(Older adj5 change*).mp.
77	(Older adj5 impair*).mp.
78	(Older adj5 deteriorat*).mp.
79	(Older adj5 decrement*).mp.
80	(Older adj5 dysfunction*).mp.
81	(Older adj5 loss*).mp.
82	(Senior* adj5 function*).mp.
83	(Senior* adj5 declin*).mp.
84	(Senior* adj5 deficit*).mp.
85	(Senior* adj5 change*).mp.
86	(Senior* adj5 impair*).mp.
87	(Senior* adj5 deteriorat*).mp.
88	(Senior* adj5 decrement*).mp.
89	(Senior* adj5 dysfunction*).mp.
90	(Senior* adj5 loss*).mp.
91	(Later life adj5 function*).mp.
92	(Later life adj5 declin*).mp.
93	(Later life adj5 deficit*).mp.

94	(Later life adj5 change*).mp.
95	(Later life adj5 impair*).mp.
96	(Later life adj5 deteriorat*).mp.
97	(Later life adj5 decrement*).mp.
98	(Later life adj5 dysfunction*).mp.
99	(Later life adj5 loss*).mp.
100	(Elder* adj5 function*).mp.
101	(Elder* adj5 declin*).mp.
102	(Elder* adj5 deficit*).mp.
103	(Elder* adj5 change*).mp.
104	(Elder* adj5 impair*).mp.
105	(Elder* adj5 deteriorat*).mp.
106	(Elder* adj5 decrement*).mp.
107	(Elder* adj5 dysfunction*).mp.
108	(Elder* adj5 loss*).mp.
109	(Cognit* adj5 trajector*).mp.
110	36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 or 94 or 95 or 96 or 97 or 98 or 99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or 107 or 108 or 109
111	35 and 110

12.2 Question 4

12.2.1 Medline

#	Search terms
1	(Aging/ or Cognitive Aging/ or Aged/) and exp Physicians/
2	Ag?ing doctor*.mp.
3	Ag?ing physician*.mp.
4	Ag?ing clinician*.mp.
5	(Ag?ing adj2 practitioner*).mp.
6	Aged doctor*.mp.
7	Aged physician*.mp.
8	Aged clinician*.mp.
9	(Aged adj2 practitioner*).mp.
10	Older doctor*.mp.
11	Older physician*.mp.
12	Older clinician*.mp.
13	(Older adj2 practitioner*).mp.
14	Elderly doctor*.mp.
15	Elderly physician*.mp.
16	Elderly clinician*.mp.
17	(Elderly adj2 practitioner*).mp.

18	Senior doctor*.mp.
19	Senior physician*.mp.
20	Senior clinician*.mp.
21	(Senior adj2 practitioner*).mp.
22	(Pre-retirement adj3 doctor*).mp.
23	(Pre-retirement adj3 physician*).mp.
24	(Pre-retirement adj3 clinician*).mp.
25	(Pre-retirement adj3 practitioner*).mp.
26	(Preretirement adj3 doctor*).mp.
27	(Preretirement adj3 physician*).mp.
28	(Preretirement adj3 clinician*).mp.
29	(Preretirement adj3 practitioner*).mp.
30	(Late-career adj3 doctor*).mp.
31	(Late-career adj3 physician*).mp.
32	(Late-career adj3 clinician*).mp.
33	(Late-career adj3 practitioner*).mp.
34	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33
35	Declin*.mp.
36	Disorder*.mp.
37	Impair*.mp.
38	Dysfunction*.mp.
39	Deteriorat*.mp.
40	Decrement*.mp.
41	Deficit*.mp.
42	Dement*.mp.
43	Loss*.mp.
44	Cognition Disorders/
45	Cognitive Dysfunction/
46	Memory Disorders/
47	Neurocognitive Disorders/
48	Dementia/
49	35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48
50	Threshold*.mp.
51	Cutoff.mp.
52	Cut-off.mp.
53	(Fit* adj4 practi#e).mp.
54	(Fit* adj4 dut*).mp.
55	(Fit* adj4 responsibilit*).mp.
56	(Fit* adj4 job).mp.
57	(Fit* adj4 work*).mp.
58	(Fit* adj4 perform*).mp.
59	(Unfit adj4 practi#e).mp.
60	(Unfit adj4 dut*).mp.
61	(Unfit adj4 responsibilit*).mp.
62	(Unfit adj4 job).mp.

63	(Unfit adj4 work*).mp.
64	(Unfit adj4 perform*).mp.
65	(Ability adj4 practi#e).mp.
66	(Ability adj4 dut*).mp.
67	(Ability adj4 responsibilit*).mp.
68	(Ability adj4 job).mp.
69	(Ability adj4 work*).mp.
70	(Ability adj4 perform*).mp.
71	(Inability adj4 practi#e).mp.
72	(Inability adj4 dut*).mp.
73	(Inability adj4 responsibilit*).mp.
74	(Inability adj4 job).mp.
75	(Inability adj4 work*).mp.
76	(Inability adj4 perform*).mp.
77	(Able adj4 practi#e).mp.
78	(Able adj4 dut*).mp.
79	(Able adj4 responsibilit*).mp.
80	(Able adj4 job).mp.
81	(Able adj4 work*).mp.
82	(Able adj4 perform*).mp.
83	(Unable adj4 practi#e).mp.
84	(Unable adj4 dut*).mp.
85	(Unable adj4 responsibilit*).mp.
86	(Unable adj4 job).mp.
87	(Unable adj4 work*).mp.
88	(Unable adj4 perform*).mp.
89	(Capable adj4 practi#e).mp.
90	(Capable adj4 dut*).mp.
91	(Capable adj4 responsibilit*).mp.
92	(Capable adj4 job).mp.
93	(Capable adj4 work*).mp.
94	(Capable adj4 perform*).mp.
95	(Incapable adj4 practi#e).mp.
96	(Incapable adj4 dut*).mp.
97	(Incapable adj4 responsibilit*).mp.
98	(Incapable adj4 job).mp.
99	(Incapable adj4 work*).mp.
100	(Incapable adj4 perform*).mp.
101	Competen*.mp.
102	exp Professional Competence/
103	(Professional* adj2 impair*).mp.
104	exp Professional Impairment/
105	Malpractice.mp.
106	Malpractice/
107	Dyscompeten*.mp.
108	(Work adj2 perform*).mp.

109	Work Performance/
110	(Health care adj2 quality).mp.
111	"Quality of Health Care"/st, sn [Standards, Statistics & Numerical Data]
112	Outcome Assessment, Health Care/st, sn [Standards, Statistics & Numerical Data]
113	Medical Errors/lj, pc [Legislation & Jurisprudence, Prevention & Control]
114	50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 or 94 or 95 or 96 or 97 or 98 or 99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or 107 or 108 or 109 or 110 or 111 or 112 or 113
115	34 and 49 and 114

12.2.2 Embase

#	**Search terms**
1	(aging/ or cognitive aging/ or aged/) and exp physicians/
2	Ag?ing doctor*.mp.
3	Ag?ing physician*.mp.
4	Ag?ing clinician*.mp.
5	(Ag?ing adj2 practitioner*).mp.
6	Aged doctor*.mp.
7	Aged physician*.mp.
8	Aged clinician*.mp.
9	(Aged adj2 practitioner*).mp.
10	Older doctor*.mp.
11	Older physician*.mp.
12	Older clinician*.mp.
13	(Older adj2 practitioner*).mp.
14	Elderly doctor*.mp.
15	Elderly physician*.mp.
16	Elderly clinician*.mp.
17	(Elderly adj2 practitioner*).mp.
18	Senior doctor*.mp.
19	Senior physician*.mp.
20	Senior clinician*.mp.
21	(Senior adj2 practitioner*).mp.
22	(Pre-retirement adj3 doctor*).mp.
23	(Pre-retirement adj3 physician*).mp.
24	(Pre-retirement adj3 clinician*).mp.
25	(Pre-retirement adj3 practitioner*).mp.
26	(Preretirement adj3 doctor*).mp.
27	(Preretirement adj3 physician*).mp.
28	(Preretirement adj3 clinician*).mp.
29	(Preretirement adj3 practitioner*).mp.
30	(Late-career adj3 doctor*).mp.
31	(Late-career adj3 physician*).mp.

32	(Late-career adj3 clinician*).mp.
33	(Late-career adj3 practitioner*).mp.
34	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33
35	cognitive defect/
36	mild cognitive impairment/
37	memory disorder/
38	"disorders of higher cerebral function"/
39	dementia/
40	Declin*.mp.
41	Disorder*.mp.
42	Impair*.mp.
43	Dysfunction*.mp.
44	Deteriorat*.mp.
45	Decrement*.mp.
46	Deficit*.mp.
47	Dement*.mp.
48	Loss*.mp.
49	35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48
50	Threshold*.mp.
51	Cutoff.mp.
52	Cut-off.mp.
53	(Fit* adj4 practi#e).mp.
54	(Fit* adj4 dut*).mp.
55	(Fit* adj4 responsibilit*).mp.
56	(Fit* adj4 job).mp.
57	(Fit* adj4 work*).mp.
58	(Fit* adj4 perform*).mp.
59	(Unfit adj4 practi#e).mp.
60	(Unfit adj4 dut*).mp.
61	(Unfit adj4 responsibilit*).mp.
62	(Unfit adj4 job).mp.
63	(Unfit adj4 work*).mp.
64	(Unfit adj4 perform*).mp.
65	(Ability adj4 practi#e).mp.
66	(Ability adj4 dut*).mp.
67	(Ability adj4 responsibilit*).mp.
68	(Ability adj4 job).mp.
69	(Ability adj4 work*).mp.
70	(Ability adj4 perform*).mp.
71	(Inability adj4 practi#e).mp.
72	(Inability adj4 dut*).mp.
73	(Inability adj4 responsibilit*).mp.
74	(Inability adj4 job).mp.
75	(Inability adj4 work*).mp.
76	(Inability adj4 perform*).mp.

77	(Able adj4 practi#e).mp.
78	(Able adj4 dut*).mp.
79	(Able adj4 responsibilit*).mp.
80	(Able adj4 job).mp.
81	(Able adj4 work*).mp.
82	(Able adj4 perform*).mp.
83	(Unable adj4 practi#e).mp.
84	(Unable adj4 dut*).mp.
85	(Unable adj4 responsibilit*).mp.
86	(Unable adj4 job).mp.
87	(Unable adj4 work*).mp.
88	(Unable adj4 perform*).mp.
89	(Capable adj4 practi#e).mp.
90	(Capable adj4 dut*).mp.
91	(Capable adj4 responsibilit*).mp.
92	(Capable adj4 job).mp.
93	(Capable adj4 work*).mp.
94	(Capable adj4 perform*).mp.
95	(Incapable adj4 practi#e).mp.
96	(Incapable adj4 dut*).mp.
97	(Incapable adj4 responsibilit*).mp.
98	(Incapable adj4 job).mp.
99	(Incapable adj4 work*).mp.
100	(Incapable adj4 perform*).mp.
101	competence/
102	Competen*.mp.
103	professional competence/
104	clinical competence/
105	Dyscompeten*.mp.
106	Professional impairment.mp.
107	Malpractice.mp.
108	malpractice/
109	(job adj2 perform*).mp.
110	job performance/
111	(Health care adj2 quality).mp.
112	health care quality/
113	medical error/pc [Prevention]
114	50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 or 94 or 95 or 96 or 97 or 98 or 99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or 107 or 108 or 109 or 110 or 111 or 112 or 113
115	34 and 49 and 114
116	limit 115 to conference abstracts
117	115 not 116

12.2.3 PsycInfo

#	Search terms
1	(Aging/ or Cognitive Aging/ or Older Adulthood/) and exp Physicians/
2	Ag?ing doctor*.mp.
3	Ag?ing physician*.mp.
4	Ag?ing clinician*.mp.
5	(Ag?ing adj2 practitioner*).mp.
6	Aged doctor*.mp.
7	Aged physician*.mp.
8	Aged clinician*.mp.
9	(Aged adj2 practitioner*).mp.
10	Older doctor*.mp.
11	Older physician*.mp.
12	Older clinician*.mp.
13	(Older adj2 practitioner*).mp.
14	Elderly doctor*.mp.
15	Elderly physician*.mp.
16	Elderly clinician*.mp.
17	(Elderly adj2 practitioner*).mp.
18	Senior doctor*.mp.
19	Senior physician*.mp.
20	Senior clinician*.mp.
21	(Senior adj2 practitioner*).mp.
22	(Pre-retirement adj3 doctor*).mp.
23	(Pre-retirement adj3 physician*).mp.
24	(Pre-retirement adj3 clinician*).mp.
25	(Pre-retirement adj3 practitioner*).mp.
26	(Preretirement adj3 doctor*).mp.
27	(Preretirement adj3 physician*).mp.
28	(Preretirement adj3 clinician*).mp.
29	(Preretirement adj3 practitioner*).mp.
30	(Late-career adj3 doctor*).mp.
31	(Late-career adj3 physician*).mp.
32	(Late-career adj3 clinician*).mp.
33	(Late-career adj3 practitioner*).mp.
34	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33
35	Declin*.mp.
36	Disorder*.mp.
37	Neurocognitive Disorders/
38	memory disorders/
39	Impair*.mp.
40	Cognitive Impairment/
41	Dysfunction*.mp.
42	Deteriorat*.mp.

43	Decrement*.mp.
44	Deficit*.mp.
45	Dement*.mp.
46	Dementia/
47	Loss*.mp.
48	35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47
49	Competen*.mp.
50	Professional standard*.mp.
51	professional standards/
52	Dyscompeten*.mp.
53	(Professional* adj2 impair*).mp.
54	Impaired Professionals/
55	Malpractice.mp.
56	Professional Liability.mp.
57	Professional Liability/
58	Job performance.mp.
59	Job performance/
60	(Health care adj2 quality).mp.
61	"Quality of Care"/
62	(Treatment adj2 outcome*).mp.
63	treatment outcomes/
64	Threshold*.mp.
65	Cutoff.mp.
66	Cut-off.mp.
67	(Fit* adj4 practi#e).mp.
68	(Fit* adj4 dut*).mp.
69	(Fit* adj4 responsibilit*).mp.
70	(Fit* adj4 job).mp.
71	(Fit* adj4 work*).mp.
72	(Fit* adj4 perform*).mp.
73	(Unfit adj4 practi#e).mp.
74	(Unfit adj4 dut*).mp.
75	(Unfit adj4 responsibilit*).mp.
76	(Unfit adj4 job).mp.
77	(Unfit adj4 work*).mp.
78	(Unfit adj4 perform*).mp.
79	(Ability adj4 practi#e).mp.
80	(Ability adj4 dut*).mp.
81	(Ability adj4 responsibilit*).mp.
82	(Ability adj4 job).mp.
83	(Ability adj4 work*).mp.
84	(Ability adj4 perform*).mp.
85	(Inability adj4 practi#e).mp.
86	(Inability adj4 dut*).mp.
87	(Inability adj4 responsibilit*).mp.
88	(Inability adj4 job).mp.

89	(Inability adj4 work*).mp.
90	(Inability adj4 perform*).mp.
91	(Able adj4 practi#e).mp.
92	(Able adj4 dut*).mp.
93	(Able adj4 responsibilit*).mp.
94	(Able adj4 job).mp.
95	(Able adj4 work*).mp.
96	(Able adj4 perform*).mp.
97	(Unable adj4 practi#e).mp.
98	(Unable adj4 dut*).mp.
99	(Unable adj4 responsibilit*).mp.
100	(Unable adj4 job).mp.
101	(Unable adj4 work*).mp.
102	(Unable adj4 perform*).mp.
103	(Capable adj4 practi#e).mp.
104	(Capable adj4 dut*).mp.
105	(Capable adj4 responsibilit*).mp.
106	(Capable adj4 job).mp.
107	(Capable adj4 work*).mp.
108	(Capable adj4 perform*).mp.
109	(Incapable adj4 practi#e).mp.
110	(Incapable adj4 dut*).mp.
111	(Incapable adj4 responsibilit*).mp.
112	(Incapable adj4 job).mp.
113	(Incapable adj4 work*).mp.
114	(Incapable adj4 perform*).mp.
115	49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 or 94 or 95 or 96 or 97 or 98 or 99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or 107 or 108 or 109 or 110 or 111 or 112 or 113 or 114
116	34 and 48 and 115

12.2.4 ERIC

#	Search terms
1	(Older Adults/ or "aging (individuals)"/) and Physicians/
2	Ag?ing doctor*.mp.
3	Ag?ing physician*.mp.
4	Ag?ing clinician*.mp.
5	(Ag?ing adj2 practitioner*).mp.
6	Aged doctor*.mp.
7	Aged physician*.mp.
8	Aged clinician*.mp.
9	(Aged adj2 practitioner*).mp.
10	Older doctor*.mp.

11	Older physician*.mp.
12	Older clinician*.mp.
13	(Older adj2 practitioner*).mp.
14	Elderly doctor*.mp.
15	Elderly physician*.mp.
16	Elderly clinician*.mp.
17	(Elderly adj2 practitioner*).mp.
18	Senior doctor*.mp.
19	Senior physician*.mp.
20	Senior clinician*.mp.
21	(Senior adj2 practitioner*).mp.
22	(Pre-retirement adj3 doctor*).mp.
23	(Pre-retirement adj3 physician*).mp.
24	(Pre-retirement adj3 clinician*).mp.
25	(Pre-retirement adj3 practitioner*).mp.
26	(Preretirement adj3 doctor*).mp.
27	(Preretirement adj3 physician*).mp.
28	(Preretirement adj3 clinician*).mp.
29	(Preretirement adj3 practitioner*).mp.
30	(Late-career adj3 doctor*).mp.
31	(Late-career adj3 physician*).mp.
32	(Late-career adj3 clinician*).mp.
33	(Late-career adj3 practitioner*).mp.
34	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33
35	Declin*.mp.
36	Disorder*.mp.
37	Impair*.mp.
38	Dysfunction*.mp.
39	Deteriorat*.mp.
40	Decrement*.mp.
41	Deficit*.mp.
42	Dement*.mp.
43	Dementia/
44	35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43
45	Competen*.mp.
46	competence/
47	Dyscompeten*.mp.
48	(Professional* adj2 impair*).mp.
49	Malpractice.mp.
50	Performance.mp.
51	Job performance/ or Job Skills/
52	(Health care adj2 quality).mp.
53	Threshold*.mp.
54	Cutoff.mp.
55	Cut-off.mp.

56	Cutting Scores/
57	(Fit* adj4 practi#e).mp.
58	(Fit* adj4 dut*).mp.
59	(Fit* adj4 responsibilit*).mp.
60	(Fit* adj4 job).mp.
61	(Fit* adj4 work*).mp.
62	(Fit* adj4 perform*).mp.
63	(Unfit adj4 practi#e).mp.
64	(Unfit adj4 dut*).mp.
65	(Unfit adj4 responsibilit*).mp.
66	(Unfit adj4 job).mp.
67	(Unfit adj4 work*).mp.
68	(Unfit adj4 perform*).mp.
69	(Ability adj4 practi#e).mp.
70	(Ability adj4 dut*).mp.
71	(Ability adj4 responsibilit*).mp.
72	(Ability adj4 job).mp.
73	(Ability adj4 work*).mp.
74	(Ability adj4 perform*).mp.
75	(Inability adj4 practi#e).mp.
76	(Inability adj4 dut*).mp.
77	(Inability adj4 responsibilit*).mp.
78	(Inability adj4 job).mp.
79	(Inability adj4 work*).mp.
80	(Inability adj4 perform*).mp.
81	(Able adj4 practi#e).mp.
82	(Able adj4 dut*).mp.
83	(Able adj4 responsibilit*).mp.
84	(Able adj4 job).mp.
85	(Able adj4 work*).mp.
86	(Able adj4 perform*).mp.
87	(Unable adj4 practi#e).mp.
88	(Unable adj4 dut*).mp.
89	(Unable adj4 responsibilit*).mp.
90	(Unable adj4 job).mp.
91	(Unable adj4 work*).mp.
92	(Unable adj4 perform*).mp.
93	(Capable adj4 practi#e).mp.
94	(Capable adj4 dut*).mp.
95	(Capable adj4 responsibilit*).mp.
96	(Capable adj4 job).mp.
97	(Capable adj4 work*).mp.
98	(Capable adj4 perform*).mp.
99	(Incapable adj4 practi#e).mp.
100	(Incapable adj4 dut*).mp.
101	(Incapable adj4 responsibilit*).mp.

102	(Incapable adj4 job).mp.
103	(Incapable adj4 work*).mp.
104	(Incapable adj4 perform*).mp.
105	45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 or 94 or 95 or 96 or 97 or 98 or 99 or 100 or 101 or 102 or 103 or 104
106	34 and 44 and 105

12.2.5 Cochrane

#	**Search terms**
1	Ag?ing doctor*.mp.
2	Ag?ing physician*.mp.
3	Ag?ing clinician*.mp.
4	(Ag?ing adj2 practitioner*).mp.
5	Aged doctor*.mp.
6	Aged physician*.mp.
7	Aged clinician*.mp.
8	(Aged adj2 practitioner*).mp.
9	Older doctor*.mp.
10	Older physician*.mp.
11	Older clinician*.mp.
12	(Older adj2 practitioner*).mp.
13	Elderly doctor*.mp.
14	Elderly physician*.mp.
15	Elderly clinician*.mp.
16	(Elderly adj2 practitioner*).mp.
17	Senior doctor*.mp.
18	Senior physician*.mp.
19	Senior clinician*.mp.
20	(Senior adj2 practitioner*).mp.
21	(Pre-retirement adj3 doctor*).mp.
22	(Pre-retirement adj3 physician*).mp.
23	(Pre-retirement adj3 clinician*).mp.
24	(Pre-retirement adj3 practitioner*).mp.
25	(Preretirement adj3 doctor*).mp.
26	(Preretirement adj3 physician*).mp.
27	(Preretirement adj3 clinician*).mp.
28	(Preretirement adj3 practitioner*).mp.
29	(Late-career adj3 doctor*).mp.
30	(Late-career adj3 physician*).mp.
31	(Late-career adj3 clinician*).mp.
32	(Late-career adj3 practitioner*).mp.
33	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32

13 APPENDIX 2: Eligibility criteria

13.1 Questions 1 to 3

Include	Exclude
Availability of full text	
Available	Unavailable
Study/Document Type	
○ Peer-reviewed literature ○ Systematic reviews and meta-analyses ○ Most recent update of a systematic review (if consecutive systematic reviews on the same subject by the same research team are available)	○ Grey literature ○ Primary studies ○ News articles, narrative reviews, editorials, conference abstracts, research protocols ○ Previous systematic reviews if updates are available
Publication Date	
○ No restrictions	○ None
Publication Language	
○ All languages	○ None
Populations/Subjects	
○ Humans ○ Population-based studies that include older adults (approximately over 50)	○ Animals ○ Populations -based studies that include only younger subjects ○ Studies of clinical populations (including dementia) ○ Studies of irrelevant populations, such as athletes
Settings	
○ Community, ambulatory care, primary care	○ Institutions, hospitals
Outcome	
○ Cognitive functioning/status ○ Decline in cognitive functions associated with “normal” aging ○ Objective measures of cognitive functions	○ Other functions (e.g., motor) ○ Pathological aging ○ Subjective complaints or subjective/self-reported cognition/cognitive decline ○ Mechanistic studies (e.g., neuroimaging, histopathological results) ○
Criterion specific to Question 3 (factors that interact with age on the cognitive decline)	
•	○ Systematic reviews and meta-analyses that include only clinical trials/intervention studies of prescribed pharmacologic or non-

	pharmacologic interventions, such as cognitive exercise, to prevent or slow-down cognitive decline

13.2 Question 4

- Population: Includes older physicians
- Independent variable: Cognitive function measure
- Dependent variable: Performance or competence measure
- Publication type: Original studies and systematic reviews

14 APPENDIX 3: Summary of characteristics of systematic reviews

14.1 Cognitive domains impacted by age (Question 1)

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
Cervera-Crespo 2017 **Objective** Cognitive aging is commonly associated with a decrease in executive functioning (EF). A specific component of EF, semantic inhibition, is addressed in the present study, which presents a meta-analytic review of the literature that has evaluated the performance on the Hayling Sentence Completion test in young and older	**Databases searched** • Web of Science • PsyINFO • PsychARTICLE • MedLine **Dates searched** • Inception - NR[15] **Supplementary searches** • Google Scholar • Bibliographies of included studies • The indexes of the journals that publish most of the papers in the field	**Inclusion criteria** • The study had to be published in a peer-reviewed journal. • The study had to include a control group of young participants and one or more groups of older participants over 60 years of age with no cognitive, neurological, and psychiatric disorders, drug or alcohol addiction, and/or sensory impairment. The study could include additional groups of older participants, such as a group with some type of dementia, but the data corresponding to these	**Cognitive functions and/or abilities assessed** • Semantic inhibition (part of executive functioning) "Inhibition can be defined as a process that suppresses irrelevant information that interferes with carrying out the task in progress (the task the individual is currently doing)." **Tests and/or methods of outcome assessment** • Hayling Sentence Completion test "The tasks used in this test are based on the SAS [Supervisory Attentional System] theoretical framework which proposes that two cognitive processes control our actions and thoughts. One	<u>Mean response time (RT) in the Automatic section (10 data sets)</u> • Hedges's g = 0.81 (95% CI: 0.35, 1.27); variance 0.06 • Heterogeneity: Q(9)=78.12; p<0.01; I2=88.48%) <u>Mean RT in the Inhibition section (12 data sets)</u> • Hedges's g = 0.98 (95% CI: 0.52, 1.44); variance 0.06 • Heterogeneity: (Q(11) = 106.06, p<0.001); I2=89.62% ["Because higher RTs on the Hayling test indicate worse performance, a positive effect size (Hedges' g) indicates a disadvantage for the older group whereas negative effect sizes show a disadvantage for the younger sample."]

[15] It is stated that "[n]o limits were applied regarding publication dates"; the date of literature search or the date up to which the literature is covered are not reported.

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
groups of individuals in order to assess the magnitude of the age effect	**Number of studies included** • 11 studies	groups were not included in the present analysis. • The study had to report at least one of the four measures from the Hayling test. • The study had to report means and standard deviations (SDs) for at least one of the Hayling measures, or other statistics convertible to effect size Cohen's d (and Hedges' g), such as t-tests or univariate F-tests. In addition, the way the scores were calculated had to be clearly explained in the article. **Exclusion criteria** • NR	of them is responsible for the routine everyday tasks, and the other operates in non-routine more challenging tasks. In the Hayling test, the individual is presented with 30 sentences where the last word is missing. In the first 15 sentences (Automatic section), the word is strongly cued by the preceding context, and the individual has to complete the sentence by producing the missing word (e.g., in the sentence 'This man has travelled everywhere around the…', the correct response would be 'world'). In the next 15 sentences (Inhibition section), a word that makes no sense in the sentence context or is unrelated to the target word must be given by the individual. For instance, for the sentence 'Most sharks attack very close to the…', the participant could give the word 'table'. Thus, in order to complete the sentence, the individual has to inhibit the automatic response coast and	<u>Error scores in the Automatic section (7 datasets)</u> • Hedges's g = 0.13 (95% CI: -0.20, 0.46); variance 0.03 • Heterogeneity: Q(6)=17.23, p<0.05; I2=65.16% <u>Error scores in the Inhibition section (14 datasets)</u> • Hedges's g = 0.55 (95% CI: 0.36-0.74); variance 0.01 • Heterogeneity: Q(13)=26.64, p<0.01; I2 = 51.21%. <u>Comparison of the effect sizes for the Automatic and Inhibition conditions of the Hayling Test</u> • Response time: Q between(1)=0.30, p=0.58; Q within(20)=184.18, p<0.01 ["no significant differences between Automatic and Inhibition conditions"] • Error scores: Q between(1)=14.36, p<0.01; Q within (19)=43.87, p<0.01 ["…the differences between Automatic and Inhibition conditions were significant."]

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
			generate a new unrelated word."	**Conclusion** • "The results revealed large age effects for response latencies in both the Automatic (Hedges' g = 0.81) and Inhibitory conditions (Hedges' g = 0.98), though the latter two effect sizes did not differ from each other." • "In contrast, analysis of errors revealed a significant difference between the small effect seen in the Automatic condition (Hedges' g = 0.13) relative to the moderate effect seen in the Inhibition condition (Hedges' g = 0.55)." • "These results may be important for a better understanding of the inhibitory functioning in elderly individuals, although they should be interpreted with caution because of the limited number of studies in the literature to date."
Vallesi 2021 **Objective** Meta-analytically comparing	**Databases searched** • PubMed • PsycINFO • Scopus **Dates searched**	**Inclusion criteria** • Only studies with healthy participants—without any psychiatric or neurological disorders	**Cognitive functions and/or abilities assessed** • Sustained attention **Tests and/or methods of outcome assessment**	<u>Reaction time (ms) on go trials</u> • Hedges' g=1, SE=0.13; 95% CI: 0.72, 1.27; 95% prediction interval 0.03, 1.96; Z=7.58, two-tailed p<0.0001

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
performance on the go/no-go Sustained Attention to Response Task (SART) in younger and older adults.	• Inception – 20 December 2020. **Supplementary searches** • Bibliographies of included studies **Number of studies included** • 12 studies.	• Studies that used paradigms that adhere to the main parameters of the Sustained Attention to Response Task (SART; Robertson et al., 1997), such as the presence of a single no-go trial type, random or quasirandom presentation of stimuli, a higher proportion of go trials (i.e., 70%–95%) than no-go trials (i.e., 5%–30%) and instructions emphasizing equally speed and accuracy. • Only studies with a lower percentage of no-go than go were chosen to reflect the criteria identified in Mackworth's (1956) review about the nature of classic vigilance tests. • Inclusion of healthy samples for younger (about 18–35 years old) and older adults (60 years old and over). • Enough statistical information, such as means or medians, standard	• Sustained Attention to Response Task (SART) [“The original SART introduced by Robertson et al. (1997) is a no-go task with a quasirandom presentation of digits from 1 to 9, in which the participant has to respond to all the digits except for 3, which is the no-go target. Digits are presented for 250 ms, followed by a 900-ms mask. The task takes about 4 minutes. The no-go trials represent only 11% of total trials, in order to favour an automated response to go trials. Hence … the SART requires one to withhold the response to targets and to respond to nontargets.”]	• “… evidence of high heterogeneity, both in terms of proportion across the observed variance (= 75.97%) and in terms of absolute value (T = .44), but the overall result can be considered anyway robust.” <u>Post-error slowing (PES) on go trials (ms) [“the prolonged RT that is observed after the commission of an error”]</u> • Hedges’ g=0.79; SE=0.07; 95% CI: 0.60, 0.99], 95% prediction interval 0.60, 0.99; Z=11.48, two-tailed p<0.0001 • The heterogeneity proportion was null (= .00%), like the estimated standard deviations of true effects around the mean effect (T =.00).” <u>Accuracy on go trials</u> • Hedges’ g=-0.18; SE=0.17; 95% CI: -0.56, 0.19], 95% prediction interval -1.36, 1; Z=-1.06, two-tailed p=0.287 • “… evidence of high heterogeneity (= 83.30%, T = .51)”

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
		deviations (SD) or ranges, separately for the younger and older adults of the whole sample, or t or F, in order to calculate the differential effect size and perform the meta-analysis. • No restriction on publication date. • English language publications only. **Exclusion criteria** • History of neurological and psychiatric diseases. • Uncorrected visual impairment. • Presence of cognitive impairment.		<u>Accuracy on no-go trials</u> • Hedges' g =0.59; SE=0.13; 95% CI: 0.32, 0.85; 95% prediction interval -0.37, 1.55; Z=4.69, two-tailed p<0.0001) • "The heterogeneity proportion was high (=76.77%) and the estimated standard deviation of true effect sizes was also considerable (T = .44)." **Conclusion** • "Results showed that older adults were slower than younger adults on go trials (g = 1, 95% CI [.72, 1.27]) and more accurate than younger adults on no-go trials (g= .59, 95%CI [.32, .85])." • "Older adults were slower after a no-go error than younger adults (g = .79, 95% CI [.60, .99])." • "These results are compatible with an age-related processing speed deficit, mostly suggested by longer go RTs, but also with an increased preference for a prudent strategy, as demonstrated by fewer no-go

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
				errors and greater post error slowing in older adults." • "An inhibitory deficit account could not explain these findings, as older adults actually outperformed younger adults by producing fewer false alarms to no-go stimuli." • "These findings point to a more prudent strategy when using attentional resources in aging that allows reducing the false-alarm rate in tasks producing a tendency for automatic responding."
Fusi 2020 **Objective** To more consistently summarize and interpret evidence about divergent thinking (DT) as an indicator of creative potential, a predictor of creative achievement, and an indicator of cognitive	**Databases searched** • PubMed • Scopus • PsychINFO **Dates searched** • NR-March 06, 2019 **Supplementary searches** • Cross-references of the selected studies were also considered to identify possible	**Inclusion criteria** • Full-text journal article published in English • Only articles concerning healthy older adults (>50 years old) • Assessed DT abilities in older adults by comparing different age groups. • Employed a specific DT psychometric task through a behavioral procedure. **Exclusion criteria**	**Cognitive functions and/or abilities assessed** • Divergent thinking (DT) [verbal DT (VDT), figural DT (FDT)] **Tests and/or methods of outcome assessment** ["… the most commonly used instruments include tasks in which people have to produce multiple ideas in response to verbal or figural prompts."] • Verbal DT Tasks • Sounds and images	• Meta-analysis was not conducted. • "Our findings highlight a complex and multi-dimensional, rather than a simple linear relationship between the aging processes and DT performances, especially if the different DT indexes are considered separately." • "We also found that findings from more recent studies suggest that older subjects are able to think as divergently as younger people, particularly in the verbal domain, if no time constraints are imposed and if the workload is not too high."

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
reserve (CR) in healthy elderly.	additional relevant articles. **Number of studies included** 16 studies [	Articles on: • Clinical populations or on young adults, • Neuroimaging • Protocols to enhance DT abilities (i.e., training and/or experimental procedures) • General focus on artistic creativity such as arts, literature, poetry • Reviews or commentaries	• Use of objects (UO) • Consequence (C) • Plot titles (PT) • Associational fluency (AF) • Expressional fluency (EF) • Ideational fluency (IF) • Word fluency (WF) • Consequences (C) • Form A • Word association test (WAT) • Alternative uses task (AUT) (coat hanger and brick) • AUT (brick, pencil, paperclip, toothpick, and a sheet of paper) • Torrance Test for Creative Thinking (TTCT) form A • AUT (eyeglasses, shoes, keys, button, wooden pencil & automobile tire) • AUT (brick and newspaper) • • Figural DT • TTCT (form B) • CIT (creative invention task) • TTCT (form A)	• "… what we argue in this review is that the comparison between studies published so far is sometimes difficult according to the great difference that characterized them." [For example, differences in research design and the sample characteristics, instruments and scoring methods used, data analyses conducted]
Jaroslawska 2019	**Databases searched** • Web of Science • PsycINFO	**Inclusion criteria** • The study contained experiments in which a	**Cognitive functions and/or abilities assessed**	**Meta-analysis of data on accuracy** <u>Single (storage only) performance</u>

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
Objective Comparing younger and older adults' performance on tasks measuring storage alone against those combining storage with concurrent processing of information, while considering the influence of task-related moderator variables.	• Ovid MEDLINE • Embase **Dates searched** • NR to April - May 2017 • Update in November 2018 by searching PsycINFO **Supplementary searches** • Selected studies included in the meta-analysis by Riby et al. (2004) and Verhaeghen et al. (2003). • Articles identified from reference sections • Suggestions from colleagues in the area of working memory and cognitive aging. **Number of studies included** • 45 studies	comparison was made between healthy younger adults (with a mean age of 30 years or younger), and older healthy adults (with a mean age of 60 years and older) • The study compared latencies, accuracy, or both for a storage task under dual task conditions with the corresponding measure of single task performance; and • At least one of the concurrent tasks involved STM storage **Exclusion criteria** • NR	• Effects of processing on storage in working memory ["… holding information in mind when performing a concurrent processing task…"] **Tests and/or methods of outcome assessment** **Storage tasks** • Articulatory suppression • Auditory or visual recognition • Backward digit recall • Binding recognition • Color recognition • Cued digit or letter recall • Delayed matching-to-sample • Delayed recognition task • Digit recall • Digit recognition • Item recognition • Letter 1-back • Letter and number forward recall • Letter and number forward recall and tapping • Letter recall • Letter recognition • Location recognition	• Standardized mean difference (Hedges' g)=0.604 (95% CI: 0.382, 0.825); z= 5.343, p < 0.01; test for heterogeneity: Q(95)=453.624, p<0.01 <u>Dual (storage + processing) performance</u> • Hedges' g=0.638 (95% CI: 0.419, 0.858); z=5.7, p<0.01; test for heterogeneity: Q(134)=627.993, p<0.01 <u>Dual task cost (the difference between storage and storage + processing)</u> • Hedges' g=-0.182 (95% CI: -0.282, -0.082), z=-3.568, p<0.01; test for heterogeneity: Q(134)=316.417, p<0.01 ["The negative sign of this coefficient suggests that the single minus dual task difference is smaller for younger adults relative to older."] <u>The effect of titration of storage task demands - single task</u> • Studies that did not titrate the storage task demands: Hedges' g=0.776 (95% CI: 0.522, 1.03)

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
			• Probed recognition • Self-paced word recall • Shape recognition • Spatial recall • Spatial recall and tapping • Timed word recall • Visual pattern recall • Visual recognition • Visuospatial memory task • Visuospatial recall • Word list recognition • Word recall • Word recognition (in operation span task) **Processing tasks** • Arithmetic • Arithmetic verification • Articulatory suppression • Auditory or visual recognition • Backward counting • Choice RT task • Color naming • Complex RT task • Cued letter recall • Delayed recognition task • Digit recall • Digit reversal	• Studies that adjusted the difficulty of storage task: Hedges' g=0.225 (95% CI: -0.076, 0.526) • Difference between the two effect sizes: -0552 (95% CI: -0.945, -0.158), z=-2.745, p<0.01 <u>The effect of titration of storage task demands -storage + processing performance</u> • Studies that did not titrate: Hedges' g=0.845 (95% CI: 0.577, 1.113) • Studies that titrated: Hedges' g=0.249 (95% CI: -0.065, 0.564) • Difference between the two effect sizes: -0.596 (95% CI: -1.009, -0.182), z=-2.826, p<0.01 • Dual task cost (the difference between storage and storage + processing) for studies that did not titrate: Hedges' g=-0.246 (95% CI: -0.38, -0.113), • Dual task cost for studies that titrated: Hedges' g=-0.111 (95% CI: - 0.274, 0.053) • Difference between the two effect sizes: 0.135 (95% CI: -0.076, 0.346), z= 1.258, p=0.208

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
			• Grip force task • Identity verification • Letter and number sequenced recall • Letter and number sequenced recall and tapping • Letter comparison task • Letter recall at encoding • Letter recall at retrieval • Letter updating • Lexical decisions • Manual box-crossing • Mental rotation • Ordered word recall • Self-paced reading span • Self-paced sentence span • Sentence reading • Sentence verification • Sequence learning • Simple RT task • Simple RT task • Symbol verification • Target detection • Timed reading span • Verbal • Visual categorization • Visual discrimination • Visual target detection • Visuospatial pattern recall	<u>The effect of titration of demands of both storage and processing tasks</u> • The effect of titrating both tasks on age differences in storage + processing performance (relative to not titrating at all): Hedges' g=-0.638 (95% CI: -1.082, -0.195), z=-2.82, p<0.01 • The effect of titrating storage tasks on age differences in storage + processing performance (relative to not titrating at all): Hedges' g=-0.551 (95% CI: -0.997, -0.104), z=- 2.414, p<0.05 • Difference score between storage only and storage + processing—titrate both: 0.114 (95% CI: -0.138, 0.366), z=0.885, p=0.376 • Difference score between storage only and storage + processing—titrate storage only: 0.155 (95% CI: -0.09, 0.4), z=1.242, p=0.214 <u>The effect of domain of the storage task: verbal or nonverbal (pictures, non-linguistic sounds, or shapes)</u>

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
			• Visuospatial tracking • Word reading • Word recall **Titration** • Adaptive • Relative	• Effect size for age differences for verbal storage tasks: 0.553 (95% CI: 0.322, 0.783) • Effect size for age differences for non-verbal storage tasks: 0.859 (955 CI: 0.546, 1.172) • Difference between the two effect sizes: -0.306 (95% CI: -0.569, -0.043), z=-2.28, p<0.05 <u>The effect of domain overlap between the storage and processing tasks on the dual task performance</u> • Effect size for age differences when there was no overlap between the domains of the two tasks: 0.429 (95% CI: 0.199, 0.659) • Effect size for age differences for studies with two verbal tasks: 0.699 (95% CI: 0.468, 0.93) • Effect size for age differences for studies with two non-verbal tasks: 1.371 (95% CI:0.929, 1.813) <u>The effect of domain overlap on age differences in the dual task cost</u> • Effect size for age differences when there was no overlap between the domains of the two

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
				tasks: -0.104 (95% CI: -0.231, 0.022) • Effect size for age differences for studies with two verbal tasks: -0.271 (95% CI: -0.398, -0.145) • Effect size for age differences for studies with two non-verbal tasks: -0.127 % CI [-0.412, 0.157) <u>The effect of combining titration and task domain on age differences in dual task performance</u> • "Domain overlap did not have a clear effect on effect sizes, whereas titration reduced the age difference in storage + processing task performance. Finally, there was no clear evidence of interaction between the two factors." <u>The effect of combining titration and task domain on dual task costs</u> • "Domain overlap revealed a tendency to make the age-related difference larger, and titration a tendency to make the age-related difference smaller; but in both cases these were not significant moderators. There was no

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
				interaction between the two factors.” Summary • “To summarize, of the moderators we considered, titration appears to play a role. It clearly reduces age differences in both storage only and storage + processing performance. Considering age-related differences in the dual task cost, titration does appear to reduce the small age difference to one that is no longer distinguishable from zero. However, we note that the overall effect of titration on the dual task cost is not itself significant, therefore, some restraint is required in interpreting this result.” **Meta-analysis of data on reaction time** • Storage only task, estimated standardized age difference: -1.144 (95% CI: -2.043, -0.245), z=-2.495, p<0.05; test for heterogeneity: Q(3)= 12.778, p<0.01

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Storage + processing tasks, estimated standardized age difference: - 1.442 (95% CI: -2.395, -0.489), z=-2.966, p<0.01; Q(5)=16.028, p<0.01 • Cost to storage with processing relative to storage only, estimated standardized age difference: 0.298 (95% CI: -0.01, 0.607), z=1.899, p=0.058 • "Given the small number of observations, we did not further consider moderators." **Brinley and state-trace analyses** of accuracy and reaction time corroborated the above results. **Conclusion** • "With regard to accuracy data, synthesizing the results of these studies we find evidence for a small, but significant, differential age effect on the ability to store information over brief intervals when concurrent processing is required. The results for RT [reaction time] were generally similar but we were limited by the

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
				number of studies that report latency in this literature." • "In sum, the present meta-analyses demonstrate a small differential effect of age on tasks requiring the temporary storage and processing of information, relative to storage alone. This age effect remains disproportionate in supplementary Brinley and state-trace analyses, further suggesting that a particular cognitive mechanism is at play." • "Moderator analysis indicated that equating single task storage performance across age groups (titration) and the nature of the stimulus material were important determinants of memory accuracy." • "Titration of storage task difficulty was found to lead to smaller, and nonsignificant, age-differences in dual task costs." • "… age differences were larger when there was domain overlap between the two tasks … relative to when there was no overlap"

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
				• “These results were corroborated by supplementary Brinley and state-trace analyses.” • “In sum, the present meta-analyses demonstrate a small differential effect of age on tasks requiring the temporary storage and processing of information, relative to storage alone. This age effect remains disproportionate in supplementary Brinley and state-trace analyses, further suggesting that a particular cognitive mechanism is at play. The literature strongly suggests that this mechanism would relate to the ability to successfully manage and coordinate multiple task demands … and task-switching between maintenance activities and the concurrent requirements …. Adjusting the level of demand of the two tasks prior to their combination appears to reduce the magnitude of age differences to near zero. What is lacking, however, is a convincing theoretical account of why this is the case, especially in light of recent strong

Reference Review Objective	Review Methods	Eligibility Criteria	Outcomes	Quantitative Results and Author-Reported Conclusion
				demonstrations to the contrary (Bier et al., 2017; Rhodes et al., 2019). Finally, there remains substantial variability in effect sizes, which we argue points to the important factor of the nature of the processing task, beyond the broad type of stimuli used. Further work directly comparing different processing tasks (e.g., those with or without a speeded response deadline, or those chosen on the basis of age-differences in PRP effects) is needed to assess an important potential source of this variability."

14.2 Risk factors/modifiers for age-related cognitive decline (Question 3)

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
Adhikari 2021 **Objective**	**Databases searched** • MEDLINE • EMBASE	**Inclusion criteria** • "…studies with mean age ≥60 years."	Statin use	**Cognitive functions and/or abilities assessed** • Global cognition	• Meta-analysis was not conducted.

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
"The purpose of our review was to summarize and critique the most recent randomized controlled trials (RCTs) and prospective observational studies, which examine the association between statin use and cognitive function. We focused on studies with mean population age ≥60 years, as cognitive impairment is seen more frequently in this population"	• Cochrane **Dates searched** • Inception – October 6, 2019 **Supplementary searches conducted** • References from identified studies • Guidelines • Expert knowledge of studies **Number of studies included** N = 24 (21 prospective observational studies, and 3 were RCTs; 6 observational studies and 2 RCTs address the risk of decline in global cognition or specific cognitive functions)	• "…prospective cohort study and RCT. **Exclusion criteria** • "studies that had patients with dementia or cognitive impairment at baseline" • "nonhuman studies" • "retrospective studies, case–control studies, case reports" • "sample <100" • "meta-analyses, systematic reviews" • "studies that were limited to specific subgroups including those with diagnoses of Parkinson's, stroke, traumatic brain injury, depression, familial hypercholesterolemia, Down's syndrome, and type 2 diabetes."		• Memory • Executive function • Attention • Visuospatial • Language **Methods of outcome assessment** • MMSE (Mini-Mental Status Exam) • Stroop-Colour-Word -test (SCW) • Letter-Digit Coding Test (LDT) • 15-Picture Learning test • Cognitive status questionnaire via telephone interview • Digit symbol substitution test (DSST) • mMOCA (modified Montreal Cognitive Assessment) • TMT-B (Trail Making Test Part B) • Benton visual retention test • TMT-A • 3MSE (Modified Mini-Mental State Examination) • Difference in scores for global cognition, memory, attention/processing speed,	• "Four studies showed no difference in the rate of decline in global cognition." • One study showed slower decline in measures of global cognition (regression coefficient -0.03; P =.006) in statin users." • "Four studies assessed cognitive domains including memory, executive function, attention, visuospatial, and language. They found no significant association between statin use and adverse cognitive outcomes in any of the individual domains tested." • "We sought to update the database of RCT and prospective observational studies that looked at the association of statin use with cognitive function; our review confirms and extends prior systematic reviews in that they do not show a

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				language, executive function, visuospatial • Boston naming • Global cognition: 19 tests Change over time in memory, and executive function	consistent negative effect. The consistent data from all the RCTs that examined statins and cognitive function should be reassuring for clinicians who prescribe statins for those at increased ASCVD risk. Most importantly, these data may provide reassurance for patients aged >60 years who are contemplating statin therapy and are concerned about the risk of changes in cognitive function with continued statin use." • "There was no evidence of adverse cognitive effects, including incidence of dementia, deterioration in global cognition, or specific cognitive domains associated with statin use in individuals aged ≥60 years." • "Limitations of this review include the duration of follow-up periods in studies. The short- to medium-term

Reference **Review Objective**	**Review Methods**	**Eligibility Criteria**	**Factors/ modifiers**	**Outcomes**	**Quantitative Results and Author-Reported Conclusion**
					nature of follow-up and absence of truly long-term follow-up (10–20 years duration) limit any conclusion on cognitive dysfunction with long-term statin therapy.” • “Future studies should examine this association in studies with longer follow-up periods.”
Akintola 2015 **Objective** “This systematic review and meta-analysis was performed to assess available evidence on the association of SCH [subclinical hypothyroidism] with cognition in community dwelling,	**Databases searched** • PubMed • Embase • Web of Science • Cochrane • CINAHL • PsycINFO • AcademicSearchPremier **Dates searched**	**Inclusion criteria** • “Human studies” • “Median/mean age 60 or above” • “Subclinical hypothyroidism (SCH) defined as: • - Elevated TSH and normal fT4; • - All self-defined subclinical hypothyroidism • •Elevated serum TSH in association with normal	Subclinical hypothyroidism (SCH)	**Cognitive functions and/or abilities assessed** • Global cognition • Memory (including tests for language) • Executive function **Tests and/or methods of outcome assessment** • Middlesex elderly assessment of mental state (MEAMS)	**Cross-sectional studies** <u>MMSE as a measure of global cognition (n=10 studies)</u> • ES [effect size] = -0.01 (95% CI: -0.09, 0.08) • Heterogeneity (I2) = 55.1% <u>Executive function (n=7 studies)</u> • ES<0.001 (95% CI: -0.10, 0.09) • I2 = 13.5% <u>Memory</u> • ES=0.01 (95% CI: -0.12, 0.14)

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
relatively healthy older adults."	• January1966 to April1, 2015 **Supplementary searches** • Reference lists of key articles **Number of studies included** 15 studies (9 cross-sectional and 6 longitudinal)	total or free T4- and T3-values • •High-normal TSH and abnormal response to TRH • •Elevated serum TSH with normal thyroid hormone levels, without symptoms that could be explained by overt hypothyroidism" • "Relatively healthy elderly participants" "Healthy as determined by the authors of the original articles" • "Free living/community dwelling" • "Original research articles including prospective studies, randomized-controlled trials, etc. that provide baseline data" • "Cognitive measure and domain specified"		• Mini-Mental State Examination (MMSE), 30 scores • Modified Mini-Mental State Examination (MMMSE) • Modified MMSE (3MSE), 100 scores • Animal naming (AN) • Auditory verbal learning test (AVLT) • Block design (BD) • Boston naming test (BNT) • Category verbal fluency test (CFT) • Controlled oral word (COWAT) • Constructional praxis test (CPT) • Constructional recall test (CRT) • Concept shifting test (CST) • California Verbal Learning Test (CVLT)	• I2=46.9% **Prospective studies** <u>MMSE as a measure of global cognition (n=4 studies)</u> • ES=0.03 (95% CI: -0.001, 0.07) • I2<0.001% <u>Executive function</u> • Meta-analysis was not conducted due to small number of studies. <u>Memory</u> • Meta-analysis was not conducted due to small number of studies. **Conclusion** "In conclusion, this systematic review and meta-analysis provides no evidence that supports an association between subclinical hypothyroidism and cognitive impairment in relatively healthy, community dwelling

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		• "All language" **Exclusion Criteria** • "Animal studies" • "Younger than 60" • "SCH not defined" • "Full blown depression, psychiatric symptoms, neurological disorders as Parkinson's disease or predefined dementia, substance abuse" • "Hospitalized patients" • "Systematic reviews, meta-analyses, reviews, conference abstracts, web pages" • "Cognitive domain not well defined, e.g. "mood," "quality of life," "mental health" etc. • "Duplicates"		• Continuous visual memory test (CVMT) • Digit spans forward and backward of the Wechsler adult intelligence scale - revised (WAIS-R) • Digit symbol coding test (from WAIS) • Digit symbol substitution test (DSST) • Milner facial memory test (FMT) • East Boston Memory Test (EBMT) • Frontal assessment battery (FAB) • Figure rotation (FR) from the Schaie- Thurstone adult mental abilities test • Go-No-Go • Hooper test • Inglis paired associates learning test (IPALT)	elderly. However, available prospective studies were limited. Thus, additional large, high-quality studies are needed that will allow for more extended analyses."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Isaacs set test of verbal fluency (IT) • Judgment of line orientation (JLO) • Letter digit coding test (LDCT) • Luria m's and n's (LMN) • Letter- number sequencing (LNS) • List of words (LW) • Matrix test (MT) • Oral reading (OR) • Paced auditory serial addition task (PASAT) • Porteus maze (PM) • Prose memory test (PMT) • Picture completion and block design (PCBD) • picture word learning test (PWLT) • Rivermead behavioral profile (RBP)	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Rey-Osterrieth complex figure test (RCFT) • aven progressive matrices test (RPM) • Rey's words (RW) immediate and delayed recall • Scribble test (ScT) • Symbol digit modalities test (SDMT) • Shipley Institute of Living scale (SILS) • Selective reminding test (Buschke) (SRT) • Trail making test A and B (TMTA&B) • Wechsler adult intelligence scale (WAIS) • Wechsler adult intelligence scale-revised (WAIS-R) • Word discrimination (WD) • Word fluency test (WFT) • Word list memory test (WLMT)	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Word list recall test (WLRT) • Word list recognition test (WRLRcT) • Word learning task (WLT) • Wechsler memory scale (WMS) Zazzos barring test (ZBT)	
Anstey 2008 **Objective** "We report here a systematic review designed to crystallize current knowledge concerning the role of serum lipids as risk factors for dementia, cognitive decline, and cognitive impairment.	**Databases searched** • PubMed • PsycINFO • Cochrane CENTRAL **Dates searched:** • PubMed: 1950 – January 2007 • PsychINFO: 1872 – January 2007 • Cochrane CENTRAL: 1800 – January 2007	**Inclusion criteria** • Prospective studies with ≥12 months follow-up • Blood measure of cholesterol analyzed as the main variable of interest or as a covariate • Cognition or dementia assessed clinically (objective assessment) **Exclusion criteria** • Subjective assessment of cognition, or dementia diagnoses	Serum cholesterol [total, HDL, LDL]	**Cognitive functions and/or abilities assessed** • Global cognition • Memory • Visuospatial abilities • Language abilities **Tests and/or methods of outcome assessment** • Mini-Mental State Examination (MMSE) • The Short Portable Mental Status Questionnaire (SPMSQ) • Digit Symbol	• Only studies addressing the risk of dementia were meta-analyzed. • "High TC [total cholesterol] in late-life was reported to be associated with a decreased risk of … cognitive decline… However, there was no effect of late-life TC on cognitive decline found in studies with larger samples, leading to the conclusion that there remains a lack of reliable evidence supporting any association between high TC in late-life and cognitive decline. One extremely small study reported that high midlife TC

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
Meta-analysis was also performed on studies that were comparable."	**Supplementary searches** • NR **Number of studies included** • 18 (5 studies of cognitive decline or cognitive performance change)	obtained from medical records • Study in a clinical sample of family members of participants with dementia • No baseline cognitive assessment if the study outcome was cognitive performance • No screening for dementia at baseline • Age of participants >60 years at baseline, or sample mean age plus two standard deviations of the sample mean age was greater than 60.			was associated with a decreased risk of cognitive decline…" • "No significant associations were found in any study reporting results for HDL or LDL. However, the small number of studies reporting relevant data prevents strong conclusions being drawn and it would be beneficial if future studies reported all available indices of serum cholesterol." • Of seven studies examining interactions between APOE and cholesterol, six studies addressed the risk of dementia, and one study addressed the risk of cognitive decline. This study "found that participants with both APOE*4 and high TC had higher risk of cognitive decline than participants with only one of these risk factors." The authors, however, concluded that

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					“[t]he seven studies reporting data on the interaction between APOE*4 and TC were mostly consistent in revealing a lack of interaction.”
Armstrong 2017 **Objective** “To examine the reliability and magnitude of ST effects on older adults’ episodic and working memory performance—two forms of memory that typically show the greatest age-related declines. In addition, we examined potential moderators of	**Databases searched** • PsycINFO • PubMed • Web of Science • Medline **Dates searched** • NR - March 9, 2016 **Supplementary searches** • Grey literature was searched in the Educational Resources Information Center (ERIC),	**Inclusion criteria** • “Studies that manipulated ST by directly activating age-related stereotypes… such as asking participants to read articles that describe age-related memory declines … or stating that the purpose of the study was to confirm age-related declines in memory…” • Studies of older adults (mean age 60 years or older) **Exclusion criteria** • Studies that did not include age-based	Stereotype Threat (ST)	**Cognitive functions and/or abilities assessed** • Episodic memory • Working memory **Tests and/or methods of outcome assessment** • Free recall, cued recall, and recognition tasks for episodic memory • Tests/tasks for working memory are not reported	<u>Episodic memory (k=23 samples)</u> • Mean weighted effect size: d = 0.253 (SE = 0.091, 95% CI = 0.074 to 0.433; z = 2.771, p = 0.006) • Heterogeneity: Q(22) = 50.648, p < .001 • Difference in effect sizes, blatant vs. subtle ST manipulations: Qbetween (1) = 0.019, p = .889. • Effect size for blatant ST manipulations (k=20): d= 0.257, z = 2.475, p = .013 • Effect size for subtle ST manipulations (k=3): d = 0.227, z = 1.213, p = .225 • Difference in effect sizes by type of memory task: Qbetween (2) = 0.099, p = .952.

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
age-based ST including type of ST manipulation, type and timing of memory task, participant age and education level."	Google Scholar, and by contacting authors who published articles on age-related ST effects on memory. • **Number of studies included:** 23	stereotypes, or if ST was induced after studying the target items, or ST was induced by subconscious manipulations, such as priming • Studies of individuals with a mean age < 60 years • Studies that did not report mean scores and standard deviations or standard errors of memory performance if these data could not be obtained by contacting the authors.			• Free recall memory tasks (k=16): d=0.237, z = 2.150, p = .032 • Recognition tasks (k=4): d = .327, z = 1.206, p = .228 • Cued-recall tasks (k= 3): d = 0.230, z = 0.879, p = .380 • Difference in effect sizes, immediate vs. delayed memory: Qbetween(1) = 0.281, p = .596 • Immediate memory (k=20), d = 0.228, z = 2.414, p = .016 • Delayed memory (k=3): d = 0.426, z = 1.176, p = .239. • Role of education in the observed ST effect: df = 15, β = −0.001, p = .988) • Role of age in the observed ST effect: df = 21, β = −0.03, p = .165 • Publication bias: (B0) = 1.384, t(21) = 0.875, p (1-tailed) = .196. <u>Working memory (n=15)</u> • Mean weighted effect size: d = 0.373 (SE = 0.170, 95% CI = 0.040 to 0.707; z = 2.192, p = .028)

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					• Heterogeneity: Q(14) = 71.750, p < .001. • Difference in effect sizes, blatant vs. subtle ST manipulations: Qbetween(1) = 11.852, p = .001. • Effect size for blatant ST manipulation (k=10): d = 0.059, z = 0.315, p = .753. • Effect size for subtle ST manipulations (k=5): d=0.964, z = 5.195, p < .001 • Role of education in the observed ST effect: df = 9, β = 0.242, p = .422 • Role of age in the observed ST effect: df = 13, β = 0.063, p = .141 • Publication bias: (B0) = −1.345, t(13) = 0.538, p(1-tailed) = .300. • “Taken together, this meta-analysis shows that exposure to negative age-based stereotypes negatively impacts both episodic and working memory performance in older adults.”

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					• "Additionally, the two types of memory appear to be differentially impacted by blatant and subtle manipulations of ST. The ST effect on episodic memory might also be influenced by differences in testing procedures, such as the type of memory tests employed or the timing of the memory tests. However, overall ST effects on memory were not moderated by age or level of education."
Arwert 2005 **Objective** "The objective of the present meta-analysis was to evaluate the relationship between particularly the IGFI status and cognition in	**Databases searched** • PubMed • Picarta **Dates searched** • 1985 – January 2005 **Supplementary searches**	**Inclusion criteria** • "Trials with quantitative data of IGF and cognitive functioning" **Exclusion criteria:** • "Reports, review articles and studies in which the psychometric quality of the used questionnaire or test was unknown."	The growth hormone Insulin-like growth factor I (IGF-I)	**Cognitive functions and/or abilities assessed** • Information processing speed • Crystallized intelligence • Fluid intelligence • Visual memory • Verbal memory • Spatial memory • Spatial reasoning	**Meta-analysis of all studies** <u>MMSE scores (n=7 studies)</u> • Pooled correlation: r=0.81 (95% CI: 0.80-0.83); p<0.0001) • Heterogeneity: Q=434, p<0.0001 <u>All measures of cognitive functioning (n=13 studies)</u> • Pooled correlation: r=0.57 (95% CI: 0.53–0.60)

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
healthy elderly by analysing the appropriate studies on this topic. Our hypothesis was that low serum IGF-I values are associated with reduced cognitive functioning in healthy elderly."	• Reference lists of review articles **Number of studies included:** 13			• Divide attention • Global cognition **Tests and/or methods of outcome assessment** • Brus reading • Benton line orientation • Digit symbol substitution • Block design • Concept shifting 15-word test • Digit span backwards • Stroop test • Route test • Immediate recall • Delayed recall • Rey visual design learning • Rey auditory verbal test • Animal naming • Trials B • MMSE	• Heterogeneity: Q=85.4, p<0.0001 **Meta-analysis excluding one large study** MMSE scores (n=6 studies) • Pooled correlation: r=0.30 (95% CI: 0.21–0.39); p<0.0001) • Heterogeneity: Q=4.35, p=0.5 All measures of cognitive functioning (n=12 studies) • Pooled correlation: r=0.35 (95% CI: 0.27–0.43) • Heterogeneity: Q=7.47, p=0.8 • "This present quantitative meta-analysis evaluates the correlation between the somatotropic axis and cognitive functioning in healthy elderly. Our hypothesis was that low IGF-I correlates with impaired cognitive functioning in aging. From our analysis we can conclude that there is a positive correlation between

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					IGF-I and cognition, assessed with the MMSE and with a variety of cognitive tests.”
Bubu 2020 **Objective** “In this systematic review, we examine the link between OSA [obstructive sleep apnea] with cognitive performance/impairment, subsequent development of mild cognitive impairment (MCI) or dementia, and AD biomarkers including effects of continuous	**Databases searched** • PubMed • Medline • Embase • Psych INFO • Cochrane library for clinical trials **Dates searched** • NR – May 1, 2019[16] **Supplementary searches** • Manual search of included articles	**Inclusion criteria** • Original research studies examining associations between OSA and cognition, OSA and cognitive decline, OSA and AD, including studies examining the effect of CPAP [continuous positive airway pressure] on cognition • Studies in human adults • Comparisons between healthy controls and OSA patients (studies without controls with comparisons based on OSA severity were also considered) • Use objective neuropsychological	Obstructive sleep apnea (OSA)	**Cognitive functions and/or abilities assessed** • Global cognition • IQ • Memory • Attention • Executive function • Construction • Language • General cognitive/intellectual ability • Psychomotor vigilance **Tests and/or methods of outcome assessment:** • NR	• Meta-analysis was not conducted. • “In older adults, cross-sectional and longitudinal associations between OSA and cognition are highly variable, depending on the study type and setting, with small sleep clinic populations (i.e., more symptomatic patients) driving most of the positive findings.”

[16] Search for studies “published prior to May 1st, 2019

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
positive airway pressure (CPAP) with a particular focus in characterizing the heterogeneity of OSA and its cognitive outcomes in distinct clinical groups. … Where findings were discrepant, we focused on methodological differences among studies.”	**Number of studies included** • 68, including 14 observational studies of cognitive functioning in older adults (mean age 60 years and older): 11 cross-sectional, 3 longitudinal studies	cognitive tests in studies of cognition or cognitive decline • Use polysomnography or clinical diagnosis of OSA. **Exclusion criteria** • “Studies conducted in OSA patients that did not include relevant cognitive parameters (i.e., executive, motor, verbal, attention, memory)” • “those that examined the effects of CPAP but did not include an examination of OSA vs. control at baseline…”			
Chapko 2018 **Objective** “The aim of this review was to	**Databases searched** • Medline • Embase • PsycINFO	**Inclusion criteria** • Primary studies with an abstract written in English • Studies which examined cognitive reserve (CR) in	• Education • Occupation	**Cognitive functions and/or abilities assessed** • Global cognition • Non-verbal reasoning • Fluid intelligence	• Meta-analysis was not conducted. • “The analysis of <u>occupation</u> as a potential CR determinant within healthy cognition presented

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
identify life-course factors which protect older individuals from expressing cognitive decline despite the presence of brain pathology."	**Dates searched** • Medline: 1946 – 06/09/13 • EMBASE: 1947 – 06/09/13 • PsycINFO: 1967 – 06/09/13[17] **Supplementary searches** • NR **Number of studies included** • 34 (including 7 studies of education and 2 studies of occupation as a cognitive reserve determinants in cognitively healthy individuals)	the context of commonest subtypes of dementia or healthy aging • Studies including older adults (mean age >60 years) • Studies that included measurement of underlying dementia-related neuropathology, cognitive function, and CR determinants in a single statistical model. • Studies using different methods to assess brain pathology, such as neuroimaging, autopsy, cerebrospinal fluid or plasma measures **Exclusion criteria** • Studies "involving only functional neuroimaging unless combined with		• Crystalized intelligence • Cognitive/mental speed • Immediate and delayed verbal memory • Visual short-term memory • Logical intelligence and reasoning • Verbal fluency • Executive function or purposive action • General intelligence **Tests and/or methods of outcome assessment** • MMSE for global cognition • Spot-the-Word test for crystallized intelligence • Raven's Progressive Matrices for fluid intelligence	inconclusive results. Based on two studies, occupation protects specific cognitive functions as opposed to general cognition, independently of childhood mental abilities. Also, it provides greatest resilience against total brain atrophy as opposed to WMH or a composite score of brain pathology measures." • "Seven models found education to be protective by preserving general cognition against a variety of neuropathological biomarkers…" • "All of the models which did not find education to contribute to CR were concerned with specific cognitive domains as opposed to global cognition."

[17] Unclear, September 6 or June 9

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		other neuropathological biomarkers; focused on CR in clinical conditions other than dementia; examining pharmacological interventions".		• Auditory Verbal Learning Test for immediate and delayed verbal memory • Symbol-Digit Modalities Test for cognitive speed • Uses of Common Objects test for executive function or purposive action • Digit Symbol test for processing speed, attention, and visual short-term memory • Tests for other cognitive functions are not reported.	• Overall conclusion: "Within healthy population suitable to inform preventative interventions, our findings suggest that education has a protective effect on general cognition in the face of multiple brain burden measures, while occupation as a potential CR determinant presented inconclusive results."
Chinnappa-Quinn 2020 **Objective** "The objectives of this systematic review and meta-analysis (MA) are to synthesize	**Databases searched** • Embase • Medline • PsycInfo, • CINAHL **Dates searched**	**Inclusion criteria** • Participants: older age • Intervention: hospitalization with medical or surgical diagnosis clearly specified as an overnight stay for acute illness • Outcome: any generally accepted cognitive	Hospitalization for acute illness	**Cognitive functions and/or abilities assessed** • Global cognition • Memory • Processing speed • Executive function (word fluency, divided attention, mental flexibility)	• Pooled effect for 4 studies reporting posthospitalization cognition or change in cognition: d=−0.16 (95% CI: −0.02, −0.30], p=0.02; I2 = 78.9%, p=0.003 • Sensitivity analysis removing a study with absent pre-hospitalization cognition measure: heterogeneity was not substantially reduced (I2 = 76%)

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
longitudinal observational studies reporting cognitive outcomes in older age adults following AIH [acute illness hospitalizations], identify potential moderating patient and hospitalization factors, and conduct an MA of the studies where statistical pooling is feasible."	• Inception – January 2020 **Supplementary searches** • NR **Number of studies included** • 24 (4 studies examining cognitive changes between pre- and post-hospitalization assessments were included in meta-analysis)	measure over any duration of post-discharge follow-up • Study design: any design except for studies with a single post-hospitalization cognitive assessment • Type of report: full-text English-language published papers reporting on original research with no restriction on publication year • **Exclusion criteria** • Studies with exclusively cognitively impaired samples • Hospitalizations for a neurological (except spinal) or psychiatric illness, or for rehabilitation • "Studies with exclusively surgical (any elective or		**Tests and/or methods of outcome assessment** • Mental Status Questionnaire (MSQ) • Cognitive Abilities Screening Instrument (CASI) • Mini-Mental State Examination (MMSE) • Delayed Word Recall • Digit Symbol Substitution • Word Fluency	• "The evidence reviewed here suggests an acceleration in the rate of cognitive decline and the onset of dementia in some older patients who have been hospitalized, regardless of type of illness." • "The handful of studies that examined specific cognitive domain outcomes … suggest the greatest impact is observed on memory, processing speed, and executive function. However, the evidence is too sparse to clearly define domain-specific deficits."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		emergency surgery including hip fracture patients), critical care or delirious patients were excluded: these were assessed to be not typical inpatient samples.”			
Cross 2017 **Objective** Systematic review of studies describing associations between obstructive sleep apnea (OSA) and cognitive function across various cognitive domains in older community-	**Databases searched** • Medline • Embase • PsycINFO **Dates searched** • Inception – August 2016 **Supplementary searches** • NR **Number of studies included:** 13	**Inclusion criteria** • Studies of healthy participants with a mean age and lower bound of 1 SD above 50 years. • Only objectively defined OSA as measured by a validated sleep apnea diagnostic device or technique was eligible. • Comparator groups must have consisted of older adults that shared the same age and gender distributions as OSA participants. The comparator participants must have also undergone a diagnostic	Obstructive sleep apnea (OSA)	**Cognitive functions and/or abilities assessed** • General cognitive/ intellectual ability across cognitive domains • Global cognition • Executive function • Processing speed • Language • Memory • Motor learning • Attention & vigilance • Visuospatial ability **Tests and/or methods of outcome assessment** NR	• Overall effect size across cognitive domains (k=13 studies): Hedge’s g=0.18 (95% CI: 0.04, 0.32), z=2.25, p = 0.009; heterogeneity: Tau2=0.029, I2 = 69.2%; Q(12)=29.4. “The funnel plot showed significant asymmetry … suggesting smaller studies reported larger effects. A trim and fill analysis imputed 6 studies; the adjusted effect size was then negligible and statistically non-significant (g = 0.02, 95%CI -0.12 to 0.16).” • Executive functioning**:** k=10, g=0.12 (95% CI: -0.03 to 0.27), p = 0.106; I2 = 69.9%,

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
dwelling adults (aged >50 years).		PSG to rule out the presence of OSA. • Studies that compared cognitive outcomes with OSA severity measures were eligible if they included control participants in the sample (i.e. a complete range of OSA severity). • Language was limited to English, German, Portuguese, Polish or Hebrew **Exclusion criteria** • Participants with a diagnosis of mild cognitive impairment (MCI), dementia or other neurological disorders (e.g. stroke, epilepsy). • Any studies that investigated the effects of medications that may have influenced cognition (e.g.			Tau2 = 0.03. No asymmetry on the funnel plot. • Processing speed: k=8, g=0.20 (95% CI: 0.02 to 0.38), p=0.033, I2=57.6%, Tau2=0.03. No asymmetry on the funnel plot. • Declarative memory: k=6, g=0.17 (95% CI: 0.04 to 0.30), p=0.009, I2=22.5%, Tau2=0.01. No asymmetry on the funnel plot. • Working memory: k=3, g=0.04 (95% CI: -0.08 to 0.15), p=0.511, I2=0.0%, Tau2=0.0 • Global cognition: k=7, g=0.14 (95% CI: -0.09 to 0.36), p=0.226, I2=78.3%, Tau2=0.05 • Motor learning: k=3, g=0.37 (95% CI: -0.17 to 0.92), p=0.18, I2=95.3%, Tau2=0.29 <u>By settings</u> • Case-control studies of populations arising from sleep clinics: k=6, g=0.49

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		anesthesia, benzodiazepines) were also excluded from the review. Full-text unavailable			(95%CI: 0.22 to 0.75), p<0.001; I2=0.0%, Tau2=0.03 • Community (baseline data from cohort studies): k=5, g=0.04 (95% CI: -0.09 to 0.16), p=0.320, I2=67.7%, Tau2=0.01 • Between-group heterogeneity: Q-between=8.08, df=1, p=0.004 <u>By OSA severity and a cut-off for the apnoea-hypopnea index (AHI) for controls:</u> • AHI<5 for controls, moderate to severe cases in the OSA group (AHI of 10 to 40): k=5, g=0.38 (95% CI: -0.03 to 0.78), p=0.077, I2=70.5%, Tau2=0.14 • AHI<5 for controls and AHI>5 for the OSA group: k=2, g=0.14 (95% CI: -0.12 to 0.40), I2=89.7 • AHI<15 for controls and AHI>15 for the OSA group: k=3, g=-0.02 (95% CI: -0.16 to 0.13), I2=33.1

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					• Between-group heterogeneity: Q-between=3.68, df=2, p=0.159 By risk of bias • High risk of bias: k=8, g=0.40 (95% CI: 0.07 to 0.73), p=0.052, I2=73.0%, Tau2=0.15 • Low risk of bias: k=5, g=0.08 (95% CI: -0.05 to 0.20), p=0.250, I2=65.4%, Tau2=0.01 • Between-group heterogeneity: Q-between=2.96, p=0.067 Meta-regression • "… a greater mean age of study participants significantly predicted variance in the analysis and reduced the effect across all combined cognitive domains (beta = −0.02, df = 1,11, Q = 27.9, p = 0.027, R2 = 34.5%)." • "Years of education, mean AHI or proportion of females in the study samples did not

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					have any effect. Year of publication had no significant effect on the outcomes." **Conclusion** • "Associations between OSA and cognition in later life are highly variable and the findings differ based on the type and setting of study." • "Some older adults may be at risk of cognitive impairments attributable to OSA; however, the risk of bias renders the evidence inconclusive."
Demnitz 2016 **Objective** Review of cross-sectional studies examining the association between objective (physical) mobility measures (gait,	**Databases searched** • Medline • EMBASE **Dates searched** • 1990 – February 2015 **Supplementary searches**	**Inclusion criteria** • Journal articles or letters in the English language. • Studies where physical mobility measured using an objective assessment of gait, balance or lower-extremity function. • Studies with cognitive ability assessed by tests	Objective mobility measures (gait, lower-extremity function, balance)	**Cognitive functions and/or abilities assessed** • Global cognition • Executive function • Memory • Processing speed **Tests and/or methods of outcome assessment** • (Executive function) Composite	• Measures of gait and global cognition (15 studies): standardized mean difference (SMD)=0.12 (95% CI:0.09 to 0.15), p<0.001; heterogeneity: Q=9.82, p=0.547, I2=0. Indication of publication bias; the Trim and Fill procedure applied to impute missing studies resulted in a mean effect size of 0.11 (95% CI: 0.08 to 0.14)

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
lower-extremity function, balance) and cognitive function (global, executive function, memory, processing speed) in healthy older adults.	• Bibliographies of included studies **Number of studies included** 26 studies	of global cognition, memory, executive function or processing speed. • Studies that examined an association between mobility and cognitive measures collected at the same time, a difference in mobility measures between groups that differed in cognitive function, or a difference in cognitive measures between groups that differed in mobility outcomes. • Studies that included a sample of healthy adults with a mean age over 60. **Exclusion criteria** • Studies with self-reported measures of ability (e.g., Balance Self-Perception Test), assessments of physical		• (Global) Composite • 10-word-pairs verbal learning test • 3MS • Benton visual retention test • Choice RT • Color trail test • Digit span • Digit symbol • Flanker task • Free and cued selective reminding test • Free recall (FCSRT) • Hopkins verbal learning test and Delayed figure reproduction (RCF) • RBANS • Immediate memory (RBANS) • Inhibition • Logical memory and Auditory verbal learning (WMS-R • MMSE • MoCA • Paired associates learning (CANTAB)	• Measures of gait and executive functioning (18 studies): SMD=0.2 (95% CI: 0.15 to 0.26), p < 0.001; heterogeneity: Q=34.81, p=0.007, I2=51.17. Indication of publication bias; the Trim and Fill procedure applied to impute missing studies resulted in a mean effect size of 0.17 (95% CI: 0.11 to 0.24) • Measures of gait and memory (10 studies): SMD=0.14 (95% CI: 0.1 to 0.19), p<0.001; heterogeneity: Q=13.38, p = 0.15, I2=32.73. No indication of publication bias • Measures of gait and processing speed (9 studies): SMD=0.15 (95% CI: 0.1 to 0.2), p<0.001; heterogeneity: Q=13.51, p=0.1, I2=40.79. Indication of publication bias; the Trim and Fill procedure applied to impute missing studies resulted in a mean effect size of 0.14 (95% CI: 0.08 to 0.19)

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		activity, and of gait during dual-task conditions were excluded. • Studies with overlapping samples were excluded if the same aspects of mobility (e.g. gait) and cognition (e.g. executive function) were examined in both papers • Studies reporting only a composite of physical measures (e.g. gait speed + muscular weakness + fatigue) • Studies that did not test for an association between mobility and cognitive measures (e.g. only used these outcomes as covariates in a model). Studies with measures of gait during dual-task conditions.		• Pattern recognition memory • Spatial recognition memory • Stroop • TMT • TMT/Verbal fluency Verbal fluency	• Measures of lower-extremity function and global cognition (6 studies): SMD=0.19 (95% CI: 0.03 to 0.36), p=0.022; heterogeneity: Q=24.75, p<0.001, I2=79.8. No indication of publication bias • Measures of lower-extremity function and executive function (3 studies): SMD=0.48 (95% CI: 0.22 to 0.74), p < 0.001; heterogeneity: Q=2.79, p=0.25, I2= 28.3. No indication of publication bias • Measures of balance and global cognition (3 studies): SMD= 0.11 (95% CI: 0.05 to 0.17), p<0.001; heterogeneity: Q=0.21, p=0.9, I2=0. No indication of publication bias • Measures of balance and executive function (3 studies): SMD=0.11 (95% CI: 0.02 to 0.21), p=0.02; heterogeneity: Q=0.75,

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					p=0.69, I2=0. No indication of publication bias. **Conclusion** • “Individuals with better mobility perform better on assessments of global cognition, executive function, memory and processing speed.” • “Not all measures of mobility were equally associated with cognitive function, however. Although there was a larger number of gait and lower-extremity function studies, and this may have driven findings, most studies examining balance and cognition measures reported no significant results.” • “Meta-analyses on reported associations supported results by revealing significant, albeit small, effect sizes in favour of a positive association between performance on mobility

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					measures and cognitive assessments.”
Dotson 2020 **Objective** A systematic review and meta-analysis on peer-reviewed studies that examined depression-related differences in cognitive control in healthy community-dwelling individuals of any age.	**Databases searched** • PsycINFO • PubMed **Dates searched** • NR - March 2018 **Supplementary searches** • NR **Number of studies included:** 76 (including 3 studies in age category “Middle Aged to Older Adult” [45-85 years] and 29 studies in age category “Older	**Inclusion criteria** • Peer Reviewed journal articles • English language • Humans • Studies of unipolar clinical depression, subthreshold depression, and depressive symptoms as measured by questionnaires. • Only baseline data from longitudinal and cross-sectional studies. • Only pre-treatment data from intervention studies targeted cognitive deficits. • Neuroimaging studies if the study reported cognitive test results, which could be based	Depression	**Cognitive functions and/or abilities assessed** Executive functioning (cognitive control)[18]: • Inhibition • Planning • Cognitive Flexibility • Set Shifting • Composite across functions **Tests and/or methods of outcome assessment** • ANT executive (RT) • CNS Vital Signs Stroop (complex RT, RT, simple RT) • Color TMT-B • Composite • Conditional RT Test (commission errors) • D-KEFS CW • D-KEFS CW Interference Test • D-KEFS CW Switching	• “The relation between mean age and study effect size was significant, with a slope of −0.0038 (95% CI between −.0072 and − .0004, p = .027), indicating that each additional year of age added −.0038 to the effect size (see Fig. 2), R2 = .004 at Level 2 and .168 at Level 3. Heterogeneity was significant (Q(219) = 1306.17, p < 0.0001, tau2 at Level 2 was 0.13, p < .0001, and tau2 at Level 3 was 0.02, p = .024).” • Meta-analysis was conducted in age subgroups with > 4 studies. • The effect of depression on measures of cognitive control in the subgroup of Older Adults: Hedges’ g=−0.45 (95% CI: −0.59 to −0.31), p<0.0001; Q(60)= 311.31, p<0.0001;

[18] “Executive functioning is a broad neurocognitive domain that includes multiple cognitive control functions such as planning, problem solving, set-shifting, concept formation, inhibition, and initiation ….” (Dotson et al. 2020)

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
	Adult" [60-97 years])	on tests completed in or out of the scanner. • Studies with objective measures of cognitive control • Reviewers also screened out • any study that, based on reviewing the full text, did not meet • eligibility criteria specified in the search terms (e.g., major • medical or psychological comorbidities). **Exclusion criteria** • Literature reviews, clinical trials, meta-analyses, systematic reviews, treatment outcomes and dissertations. • Studies of depression with comorbid psychiatric conditions other than anxiety disorders based on the		• D-KEFS Fluency Switching • D-KEFS Tower • D-KEFS Trail Making Number-Letter • D-KEFS Trail Making Switching • D-KEFS Trails Switching • Flanker (Eriksen effect accuracy and RT) • Flanker (incongruent percent errors, RT) • Go/No-Go (commission errors, omission errors, RT) • Go/No-Go (commission errors, omission errors, RT, RT variability) • Go/No-Go (hit rate, RT) • Go/No-Go (No-Go RT easy trials, No-Go RT difficult trials, No-Go % correct inhibition easy trials, No-Go % correct inhibition difficult trials • Go/No-Go (number error, number hit, speed error, speed hit)	tau2 at Level 2 = 0.21, p=0.0001; tau2 at Level 3 = 0.00, p<0.0001; I2 at level2 = 0.89; I2 at Level 3 = 0.00 • "We did not find significant effects for cognitive domain. … Cognitive domain also failed to be a significant moderator when we restricted the analyses to studies with participants with an average age older than the median split (i.e., age 39 or over: intercept = −0.43, 95% CI = −0.58 to −0.26, p < .0001; slope for cognitive flexibility = −0.05, 95% CI = −0.30 to 0.20, p = .70; slope for planning = 0.12, 95% CI = −0.12 to 0.36, p = .34; slope for set-shifting = 0.31, 95% CI = −0.31 to 0.20, p = .32; R2 = .014 at Level 2 and .236 at Level 3). Heterogeneity was significant at Level 2 (Q [94] = 601.72, p < 0.0001; tau2 at Level 2 was 0.17, p < .0001, and tau2 at Level 3 was 0.02, p = .47)."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		high comorbidity of depression and anxiety. • Studies conducted in inpatient settings, nursing homes, or prisons. • Intervention studies, unless the intervention targeted cognitive deficits, in those cases, only the pre-treatment data were used. Studies with subjective (self-reported) measures of cognitive control.		• Go/No-Go (percent hits, percent false alarm, RT) • Haylings Test-B (errors) • Intra-Dimensional Extra-Dimensional (stages completed, total errors) • Intra-Dimensional Extra-Dimensional Set Shifting (stages completed, total errors) • MCST (number of categories) • MCST (perseverations) • Modified Flanker (incongruent preceded by congruent trial errors and RT, incongruent preceded by incongruent trial errors and RT) • Neuropsychological Assessment Battery Mazes • Plus-Minus Task (switch cost) • Preparing to Overcome Prepotency (RT) • Response Suppression Test (categorized completions, nonsensical sentences errors, total time)	• Clinical vs. subthreshold depression. When analysis was restricted to studies with average age of participants older than the median of 39 years, "depression status did yield a significant effect, increasing the average effect size from −0.16 in the subthreshold group to −0.44 in the group with participants with clinical diagnosis (slope of the regression line = −0.28, 95% CI = −0.54 to −0.03, p = .031; R2 = .010 at Level 2 and .539 at Level 3)." • Antidepressant medications. "When we restricted the analysis to studies with participants with an average age older than the median split (i.e., age 39 or over), however, medication status yielded a significant effect (slope of the regression line =−0.29, 95% CI = −0.53 to −0.05, p = .016; R2 = .039 at Level 2 and .221 at Level 3). Heterogeneity was significant

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Sequencing Stop Signal Task (RT) • Shape-color Switching Task (RT) • Simon Task (Simon effect RT, errors to Simon trials) • Stocking of Cambridge (number of moves) • Stocking of Cambridge (problems solved in minimum moves, initial thinking time for 5, 4, 3, and 2 moves) • Stockings of Cambridge (number of moves) Composited • Stop Signal Task (probability of , stop signal RT, mean RT) • Stop Signal Task (RT) • Stop Signal Task (RT) • Stop Signal Task (RT) • Stroop • Stroop (accuracy, RT) • Stroop (CW – C time) • Stroop (CW total) • Stroop (CW) • Stroop (CW, interference)	at Level 2, but not Level 3 (Q [71] = 291.74, p < 0.0001; tau2 at Level 2 was 0.06, p = .024, and tau2 at Level 3 was 0.05, p = .073)." **Conclusion** • "Many of the studies (n = 30) included in the meta-analysis demonstrated a statistically significant relationship between depression and cognitive control, reflected in lower performance in the depressed group compared to controls or a negative correlation between depressive symptom severity and scores on cognitive control measures (Fig. 2). None of the included studies demonstrated statistically significant differences in the opposite direction." • "This relationship was stronger in study samples with an older mean age, and within adult samples, but not

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Stroop (incongruent - congruent accuracy, RT) • Stroop (incongruent accuracy, RT) • Stroop (incongruent RT) • Stroop (interference errors) • Stroop (interference RT) • Stroop (interference score) • Stroop CW (error rate, RT) • Switch Task (switch cost, errors to switch trials) • TEA-Ch (accuracy, RT) • TMT-B ("points") • TMT-B (completion time) • TMT-B (completion time) Go/No-Go (accuracy) • TMT-B (completion time) TMT-B (completion time) • TMT-B (completion time) WCST (total errors) Stroop 5 (reading time) TMT-B (completion time) • TMT-B (completion time) WCST-64 (total errors) Stroop • TMT-B (completion time, errors) • TMT-B (errors) • TOL	child and adolescent samples." • "Consistent with our hypothesis, the relationship between cognitive control deficits and depression was stronger in later stages of the lifespan. Subgroup analyses showed that effect sizes did not significantly vary based on cognitive domain (cognitive flexibility, inhibition, and planning), comorbid anxiety, or test format (computerized vs. paper-and-pencil)." • "Within studies with a mean age of 39 years or higher, the relationship was stronger in clinical compared to subthreshold depression and in individuals taking antidepressant medication."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• TOL (number of excess moves, average initial thinking time, average subsequent thinking time, perfect solution percent) • TOL (number of excess moves, initial movement time, initial thinking time, perfect solution percentage, subsequent movement time, subsequent thinking time) • TOL (total moves across 10 trials) • Verbal fluency-alternation • WCST (“random error”, “total trial”, perseverative errors) • WCST (nonperseverative errors, perseverative errors, trials to completion) • WCST (number of categories) • WCST (number of categories, loss of set, perseverative errors) • WCST (number of categories, percent total correct, percent error, trials to first category) TMT-B (completion time)	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• WCST (number of categories, perseverative responses) • WCST (number of categories, total errors, perseverative responses, perseverative errors, loss of set, learning to learn) • WCST (number of errors) • WCST (number of trials, nonperseverative errors, perseverative errors) • WCST (number of trials, nonperseverative errors, perseverative errors, total errors) • WCST (percent conceptual level responses, perseverative errors, total errors, trials to first category) • WCST (percent errors) • WCST (perseverative errors) • WCST (perseverative errors, total errors, loss of set) • WCST (total errors) WCST-64 (number of categories, perseverative responses)	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
Duggan 2020 **Objective** Systematic review of longitudinal results on the aging-related dynamics linking pulmonary function and cognitive performance.	**Databases searched** • PsychINFO • PubMed • Web of Science **Dates searched** • NR **Supplementary searches** • NR **Number of studies included:** 14 studies of which 4 studies met full inclusion criteria (three or more measurement occasions on both pulmonary function and cognition); 3 "two-wave" studies (two measurement occasions of both cognition and	**Inclusion criteria** • Studies that used individual-level data from adult (age ≥18) community-dwelling samples • Studies including objective measurements of both pulmonary and cognitive functioning and analysis of association (i.e., not merely covariates in a model of another outcome variable), • Studies that analyzed longitudinal data (i.e., three or more measurement occasions) on both pulmonary function and cognition, • Studies reported original data in English. • Studies reporting two measurement occasions of both cognition and	Pulmonary functions	**Cognitive functions and/or abilities assessed** • Global cognition • Attention • Crystallized ability • Episodic memory • Executive function • Fluid reasoning • Memory (Fluid intelligence) • Processing speed (Fluid intelligence) • Semantic memory • Short-term memory • Spatial ability (Fluid intelligence) • Verbal ability • Verbal ability (Crystallized intelligence) • Visuospatial ability • Working memory **Tests and/or methods of outcome assessment** • Mini-Mental Status Examination (MMSE) • Block design • Card rotations	• Meta-analysis was not conducted. • Evidence from cross-sectional analyses: "The most reliable finding across all studies is the support for a concordant cross-sectional association between pulmonary function and cognition (i.e., higher pulmonary function is associated with better cognitive performance and lower pulmonary function is associated with poorer cognitive performance) in mid-life and older adults. • "There is currently little evidence to substantiate claims of longitudinal associations between pulmonary function and cognition."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
	pulmonary function; 7 "mixed-wave" studies (a single measurement of one variable and two or more measurements of the other)	pulmonary function ("two-wave" studies). • Studies with a single measurement of one variable (pulmonary function or cognition) and two or more measurements of the other ("mixed-wave" studies). **Exclusion criteria** • Intervention studies (e.g., rehabilitation or drug trials).		• Computation span task • Constructional praxis • Continuous performance • Delayed word list recall • Digit span • Digit span backward • Digit symbol • Fact recall test • Figure identification • Immediate word list recall • Information Synonyms Analogies • Letter series task • Pattern comparison • Pattern memory • Picture memory • Recognition vocabulary • Verbal fluency • Vocabulary • Word recall test	
Engeroff 2018 **Objective** "We performed a systematic review of the	**Databases searched** • PubMed • Web of Science	**Inclusion criteria** • Leisure PA [physical activity] assessed via objective (e.g., accelerometry) or subjective methods	Leisure physical activity throughout the adult lifespan of 18 years of age and older	**Cognitive functions and/or abilities assessed** • Global cognitive function • Attention • Executive function	• Meta-analysis was not conducted. • "Moderate- and vigorous-intensity leisure physical activity was associated with global cognitive function and

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
associations between adherence to leisure PA [physical activity] during adulthood and domain-specific cognitive function in old age. We hypothesized that PA over the adult life span (age 18+ years) is connected with maintained domain-specific cognitive functions during late adulthood (age 60+ years)."	**Dates searched** • NR-November 8, 2017 **Supplementary searches** • Google Scholar • References in identified articles **Number of studies included** 23 studies •N = 9 cross-sectional studies •N = 14 longitudinal studies	(e.g., questionnaires) during a time point or time span of adulthood (age 18+ years). • Cognitive function assessed during a time point or time span of old age, defined as a mean age of 60+ years • Cognitive function is defined as "an assessment/outcome that indicates the performance or decline in (1) a definable cognitive domain, or (2) multiple cognitive domains, or (3) overall/global cognitive function". • ≥10 years between at least one time point of leisure PA behavior and cognitive function assessment	Leisure PA is defined as "all activities that people participated in during their free time and that were not work related and did not involve life maintenance tasks such as housecleaning".	• Memory • Working memory **Tests and/or methods of outcome assessment** • Trail Making Test A • Stroop Color and Word Test (word reading and color naming condition) • Symbol Digit Modalities Test • Choice reaction time task • Wechsler Adult Intelligence Scale Digit-Symbol Test • D2 Test • Attention Network Test • Auditory Consonant Trigram Test • Judgement of Line Orientation Test • Letter Search Test • Automated Neuropsychological Assessment Metrics Battery	specific cognitive domains including executive functions and memory but not attention or working memory." • "Most studies assessed mid- to late-adulthood physical activity, thus information concerning the influence of young adult life-span physical activity is currently lacking." • "Observational evidence that moderate- and vigorous-intensity leisure physical activity is beneficially associated with maintained cognitive functions during old age is accumulating. Further studies are necessary to confirm a causal link by assessing objective physical activity data and the decline of cognitive functions at multiple time points during old age."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		• Participants with no cognitive impairments or mental illnesses **Exclusion criteria** • "Cognitive assessments were solely used to define a mental illness (such as mild cognitive impairment or dementia) using cut-off values or scoring systems" • PA effects were not assessed in a subsample with a mean age ≥60 years		• Mini-Mental State Examination (MMSE) subtest for attention/concentration • Simple reaction time task • Trail Making Test B • Stroop Color and Word Test (interference condition) • Phonemic Fluency Test • Word Fluency Test • Category Fluency Test • Alphabet Coding Task-15 • Wilde Test of Intelligence – Mirrored Figures • Delis-Kaplan Executive Function System (D-KEFS) Card-Sorting Test • D-KEFS Color-Word Inference Test • D-KEFS Verbal Fluency Test • Modified Wisconsin Card Sorting Task	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Wechsler Adult Intelligence Scale Digit-Span Test • Digit-Span Backward Test • Visual-Span Backward Test • Running Span Memory Task • Automated Neuropsychological Assessment Metrics Battery • Spatial Working Memory Test • Verbal Learning and Memory Test • Wechsler Memory Scale Logical Memory • Delayed Recall • California Verbal Learning Test II Immediate Recall and Delayed Recall • Rey Auditory Verbal Learning Test • Spatial Span Test • Paired Associates Learning Test	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Delayed Matching to Sample Test • Pattern Recognition Memory Test • Delayed Word List Recognition Task • Immediate Word List-Recall • Immediate Recall • Word fluency • 20-Word Short Term Verbal Free Recall • Word Learning Task • East Boston Memory Test, Immediate Recall, Delayed Recall • Medical College of Georgia Complex Figures Tet • Selective Reminding Test Memory, Cued Recall, Multiple Choice Recognition, Oral Delayed Recall • Picture association • Object naming	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Multitrial Word-List-Learning Task • MMSE • Modified MMSE • Telephone Interview for Cognitive Status • Cognitive Performance Scale • Wechsler Test of Adult Reading • 10-Item Short Portable Mental Status Questionnaire • Mattis Dementia Rating Scale • Multiple Choice Word Test • Raven's Standard Progressive Matrices • Primary Mental Abilities – Reasoning Measure • Adult Development and Enrichment Project Letter Series • Word Series	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Educational Testing Service Number Series • Nurnberger Altersinventar • Leistungsprufsystem • MMSE subtest – registration, repeating and orientation • Pattern recognition memory • Delayed Matching to Sample Task	•
Evans 2019 **Objective** "Given that social isolation may be associated with poor cognitive function in later life, we aimed to investigate, through a systematic review and metaanalysis of	**Databases searched** • PsycInfo • CINAHL • PubMed • AgeLine **Dates searched** • Inception- 8 January 2018	**Inclusion criteria** • English-language peer-reviewed publications • Study sample comprised community-dwelling individuals aged ≥50 years at baseline with no cognitive impairment • Social isolation measured as social network/contact and/or social engagement/activity	Social isolation assessed in terms of social network/contact or social engagement/activity	**Cognitive functions and/or abilities assessed** • Global cognition • Memory • Episodic memory • Semantic memory • Working memory • Immediate and delayed memory • Prospective memory • Verbal fluency	**Meta-analysis results: effect size (r) (95% CI), p value; measures of heterogeneity I2 and p value** <u>All social measures</u> • All cognitive measures: r=0.054 (0.043, 0.065), p<0.001; heterogeneity: I2= 58.86, Q=121.46, p<0.001; • Global measures: r= 0.061 (0.044, 0.079), p<0.001; heterogeneity: I2=78.80, Q=198.12, p<0.001

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
data from longitudinal cohort studies, the relationship between aspects of social isolation (including social activity and social networks) and cognitive function in community-dwelling older people.”	**Supplementary searches** • Searching reference lists (see PRISMA diagram) **Number of studies included** 65 (51 studies included in meta-analysis)	• Cognitive function, decline, or change assessed using a standardized measure of global cognition, memory, or executive function • Longitudinal study with at least one-year follow-up **Exclusion criteria** Studies that assessed dementia status as an outcome		• Perceptual speed • Spatial ability • Delayed spatial recognition • Visuospatial ability • Executive function • Abstraction **Tests and/or methods of outcome assessment** • MMSE • Modified MMSE • The Mental Status Questionnaire • The Short Portable Mental Status Questionnaire (SPMSQ) • PCL [Leganes' Cognitive Test (Prueba Cognitiva de Leganes)] • Clifton Assessment Procedure for the Elderly	• Memory: r= 0.050 (0.028, 0.072), p<0.001; heterogeneity: I2=64.51, Q= 33.81, p<0.001 • Executive function: r=0.031 (0.015, 0.047), p<0.001; heterogeneity: I2=34.95, Q=9.22, p=0.161 <u>Social activity</u> • All cognitive measures: r=0.070 (0.050, 0.089), p<0.001; heterogeneity: I2= 84.48, Q= 244.89, p<0.001 • Global measures: r=0.072 (0.048, 0.095), p<0.001; heterogeneity: I2=84.59, Q= 194.68, p<0.001 • Memory: r=0.049 (0.023, 0.075), p<0.001; heterogeneity: I2=71.39, Q= 31.46, p<0.001 • Executive function: r= 0.032 (0.011, 0.052), p=0.002; heterogeneity: I2=45.47, Q=9.17, p=0.103

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Short Index of Cognitive Function • Mattis Dementia Rating Scale • Cognitive Performance Scale • Community Screening Instrument for Dementia (CSID) • Mini-D • Fuld object memory evaluation • Rey Auditory Verbal Learning Test • Boston naming test • Verbal fluency • Reading test • Delayed recognition span test • Similarities subtest of the WAIS-R • Figure copying • the Barcelona test • Short story recall	Social network • All cognitive measures: r=0.072 (0.032, 0.112), p<0.001; heterogeneity: I2=89.77, Q= 156.41, p<0.001 • Global measures: r=0.067 (0.026, 0.108), p<0.001; heterogeneity: I2=90.13, Q= 151.95, p<0.001 • Memory: r= 0.107 (-0.041, 0.250), p=0.156; heterogeneity: I2=66.51, Q=2.99, p=0.084 • Executive function: -- Combination of social activity and social networks • All cognitive measures: r= 0.036 (0.024, 0.049), p<0.001; heterogeneity: I2=0.00, Q=7.32, p=0.604 • Global measures: 0.036 (0.020, 0.052), p<0.001; heterogeneity: I2=6.05, Q=8.52, p=0.385

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Recall test • List learning and recall • Immediate and delayed recall, word list memory, recall, and recognition • Immediate and delayed verbal learning task • Immediate and delayed word recall • Word and story recall • Category recall • Fact recall • Vocabulary • Free and cued recall and recognition • Category fluency test • Cross-out test • Digit span forward and backward • Digit ordering • Symbol digit modalities test	• Memory: r=0.046 (0.021, 0.070), p<0.001; heterogeneity: I2=0.00, Q=0.16, p=0.693 • Executive function: -- <u>All social measures and all cognitive measures</u> • Men: r= 0.048 (0.021, 0.074), p<0.001; heterogeneity: I2=7.48, Q=6.49, p=0.371 • Women: r=0.059 (0.028, 0.090), p<0.001; heterogeneity: I2= 61.83, Q=18.34, p=0.011 • Follow-up 2-3 years: r=0.046 (0.030, 0.062), p<0.001; heterogeneity: I2=49.00, Q=29.41, p=0.014 • Follow-up 4-9 years: r=0.058 (0.036, 0.080), p<0.001; heterogeneity: I2=69.63, Q=65.86, p<0.001 • Follow-up 10-24 years: r=0.059 (0.039, 0.078),

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Number comparison • Stroop test • Judgement line orientation • Raven's standard progressive matrices • Similarities fluency task • Modified Telephone Interview for Cognitive Status – Memory (TICS-M) • Modified Telephone Interview for Cognitive Status – Mental status (TICS-Mental status) Remembering to carry out a previous instruction	p<0.001; heterogeneity: I2=60.09, Q=40.09, p<0.001 <u>By type of social activity</u> • Social and community activities: r= 0.037 (0.020, 0.054), p<0.001; heterogeneity: I2=0.00, Q=7.79, p=0.555 • Frequency of visits from or to family, friends, and neighbors: r= 0.074 (0.029, 0.120), p<0.001; heterogeneity: I2=79.06, Q=33.42, p<0.001 • Voluntary or paid work: r=0.043 (0.024, 0.062), p<0.001; heterogeneity: I2=19.72, Q=8.72, p=0.273 • Cultural and leisure activities: r= 0.090 (0.028, 0.151), p=0.005; heterogeneity: I2=95.91, Q= 317.48, p<0.001 <u>By characteristics of social network</u>

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					• Social network size: r= 0.048 (0.022, 0.074), p<0.001; heterogeneity: I2=13.00, Q=5.75, p=0.332 • Frequency of interaction with social contacts: -- • Marital status: r= 0.015 (-0.021, 0.050), p=0.413; heterogeneity: I2=0.00, Q=0.08, p=0.774 • Living arrangements and proximity to other family: -- <u>Studies using Mini-Mental State Examination (MMSE)</u> • All social measures: r= 0.038 (0.025, 0.050), p<0.001; heterogeneity: I2= 18.71, Q=20.91, p=0.230 • Social activity: r= 0.042 (0.023, 0.062), p<0.001; heterogeneity: I2=29.60, Q= 15.63, p=0.156 • Social network: r=0.031 (0.015, 0.048), p<0.001;

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					heterogeneity: I2=5.57, Q=6.35, p=0.385 • Combination of social activity and social networks: r=0.036 (0.012, 0.061), p=0.003; heterogeneity: I2=21.1, Q=2.54, p=0.282 • Removing three articles with large effect sizes resulted in a considerable reduction in heterogeneity and a slight reduction in effect sizes • Heterogeneity was also reduced when analysis was restricted to studies that assessed cognitive function using the MMSE; the effect sizes were reduced but remained statistically significant. **Conclusion** • "We have demonstrated that in later life larger social networks and engagement in social activity are associated with better cognitive function. The reported

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					association was small, which may be attributed to the methodological issues associated with assessing social concepts and the fact that social connections is only one of many factors that influence cognitive function over time." • "Aspects of social isolation are associated with cognitive function in later life. There is wide variation in approaches to measuring social activity and social networks across studies which may contribute to inconsistencies in reported findings."
Forte 2020 **Objective** "… to systematically analyze the results found by the studies that investigated whether high	**Databases searched** • PubMed • PsychINFO • Medline • PsycArticles **Dates searched**	**Inclusion criteria** • "studies that included the adult population (age equal to or higher than 18 years), one or more cognitive measure(s), and that analyzed the	Blood pressure	**Cognitive functions and/or abilities assessed** • Global cognitive performance / function • Memory • Attention • Executive functions	• Meta-analysis was not conducted. • "High blood pressure in midlife was linked with poorer cognitive functioning; this evidence was found in cross-sectional and longitudinal studies. However, this association

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
blood pressure, in both hypertensive and healthy people, is related to cognitive performance. Furthermore, it points to evaluate the role of age in this relationship."	• NR - August 2020 **Supplementary searches conducted** • Searched references of articles retrieved **Number of studies included** • N = 68 (including 20 cross-sectional and 9 longitudinal studies in "elderly" [65–74 years], 5 cross-sectional and 6 longitudinal studies in "old age" [≥75 years]	relationship with blood pressure (BP)" **Exclusion criteria** • "Review and randomize control trial or intervention studies" • "… studies that included participants with medical conditions that could potentially influence the investigated relationship (for example, individuals with other CVDs)" • "studies that included participants diagnosed with dementia, psychiatric disorders, strokes, and head traumas" • "studies that presented methodological criticisms" • "studies that do not report essential data"		• Visuospatial abilities • Processing speed • Psychomotor speed • Visual memory • Verbal abilities / memory / semantic fluency • Language skills • Mental control • Abstract thinking • Cognitive flexibility • Immediate recall **Tests and/or methods of outcome assessment** • Mini-Mental State Examination • Psychomotor tests • Cognitive Abilities Screening Instrument (CASI) • Montreal Cognitive Assessment (MoCA)	declines with increasing age and tends to become inconsistent. In older people, the relationship between blood pressure and cognitive performance is non-linear, highlighting a beneficial effect of high blood pressure on cognition." • "… the association of BP in elderly and old age with cognitive performance is unclear, with evidence of non-linear relation and beneficial effects of high BP on attention, memory, executive functions, and global cognition. These results show that elderly and old adults need an appropriate BP level to maintain adequate cerebral perfusion." • "The optimal BP levels required to maintain high cognitive functioning in elderly people should be further investigated."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
Gifford 2013 **Objective** • "… this meta-analysis aims to better understand and clarify how blood pressure affects specific cognitive systems independent of etiology (e.g., AD, microvascular pathology) in older individuals without a history of clinical stroke or dementia."	**Databases searched** • PubMed, • PsycInfo **Dates searched** • PubMed: 1966 – October 1, 2013 • PsychINFO: 1877 – October 1, 2013 **Supplementary searches** • NR **Number of studies included:** 12	**Inclusion criteria** • Published peer-reviewed data from an observational study (cross-sectional or longitudinal prospective) • Objective cognitive measure(s) • Includes participants with hypertension (systolic blood pressure >140 mmHg and/or diastolic blood pressure >90 mmHg) • Provides average values of systolic and diastolic blood pressure • Includes participants with a mean age of ≥55 years • Explicitly excludes participants with clinical dementia/AD and stroke	Blood pressure	**Cognitive functions and/or abilities assessed** • Global cognition • Episodic memory • Language • Attention • Executive function • Information processing speed • Visuoperceptual skills **Tests and/or methods of outcome assessment** • Composite Scores • MMSE • California Verbal Learning Test-II • CERAD Word List Immediate and Delay Recall • WMS-R Logical Memory I and II	<u>Meta analysis of unadjusted studies</u> • Global cognition (n=5 studies): r=-0.07 (99%CI: -0.13; -0.02); p<0.001. Meta-analysis limited to composite measures of global cognition (excluding MMSE): r=-0.10 (99% CI: -0.17; -0.03); p<0.001 • Episodic memory (n=10 studies): r=-0.18 (99%CI: -0.25; -0.12); p<0.001 • Language (n=3 studies): r=-0.03 (99%CI: -0.18; 0.12); p=0.62 • Attention (n=5 studies): r=0.09 (99%CI: -0.01; 0.19); p=0.02 • Executive functioning (n=9 studies): r=-0.08 (99%CI: -0.25; 0.09); p=0.21 • Information processing speed (n=5 studies): r=-0.03 (99%CI: -0.06; 0.00); p=0.02 • Visuoperceptual abilities (n=4 studies): r=0.00 (99%CI: -0.12; 0.13); p=0.98

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		• Reports sufficient data to allow calculation of a correlation coefficient • English language • **Exclusion criteria** • Randomized control trials and intervention studies • Other studies not meeting the inclusion criteria		• WMS-III Logical Memory I and II • Morris Word List Immediate and Delay Recall • WMS-R Visual Reproduction I and II • WMS-III Visual Reproduction I and II • Animal Fluency • Boston Naming Test • Category Fluency • WAIS or WMS-R digit span forward • WAIS or WMS-III-digit span forward • WMS-R Visual Span-Tapping Forward • Clock Drawing • WAIS or WMS-R digit span backward • WAIS or WMS-III-digit span backward	• Comparison across cognitive domains: stronger correlation with episodic memory than with attention, information processing speed, or visuospatial skills. • Systolic versus diastolic blood pressure: Diastolic blood pressure was more strongly correlated with episodic memory (r=-0.29; 99% CI: -0.38 to -0.18); p<0.001) than systolic blood pressure (r=-0.09; 99% CI: -0.12 to -0.05; p<0.001) <u>Meta-analysis of studies that adjusted for vascular covariates</u> • Global cognition (n=3 studies): r=-0.11 (99% CI: -0.18; -0.04); p<0.001 • Episodic memory (n=7 studies): r=-0.20 (99% CI: -0.28; -0.12); p<0.001 • Language (n=1 study): r=-0.22 (99%CI: -0.50; 0.09); p=0.07 • Attention (n=4 studies): r=0.14 (99% CI: 0.03; 0.25); p=0.002

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Everyday Problem Solving 3 EXIT 25 • Letter Fluency • Stroop Color-Word Test • Trails B • Verbal Fluency • WMS-R Visual Span-Tapping Backward • Word Fluency • Working Memory Composite • Trails (Motor speed and scanning subtests) • Trials A • WAIS-R Digit Symbol Coding • WAIS-III Digit Symbol Coding • WAIS-R Block Design • Figure-copying Test • Judgment of Line Orientation • Pattern Comparison Test	• Executive functioning (n=7 studies): r=-0.12 (99% CI: -0.34; 0.12); p=0.20 • Information processing speed (n=3 studies): r=-0.01 (99%CI: -0.07; 0.04); p=0.47 • Visuoperceptual abilities (n=3 studies): r=0.00 (99% CI: -0.14; 0.15); p=0.97 • Comparison across cognitive domains: blood pressure was more strongly negatively correlated with episodic memory than with attention or processing speed; with global cognition than with attention. • Systolic vs. diastolic blood pressure: Diastolic blood pressure was more negatively correlated with episodic memory (r=-0.32; 99% CI: -0.4 to -0.21; p<0.001) than systolic blood pressure (r=-0.10; 99% CI: -0.15 to -0.05; p<0.001). • "… results from the current meta-analysis offer some insight into the specific cognitive domains affected by blood pressure and

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					suggest that in a group of at-risk older adults free of clinical dementia and stroke brachial artery, blood pressure is modestly correlated with lower cognitive performances, specifically within the areas of global cognition, episodic memory, language, and executive functioning.”
Gu 2019 **Objective** “The purpose of the present review was to objectively evaluate the research literature regarding the effects of OSE [open skill exercise] versus	**Databases searched** • Web of Science • EMBASE • Google Scholar • PubMed • PsycINFO • SPORTDiscus **Dates searched** • Inception – December 2018[19]	**Inclusion criteria** • Observational and intervention studies published in English-language peer reviewed journals • Both OSE and CSE are clearly defined and simultaneously examined • At least one measurement of any aspect of cognitive functioning	Physical exercise, open skill and closed skilled	**Cognitive functions and/or abilities assessed** [in observational studies of older adults] • Cognitive flexibility • Visuospatial working memory • Visuospatial attention • Inhibitory control **Tests and/or methods of outcome assessment** [in	• Meta-analysis was not conducted. • “In the older adults, evidence from this review’s six observational studies … and two intervention studies … consistently support a beneficial role of exercise on cognitive function. Furthermore, three observational studies … and two intervention studies … suggested that, in this population, OSE may be more effective for improving

[19] Searching for “for all research in these databases up to December 2018”

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
CSE [closed skill exercise] on cognitive function."	**Supplementary searches** • Bibliographies of all eligible articles **Number of studies included** • 19 (14 observational and 5 intervention studies). • Of the 14 observational studies 6 included adults older than 55 years.	**Exclusion criteria** • Combined interventions (e.g., OSE, CSE and a nutritional program)		observational studies of older adults] • Task-switching paradigm • Visuospatial working memory task (VWMT) • Visuospatial short-term memory task (VSMT) • Visuospatial mental rotation task (VMTT) • Eriksen flanker task • Stroop Color-Word Interference Test (SCWIT) • Central cue Posner paradigm	attention, audio-visual perception, or cognitive flexibility. However, in this population as in others, it is worth noting that the beneficial effects of CSE (e.g., jogging) should not be neglected, even though there may be superior cognitive benefits for OSE."
Hudon 2020 **Objective** "This meta-analysis assessed (a) the predictive	**Databases searched** • Medline (PubMed), • Embase (Ovid) • PsycINFO • Web of Science	**Inclusion criteria** • "participants were middle-aged or older adults (no predefined or specific age range) either without cognitive impairment or persons with subjective cognitive decline.	Behavioral and psychological symptoms	**Cognitive functions and/or abilities assessed** • Global cognition • Verbal knowledge • Verbal fluency • Figural memory	<u>Effects of behavioral and psychological symptoms on cognitive score change</u> • Anxiety symptoms (n=2 studies): OR=1.57 (95% CI: 0.78; 3.16); I2=0% (p=0.80) • Depressive symptoms and depression (n=5 studies):

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
accuracy of the most frequent behavioral and psychological symptoms tested as predictors of cognitive decline, (b) the predictors common to a given outcome, and (c) the predictors specific to a given outcome.”	**Dates searched** • Inception – January 17, 2017 **Supplementary searches** • Reference lists of eligible articles and relevant literature reviews • “…post-hoc literature search was performed to identify eligible studies published after January 2017. No study met the strict eligibility criteria of this meta-analysis.” **Number of studies included**	Studies needed to report enough information to confirm the absence of cognitive impairment.” • “use of behavioral or psychological questionnaires, and diagnostic interviews were used to identify non-cognitive symptoms or psychiatric clinical conditions…” • “follow-up of at least one year” • “control group showing no evidence of the reported behavioral and psychological symptoms or psychiatric clinical conditions” • cognitive measure score change, diagnosis of MCI, Alzheimer’s disease or dementia as an outcome		• Verbal memory • Attention • Working memory • Spatial ability • Processing speed • Executive functions • Visuospatial memory • Episodic memory • Language **Tests and/or methods of outcome assessment** • Mini-Mental State Exam (MMSE) • Modified Mini-Mental State (3MS) • Telephone Interview for Cognitive status-modified (TICS-m) • Trail B • Delayed 10-Word Recall Test (DWRT-10)	OR=1.70 (95% CI: 1.25; 2.31); I2=78% (p<0.01) • Long sleep duration (n=6 studies): OR=1.24 (95% CI: 1.05; 1.48); I2=1% (p=0.41) • Short sleep duration (n=6 studies): OR=1.34 (95% CI: 1.11; 1.62); I2=23% (p=0.26) • Sleep disturbances (n=2 studies): OR=1.17 (95% CI: 1.17; 2.62); I2=0% (p=0.33) • Sleep latency (n=2 studies); OR=1.15 (95% CI: 0.93; 1.41); I2=0% (p=0.73) • Subjective sleep quality: OR=1.27 (95% CI: 0.93; 1.73); I2=0% (p=0.45) • “…after a one-year follow-up, clinically significant anxiety (syndrome) did not predict a significant MMSE score change.” • “…depression or depressive symptoms appear good predictors of a cognitive score change.” • “Long and short sleep duration was also

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
	• 28 (13 studies of cognitive score change as an outcome) [see table 1]	• retrospective or prospective study design • "studies needed to report an association estimate (relative risk, odds ratio, or hazard ratio) with confidence intervals" **Exclusion criteria** • Cross-sectional studies or randomized-control trials • Published in an abstract format • Examined biomarkers • Published in languages other than English or French		• Naming, construction • Delayed spatial recognition • Abstraction • Delayed incidental recall • Animal fluency	consistently associated with a cognitive score change in follow-up." • "… sleep disturbances were associated with a cognitive score change after one year …" • Difficulties initiating sleep (sleep latency) and subjective sleep quality did not predict a significant cognitive score change. Note. Examples of sleep disturbances studied: wake after sleep onset, number of long wake episodes, difficulties maintaining sleep, use of sleep medication (see Supplemental Materials)
•	•	•		•	•
Issa 2006 **Objective**	**Databases searched** • Medline	**Inclusion criteria** • Human subjects	Omega–3 Fatty Acid Intake	**Cognitive functions and/or abilities assessed** • Global cognition	• Meta-analysis was not conducted. • **"**A single cohort study has assessed the effects of

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
"A systematic literature review was performed in order to determine whether sufficient evidence exists to substantiate claims of a health benefit for omega–3 fatty acids on cognitive function in normal aging and in dementia".	• PreMedline • EMBASE • Cochrane Central Register of Controlled Trials • Dissertations Abstracts • CAB Health **Dates searched** • Medline: 1966 – 2003 • PreMedline: December 2003 • Embase: 1980 – 2003 • Cochrane central Register of Controlled trials: Q4, 2003 • Dissertation abstracts: 1861 – 2003	• Study design: controlled clinical trials (randomized or nonrandomized), prospective cohort and case-control studies, case series • Study describes a difference in omega–3 fatty acid content between study arms (this criterion was not applied to case series) • Study describes the effect of omega–3 fatty acids on cognitive function in normal aging, incidence of dementia or treatment of dementia. **Exclusion criteria** • Cross-sectional studies • Case reports		**Tests and/or methods of outcome assessment** • MMSE ["Cognitive decline was defined as a drop of more than two points in the MMSE over a 3-year period, which corresponds to the 15th percentile of change."]	omega–3 fatty acids on cognitive function with normal aging and found no association for fish or total omega-3 consumption." • "The data … are insufficient to draw conclusion about the effects of omega–3 fatty acids on cognitive function in normal aging…"

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
	• CAB Health: 1973 – 2003 **Supplementary searches** • "references of relevant literature" **Number of studies included** • 5 (1 study on cognitive function in normal aging)				
Kelly 2017 **Objective** " … to evaluate the association between different aspects of social relationships; specifically social activity, social networks,	**Databases searched** • PubMed • Medline • PsychInfo **Dates searched** • January 2000 to January 2017 •	**Inclusion criteria** • "(1) peer-reviewed and academically published observational, RCT or twin studies" • "(2) investigated the impact of engagement in social activities, social networks or social support on cognitive function"	Social relationships (social activity, social networks, social support, and composite measures)	**Cognitive functions and/or abilities assessed** • Global cognition • Global / composite measures of cognitive function • Episodic memory • Semantic memory • Overall memory ability (global / composite measures)	• Meta-analysis was not conducted • "The results support prior conclusions that there is an association between social relationships and cognitive function but the exact nature of this association remains unclear."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
and social support, with the cognitive functioning of healthy older adults with no known cognitive impairment."	**Supplementary searches conducted** • Searched Google Scholar • Hand Searched reference lists of reviews and studies **Number of studies included** • N = 34 observational studies • N = 3 RCT • N = 2 twin studies	• "(3) included a sample of community dwelling older adults (> 50 years) with no known cognitive impairment." **Exclusion criteria** • "participants had been diagnosed with any cognitive impairment, cardiovascular disease, or other significant medical, psychiatric or neurological problems" • "studies that combined data from participants with cognitive function within the normal range with data from participants experiencing cognitive decline"		• Working memory • Verbal fluency • Reasoning • Attention • Processing speed • Visuospatial abilities • Overall executive functioning (global / composite measures) **Tests and/or methods of outcome assessment** • Composite of Auditory Verbal Learning Test (AVLT), Category Verbal Fluency Test (CVLT) • Bell cancellation Test • Stroop • Trail making Test (TMT) A • Category • Rey Complex Figure Task (CFT)	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Wechsler Adult Intelligence Scale (WAIS) Digit Span • WAIS Similarities • Boston Naming Test • Clock-Drawing Test • Mattis Dementia Rating Scale (MDRS) • Cambridge Tests of Cognitive Function (Cantab) • Hopkins Verbal Learning Test (HVLT) • Raven's Progressive Matrices • Digit Span • Flanker Task • Mini Mental Status Examination (MMSE) • Alzheimer's disease Assessment Scale-Cognition (ADAS-Cog) • 15D • AVLT: 15 Words Test	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Raven's Coloured Progressive Matrices • Coding Task • Modified MMSE: 3MS • Composite of episodic memory, perceptual speed, and MMSE • Leganes' Cognitive Function Test • PCL: composite of orientation and memory items from Short Portable Mental Status Questionnaire • The Barcelona Test • Established populations for epidemiologic studies of the elderly (EPESE) short story recall • Lexical decision making • Semantic decision making • Simple and choice reaction time	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Ten Word Delayed Recall Test • Immediate recall • Delayed recall • Category Fluency Task • Verbal Learning Test • Letter-Digit Coding Test • Word Fluency Task • Short Portable Mental Status Questionnaire (SPMSQ) • WAIS-revised (R) Digit Symbol Substitution (DSS) • Letter Series Test • Educational Testing Service Kit-Controlled Associations Test (ETS-CA) • ETS-Recognition Vocabulary • Composite of Hayling Sentence Completion Test, Stoop, Brixton Test, Colour Trails, computational span, and reading span	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Composite of coding task, Raven's, and MMSE • Telephone Interview for Cognitive Status (TICS) • Clifton Assessment Procedure for the Elderly (CAPE) • TMT B • Composite score from 19 tests • Logical Memory • East Boston Story • Word List Memory • Word List Recall • Word List Recognition • Boston Naming Verbal Fluency • Reading test • Digit Span Forward and Backward • Digit Ordering	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Symbol-Digit Modalities Test (SDMT) • Number Comparison • Line Orientation • Standard Progressive Matrices • Brief Cognitive Function Examination • Digit Letter • Identical Pictures • Composite of free and cued recall tasks • Recognition tasks • Composite of three verbal fluency tasks and a vocabulary test • MDRS – Initiation and Perseveration Subtest • Fuld Object Memory Evaluation • Clock Drawing Test • WAIS-R Vocabulary	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Composite score: Boston Naming Test, WAIS-R Similarities, copying task, delayed spatial recognition, incidental recall, delayed recall • Story recall • Fast recall • Cognitive Performance Scale • Community Screening Instrument for Dementia (CSID) • Word List Learning • IU Story Recall • Animal Fluency Test • IU Token Test • California Verbal Learning Test (CVLT) immediate recall • Wechsler Memory Scale – Digit Span Backward (WMS-DSB) • Composite of Logical Memory Story A, RAVLT,	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				Benson Visual Retention Test (BVRT) • Composite of TMT-A, Digit Symbol Coding • Composite of Controlled Oral Word Association Test (COWAT), Boston Naming Test • Composite of Digit Span Backward, TMT-B/A, Stroop • Composite of four cognitive domain scores	
Lee 2018 **Objective** "… to examine the effects of varying levels of milk intake alone or in combination with other dairy products on the outcomes of cognitive function and	**Databases searched** • PubMed • CINAHL • EMBASE **Dates searched** • PubMed: Inception to Sept 18, 2017 • CINAHL: Inception to Oct 12, 2017	**Inclusion criteria** • "prospective cohort studies and intervention trials with follow-up durations of longer than 4 weeks in adults" • "aged 18 years or older" • "have compared varying doses of milk intake, alone or in combination with other dairy products (i.e., yogurt and cheese)"	**Factors** • Milk intake alone • Milk intake with other dairy products	**Cognitive functions and/or abilities assessed** • Verbal memory • Processing speed • Working memory • Visual attention • Verbal fluency • Abstract reasoning • Selective attention	• One cohort study found that the regular full-cream milk consumption group demonstrated a significant decrease in successful mental health aging compared with the rare consumption group (adjusted hazard ratio = 0.63; 95% CI: 0.45, 0.89) [36]. The other two studies found no significant associations between milk and dairy consumption and cognitive decline [34, 35]. …"

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
disorders in adults."	• EMBASE: Inception to Oct 12, 2017 **Supplementary searches conducted** NR **Number of studies included** • N = 1 RCT • N = 7 Cohorts • N=3 cohort studies of cognitive decline were meta-analyzed	• "reported outcomes related to cognitive function, including any stage of dementia (i.e., cognitive decline, mild cognitive impairments, and dementia) or any type of dementia (i.e., Alzheimer's disease and vascular dementia)" **Exclusion criteria** • "schizophrenic patients" • "measured only isolated specific nutrients in milk"		• Executive function **Tests and/or methods of outcome assessment** • Rey Auditory Verbal Learning Test (RAVLT) total • RAVLT delayed verbal recall • RAVLT written recall • Digit symbol coding • Inspection time • Spatial Span forward • Spatial Span backward • Spatial Span total • Letter Number Sequencing • Letter cancellation • Initial letter fluency • Matric reasoning • Stroop interference • Design fluency total • Depression Anxiety Stress Scale (DASS) total	• "Studies were synthesized qualitatively using a strength of evidence (SoE) rating tool." • "…the overall SoE was rated as insufficient regarding the associations between milk intake and cognitive decline, dementia, and Alzheimer's disease outcomes." • "Our random-effects meta-analysis results did not show significant differences in risk for cognitive decline or cognitive impairment by comparing the highest milk intake to lowest intake groups (pooled adjusted risk ratio = 1.21; 95% CI: 0.81, 1.82), with large statistical heterogeneity (I2 = 64.1%) …" • "Based on best available evidence, we concluded that the overall strength of evidence is inadequate for the effects of milk or dairy consumption on cognitive

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Mini-Mental State Examination (MMSE) • Geriatric Depression Scale 15 (GDS-15) • Delis-Kaplan trail-making test (TMT) • RI-48 test • Delayed Word Recall Test (DWRT) • Digit Symbol Substitution Test (DSST) • Word Fluency Test (WFT) • Observed cognitive deterioration (DECO) score • Instrumental activities of daily living (4-IADL) score	decline and disorders, due to the insufficient number of high-quality studies and large heterogeneity across studies." • "The existing evidence (mostly observational) is too poor to draw a firm conclusion regarding the effect of milk or dairy intake on the risk of cognitive decline or disorders in adults."
Lei 2019 **Objective** A systematic review and meta-analysis to study the true	**Databases searched** • Cochrane Library • Medline • EMBASE • China National Knowledge	**Inclusion criteria** • Studies in English or Chinese languages • Studies with more than 10 subjects • Age of participant: 18+ years old	• Silent Brain Infarcts (SBI)	**Cognitive functions and/or abilities assessed** • Global cognitive function • Intelligence • Abstraction • Associational memory of portraits • Attention	• Meta-analysis of continuous data on the relationship between SBI and Mini-Mental State Examination: SMD=-0.47 (95% CI: -0.72, -0.22), test for overall effect Z=3.65 (p=0.0003); heterogeneity: tau2=0.11,

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
association between SBI and cognitive function and SBI and special domain of cognitive function limited, including memory, motor function, visual perception, intelligence, attention, language, and executive function.	Infrastructure database **Dates searched** • Cochrane Library: Issue 12, 2016 • Medline: 1966 – May 2016 • EMBASE: 1980 – May 2016 • China National Knowledge Infrastructure database: 1999 – May 2016 **Supplementary searches** • Bibliographies of included studies **Number of studies included** • 22 studies (19 case-control and 3 cohort)	• Participants without nervous and psychiatric system diseases seriously affecting cognitive function. • SBI defined as round or ovoid lesions 3-15 mm in diameter, with hypointensity on T1-weighted images and hyperintensity on T2-weighted images and excluded perivascular spaces • Studies had to be controlled, with participants divided into the SBI group and non-SBI group. • Studies had to evaluate either global cognitive function or at least domains of cognitive function separately, including psychomotor speed, fluency, attention, memory, processing speed, executive function,		• Calculation • Direction memory • Executive function • Word/Verbal Fluency • Language • Meaningless figures recollection • Memory • Memory quotient • Motor function • Naming • Pictures freely memory • Processing speed • Psychomotor speed • Recall • Visual perception **Tests and/or methods of outcome assessment** • Auditory-verbal learning test (AVLT) • Block Test (BT) • Clinical memory scale • Clock-drawing Test (CDT) • Digit-Symbol Substitution test • Kana-Hiroi'' test	chi2=29.64, df=8 (P=0.0002), I2=73% • Meta-analysis of continuous data on the relationship between SBI and Montreal Cognitive Assessment Scale: SMD=-3.66 (95% CI: -5.90, -0.82), test for overall effect Z=2.59 (p=0.01); heterogeneity: tau2=6.60, chi2=256.30, df=3 (P<0.00001), I2=99% • Meta-analysis of dichotomous data on the relationship between SBI and Montreal Cognitive Assessment Scale: OR=3.08 (95% CI: 2.08, 4.57), test for overall effect Z=5.61 (p<0.00001); heterogeneity: chi2=2.67, df=3 (P=0.45), I2=0%. • "Meta-analysis of 9 studies showed that SBI was an important factor in cognitive function decline." • "Another meta-analysis of 4 studies reported the SBI was

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		naming, calculation, language, recall, and abstraction. • Outcome measures had to include the presence of SBI. • Cognitive impairment had to be scored according to a widely accepted standardized scale, and was defined as statistically significant deterioration in global cognitive function in any domain of cognitive function. **Exclusion criteria** • NR		• Letter Digit Substitution test • MMSE • Modified MMSE • Montreal Cognitive Assessment Scale (MOCA) • Neuropsychological tests • Perdue Peg Board test • Raven's colored progressive matrices (RCPM) test • Revised Visual Retention Test (VRT) • Stroop test • Three word-recall lists (12 words each) • Verbal Fluency Test (BFT) Word fluency test (WFT)	an independent factor in cognitive dysfunction" • "Ten studies further reported that SBI was associated with decreases in specific areas of cognitive function." • "These results suggest that rather than being clinically silent, SBI might be a factor inducing cognitive dysfunction."
Loughrey 2017 **Objective** "This systematic review and meta-analysis examines the impact of the	**Databases searched** • PubMed • Cochrane Library • EMBASE • Scopus database **Dates searched**	**Inclusion criteria** • "Cohort studies and RCTs that investigated the effects of the MeDi on the cognitive function of community-dwelling older adults	• Mediterranean diet	**Cognitive functions and/or abilities assessed** • Global cognition • Immediate recall • Verbal fluency • Attention • Episodic memory	<u>Cohort studies</u> • Global cognition (n=13 studies): r= 0.051 (95% CI: 0.026, 0.077), z= 3.95 (p<0.001); heterogeneity: Q=9.17 (p<0.001), I2= 85.82%

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
MeDi [Mediterranean diet] on the cognitive functioning of healthy older adults ”	• NR **Supplementary searches conducted** • Reference lists in reviews • Authors' files • Google Scholar **Number of studies included** <u>Qualitative Synthesis</u> • N = 15 observational studies • N = 2 RCTs <u>Quantitative Synthesis</u> • N = 14 observational studies • N = 2 RCTs	(aged ≥50 y) with no known cognitive impairment were included.” • “RCTs required ≥10 participants/condition to be included in the review.” **Exclusion criteria** • “We excluded studies if participants had a diagnosis of any cardiovascular disease or other serious medical, psychiatric, or neurological problems” •		• Executive functioning • Semantic memory • Working memory • Processing speed • Reasoning • Delayed recall • Paired associates **Tests and/or methods of outcome assessment** • Benton Visual Retention Test (BVRT) • Free and Cued Selective Reminding Test (FCSRT) • Composite Rey Complex Figure Test (RCFT) • Composite Telephone Interview for Cognitive Status – Modified (TICS-mod) • Telephone Interview for Cognitive Status (TICS) • Stroop • Tower of London (TOL) • Digit Span Forward (DSF) • Wechsler Adult Intelligence Scale (WAIS) IV SS • Coding • Excluded Letter Fluency (ELF) • Initial Letter Fluency (ILF)	• Attention (n=1 study): r= 0.025 (95% CI: -0.06, 0.11), z=0.58 (p=0.56); heterogeneity: Q=0 (p>0.99), I2=0% • Episodic memory (n=5 studies): r= 0.015 (95% CI: -0.01, 0.039), z=1.16 (p=0.24); heterogeneity: Q=11.13 (p=0.03), I2=64.05% • Immediate recall (n=1 study): r= 0.029 (95% CI: -0.03, 0.088), z= 0.96 (p=0.34); heterogeneity: Q=0 (p>0.99), I2=0% • Processing speed (n=1 study): r= 0.146 (95% CI: 0.079, 0.212), z=4.24 (p<0.001); heterogeneity: Q=0 (p>0.99), I2=0% • Reasoning (n-1 study): r= 0.107 (95% CI: 0.039, 0.173), z=3.09 (p=0.002); heterogeneity: Q=0 (p>0.99), I2=0% • Semantic memory (n=2 studies): r= 0.076 (95% CI: -0.062, 0.212), z= 1.079

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Digit Span Backwards (DSB) • Letter Number Sequencing (LNS)	(p=0.28); heterogeneity: Q= 6.51 (p=0.01), I2=84.63 • Verbal fluency (n=1 study): r= 0.043 (95% CI: -0.016, 0.102), z=1.42 (p=0.16); heterogeneity: Q=0 (p>0.99), I2=0% • Working memory (n=2 studies): r=0.007 (95% CI: -0.15, 0.164), z= 0.09 (p=0.93); heterogeneity: Q=8.5 (p=0.004), I2=88.24% <u>Randomized controlled trials</u> • Global cognition (n=2 studies/subgroups): SMD=0.19 (95% CI: 0.003, 0.39), z=1.99 (p=0.047); heterogeneity: Q=0.54 (p=0.46), I2=0% • Attention (n=3 studies/subgroups): SMD=-0.06 (95% CI: -0.036, 0.24), z=-0.4 (p=0.69); heterogeneity: Q=6.3 (p=0.04), I2=68.23% • Delayed recall (n=2 studies/subgroups): SMD=0.26 (95% CI: 0.07,

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					0.45), z=2.63 (p=0.01); heterogeneity: Q=0.35 (p=0.55), I2=0% • Episodic memory (n=3 studies/subgroups): SMD=0.19 (95% CI: -0.07, 0.45), z=1.42 (p=0.15); heterogeneity: Q=4.75 (p=0.09), I2=57.85% • Immediate recall (n=3 studies/subgroups): SMD=0.12 (95% CI: -0.05, 0.28), z=1.39 (p=0.17); heterogeneity: Q=1.96 (p=0.38), I2=0% • Paired associates (n=3 studies/subgroups): SMD=0.13 (95% CI: -0.07, 0.32), z=1.29 (p=0.2); heterogeneity: Q=0.06 (p=0.81), I2=0% • Processing speed (n=2 studies/subgroups): SMD=-0.11 (95% CI: -0.34, 0.12), z=0.93 (p=0.35); heterogeneity: Q=3.87 (p=0.15), I2=48.28% • Verbal fluency (n=3 studies/subgroups): SMD=-

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					0.1 (95% CI: -0.27, 0.06), z=-1.2 (p=0.23); heterogeneity: Q=1.71 (p=0.43), I2=0% • Working memory (n=3 studies/subgroups): SMD= 0.19 (95% CI: 0.02, 0.36), z= 2.24 (p=0.03); heterogeneity: Q=1.26 (p=0.53), I2=0% **Summary** • "The results across both observational and RCT studies consistently indicate that the MeDi benefits global cognition. There were, however, differences between observational and RCT data in relation to the impact of the MeDi on specific cognitive domains. Results from cohort studies showed associations between the MeDi and processing speed and reasoning, whereas RCTs reported that the MeDi improved delayed recall, working memory, and executive function compared

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					with controls. These divergent findings could simply be a result of the distinct study designs and follow-up periods. It should be noted, however, that executive functions include processing speed, working memory, and reasoning (46); although there were some specific differences, both study designs consistently report an association between the MeDi and some aspect of executive function. **Conclusion** • "The analysis of pooled data from 15 cohort studies and 2 RCTs suggests that adherence to the MeDi might benefit global cognition for healthy older adults. Results also showed evidence of some benefit of the MeDi in domains of delayed recall, working memory, processing speed, and reasoning."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					• "Our review indicates that only some components, including olive oil, fish, and vegetables, have beneficial effects."
Loughrey 2018 **Objective** "We conducted a systematic review and meta-analysis to investigate and quantify the association between ARHL [age-related hearing loss] and cognitive function, cognitive impairment, and dementia."	**Databases searched** • PubMed • Cochrane • Embase • Scopus **Dates searched** • Inception-April 15, 2016 **Supplementary searches** • "Cross-referencing for potentially eligible studies was conducted using retrieved studies and personal files belonging to one of us (D.G.L.)."	**Inclusion criteria** • Cross-sectional and cohort studies • Published studies • Any language • Study participants 18 years or older • Baseline sample that included the general, community-dwelling population • Peripheral hearing status assessed by pure-tone audiometric assessment as the main exposure variable • "full inclusion of hearing loss sample (ie, no pure-tone audiometric cutoff)" • Cognitive function, cognitive impairment,	• Age-related hearing loss (ARHL)	**Cognitive functions and/or abilities assessed** • Global cognition • Attention • Processing speed • Reasoning • Semantic memory • Visuospatial ability • Working memory • Immediate recall • Delayed recall • Fluency **Tests and/or methods of outcome assessment** • NR	<u>Meta-analysis of cross-sectional studies</u> • Attention (n=9 studies): r=-0.156 (95% CI: -0.237, -0.073), Fisher's Z=-0.157, SE=0.043, Z(p)= -3.64 (<0.001), Q(p)= 79.9 (<0.001), I2=87.5% • Delayed recall (n=6 studies): r=-0.098 (95% CI: -0.157, -0.037), Fisher's Z=-0.098, SE=0.031, Z(p)= -3.13 (0.002), Q(p)= 17.1 (0.01), I2=64.8% • Fluency: (n=7 studies): r=-0.081 (95% CI: -0.121, -0.041), Fisher's Z=-0.081, SE=0.02, Z(p)= -3.97 (<0.001), Q(p)= 11.6 (0.2), I2=30.8% • Global cognition (n=13 studies): r=-0.146 (95% CI: -0.182, -0.109), Fisher's Z=-0.147, SE=0.019, Z(p)= -7.55

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
	Number of studies included • 40 studies included in qualitative analysis, 36 studies included in quantitative analysis, of which 35 studies (26 cross-sectional and 9 cohort) reported on cognitive functioning	or dementia as outcomes • Exposure and outcome assessed by health care professionals or trained investigators **Exclusion criteria** • Case-control studies • Study in special risk groups, such as patients with coronary heart disease • Exposure and outcome based on self-reported data			(<0.001), Q(p)= 31.0 (0.01), I2=54.8% • Immediate recall (n=13 studies): r=-0.143 (95% CI: -0.19, -0.088), Fisher's Z=-0.144, SE=0.029, Z(p)= -5.01 (<0.001), Q(p)= 72.1 (<0.001), I2=80.6% • Processing speed (n=18 studies): r=-0.128 (95% CI: -0.176, -0.079), Fisher's Z=-0.128, SE=0.025, Z(p)=-5.08 (<0.001), Q(p)= 127.4 (<0.001), I2=85.1% • Reasoning (n=9 studies): r=-0.178 (95% CI: -0.253, -0.101), Fisher's Z=-0.18, SE=0.04, Z(p)= -4.55 (<0.001), Q(p)= 45.9 (<0.001), I2=76% • Semantic memory (n=8 studies): r=-0.141 (95% CI: -0.204, -0.076), Fisher's Z=-0.142, SE=0.033, Z(p)= -4.23 (<0.001), Q(p)= 26.3 (0.002), I2=65.8% • Visuospatial ability (n=3 studies): r=-0.107 (95% CI: -0.185, -0.027), Fisher's Z=-0.107, SE=0.041, Z(p)= -2.63

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					(0.01), Q(p)= 4.3 (0.4), I2=7.3% • Working memory (n=7 studies): r=-0.098 (95% CI: -0.148, -0.047), Fisher's Z=-0.098, SE=0.026, Z(p)= -3.73 (<0.001), Q(p)= 18.1 (0.02), I2=55.9% • Overall (n=26 studies): r=-0.122 (95% CI: -0.139, -0.105), Fisher's Z=-0.123, SE=0.009, Z(p)= -13.97 (<0.001), Q(p)= 482.0 (<0.001), I2=76.9% <u>Meta-analysis of cohort studies</u> • Attention (n=1 study): r=-0.1 (95% CI: -0.197, 0.0), Fisher's Z=-0.1, SE=0.051, Z(p)= -1.98 (0.048), Q(p)= 0.0 (>0.99), I2=0.00% • Delayed recall (n=3 studies): r=-0.101 (95% CI: -0.147, -0.054), Fisher's Z=-0.101, SE=0.024, Z(p)= -4.14 (<0.001), Q(p)= 2.1 (0.55), I2=0.0%

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					• Fluency (n=3 studies): r=-0.067 (95% CI: -0.139, 0.006), Fisher's Z=-0.067, SE=0.037, Z(p)= -1.79 (0.07), Q(p)= 7.1 (0.07), I2=57.5% • Global cognition (n=4 studies): r=-0.139 (95% CI: -0.189, -0.089), Fisher's Z=-0.14, SE=0.026, Z(p)= -5.36 (<0.001), Q(p)= 18.9 (0.002), I2=73.5% • Immediate recall (n=5 studies): r=-0.061 (95% CI: -0.102, -0.02), Fisher's Z=-0.061, SE=0.021, Z(p)= -2.91 (0.004), Q(p)= 40.7 (<0.001), I2=87.7% • Processing speed (n=7 studies): r=-0.084 (95% CI: -0.136, -0.031), Fisher's Z=-0.084, SE=0.027, Z(p)= -3.12 (0.002), Q(p)= 285.9 (<0.001), I2=96.9% • Reasoning (n=1 study): r=-0.064 (95% CI: -0.124, -0.003), Fisher's Z=-0.064, SE=0.031, Z(p)= -2.08 (0.04), Q(p)= 0.00 (>0.99), I2=0.00%

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					• Semantic memory (n=1 study): r=-0.141 (95% CI: -0.23, -0.05), Fisher's Z=-0.142, SE=0.047, Z(p)= -3.01 (0.003), Q(p)= 0.00 (>0.99), I2=0.00% • Overall (n=9 studies): r=-0.09 (95% CI: -0.112, -0.068), Fisher's Z=-0.09, SE=0.01, Z(p)= -8.74 (<0.001), Q(p)= 552.8 (<0.001), I2=94.2% **Conclusion** • "We found a small but statistically significant association between ARHL and all 10 cognitive domains of interest in cross-sectional studies …" • Similar results were observed in 7 of 8 domains in cohort studies, excluding fluency, which was not significant …" • "No cohort data were available for visuospatial ability or working memory." • "In this meta-analysis, ARHL had significant associations

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					with accelerated multidomain cognitive decline …" • "Age-related hearing loss is a possible biomarker and modifiable risk factor for cognitive decline …"
Lourida 2013 **Objective** "Our objective was to systematically review the literature to synthesize and evaluate available evidence on the association between adherence to Mediterranean diet and cognitive function or dementia."	**Databases searched** • Medline • EMBASE • PsychInfo via Ovid • Science Citation Index Expanded • Social Sciences Citation Index • Arts and Humanities Citation Index • Conference Proceedings Citation Index via Web of Science • The Health Management Information Consortium	**Inclusion criteria** • "Studies were included if they examined the association of a defined score used to measure adherence to the Mediterranean diet and included cognitive function or dementia as outcomes." • "…no restriction in study design or language of publication." • "Conference abstracts were included if there were sufficient details to allow appraisal of study quality."	• Mediterranean diet adherence	**Cognitive functions and/or abilities assessed** • Global cognition • Memory (short- and long-term) • Language (comprehension, naming, fluency) • Executive function • Visual-spatial skills • Orientation • Abstract reasoning and construction (copying and matching) **Tests and/or methods of outcome assessment** • Mini-Mental State Examination test (MMSE) • Isaacs Set Test • Benton Visual Retention Test	• Meta-analysis was not conducted. • "Published studies suggest that greater adherence to Mediterranean diet is associated with slower cognitive decline …."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
	• The Cumulative Index to Nursing and Allied Health Literature • The Allied and Complementary Medicine Database via National Health Service Evidence database • The Cochrane Library of Systematic Reviews **Dates searched** • Inception – January 2012 **Supplementary searches** • Reference lists • Selected content of journals • Relevant websites	**Exclusion criteria** • "We excluded studies evaluating adherence to a recommended guideline, to a dietary pattern other than a Mediterranean diet, or to individual components and not Mediterranean diet as a whole." • "We also excluded letters and editorials that did not include original research findings."		• Free and Cued Selective Reminding Test • California Verbal Learning Test • Symbol Digit Modalities Test • Purdue Pegboard test for investigation of cognitive change • 12 neuropsychological tests examining memory, orientation, abstract reasoning, language, and construction • East Boston tests of immediate and delayed recall • 15 neuropsychological tests examining memory, language, processing speed, visual-spatial ability to summarize cognitive performance 12 items of the COMPASS battery with tasks examining change in attention, working memory, long-term memory, executive function	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
	• Contacted authors of included studies **Number of studies included** • N = 12 total N = 9 relevant to cognitive decline or performance				
Meng 2017 **Objective** "The purpose of the current study was to systematically review the evidence for the impact of retirement on cognitive functioning and on age related cognitive decline."	**Databases searched** • Medline via PubMed • PsycNET via APA host • Web of Science, which includes Sciences Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI) and Arts & Humanities Citation Index (A&HCI)	**Inclusion criteria** • Population: "Employed or retired peopled aged 40+" • Design: "Longitudinal studies: Observational cohort studies, case-control, or randomized controlled trials (at least 1 follow-up wave)" • Exposures: "Retirement; Psychosocial working conditions e.g. mental job demands" • Outcomes: "Age related cognitive decline and/or cognitive function"	• Retirement	**Cognitive functions and/or abilities assessed** • Episodic memory • Working memory • Spatial ability • Verbal ability • Memory • Processing speed • Mental status • Short term verbal memory • Inductive reasoning • Verbal fluency • Immediate memory • Verbal memory **Tests and/or methods of outcome assessment**	• Meta-analysis was not conducted. • "We found weak evidence that retirement accelerates the rate of cognitive decline in crystallised abilities, but only for individuals retiring from jobs high in complexity with people. The evidence of the impact of retirement on the rate of decline in fluid cognitive abilities is conflicting." • "We only found weak and contradicting evidence for an association between retirement and age related cognitive decline. However,

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
	• OSH which includes CISDOC, HSELINE, NIOSHTIC, RILOSH **Dates searched** • Inception - August 1, 2015 **Supplementary searches** • NR **Number of studies included:** 7	**Exclusion criteria** • Population: "Diseases, disorders, or medical conditions (e.g., brain diseases, dementia)" • Design: "Cross-sectional studies, case studies, discussion papers, reviews, meta-analyses." • Exposures: "Chemicals (e.g., solvents, manganese) physical demands, psychological distress" Outcomes: "Outcomes that do not include a defined measurement of cognitive function (e.g., psychological health, psychological stress, depressive symptoms)"		Episodic memory • Immediate and delayed recall test Working memory • Subtract 7 from 100 up to five times Spatial ability • Figure logic • Block design • Card rotation Verbal ability • Information • Synonymous • Analogies • PMA • ETS Memory • Digit span • Picture memory • Names & faces Processing speed • Symbol digit • Figure identification Mental status	this systematic review revealed that there is a major research gap in this field. More knowledge on the association between retirement and age related cognitive decline as well as knowledge on the mechanisms behind these associations is needed. For example, how occupational characteristics influence the association between retirement and cognitive decline."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Telephone interview of cognitive status <u>Short term verbal memory</u> • Free recall test <u>Inductive reasoning</u> • AH4 – Part 1 • PMA • ADEPT • Word series • Number series <u>Verbal fluency</u> • "s" words and animal names <u>Immediate memory</u> • Recall from 10-word lists <u>Verbal memory</u> • PMA • Immediate recall • Delayed recall	
Nexo 2016 **Objective** "This study aimed to systematically review the	**Databases searched** • MEDLINE via the PubMed interface	**Inclusion criteria** • English-language articles • Population: "Employees exposed to psychosocial working conditions in	• Psychosocial working conditions: mental work demands, work complexity,	**Cognitive functions and/or abilities assessed** • Global cognition • Episodic memory • Mental status • Memory	• Meta-analysis was not conducted. <u>Mental work demands</u> • *Level of cognitive functioning*: Two studies of high quality ... and one study

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
evidence that addresses following research question: Which psychosocial working conditions are prospectively associated with individuals' levels of cognitive function and/or changes in cognitive function over time?"	• PsycNET via the APA host interface • Web of Science • Occupational Safety and Health (OSH) UPDATE **Dates searched** • Inception – August 1, 2014 **Supplementary searches** • "reference lists of other relevant articles and reviews … and references recommended by colleagues within the field." **Number of studies included** • N=11 [all cohort studies]	midlife or late life (minimum 40 years)" • Design: "Longitudinal studies: observational cohort studies, case-control or randomized controlled trials" • Exposures: "Psychosocial working conditions (eg, working hours, psychological work demands), work environment factors (eg, job control)" • Outcomes: "Levels of cognitive function or changes in cognitive function over time (eg, age-related cognitive decline)" **Exclusion criteria** • Population: "Diseases, disorders or medical conditions (eg, brain diseases or dementia)" ["… studies that examined cognitive decline in clinical	work environmental factors	• Processing speed • Attention • Non-verbal short-term memory • Reasoning • Verbal ability • Spatial ability • Intellectual flexibility (researchers' rating of intellectual ability and agreeableness) • Short-term memory • Inductive reasoning • Vocabulary • Phonemic fluency • Semantic fluency • Verbal memory **Tests and/or methods of outcome assessment** • MMSE • Immediate recall • Delayed recall • Telephone Interview of Cognitive Status (TICS) • Rey auditory verbal learning test	of moderate quality … provided strong evidence that workers in jobs with a high level of mental work demands were prospectively associated with a high level of cognitive function. One study of moderate quality … showed the opposite effect. Since this study accounted for <33% of the results, it did not affect the final synthesis of evidence." • *Rate of cognitive decline*: "We found conflicting evidence as to whether mental work demands could protect against cognitive decline. Two studies of high quality … provided strong evidence that mental work demands slowed the rate of cognitive decline. One study of moderate quality … provided weak evidence that mental work demands had no effect on cognitive decline."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		populations—for example, dementia"] • Design: "Cross-sectional studies, case studies, discussion papers, reviews, meta-analyses" • Exposures: "Chemicals (eg, solvents, manganese) physical demands, psychological distress" ["We regarded psychological distress as a reaction to, rather than an exposure to, an environmental strain …"] • Outcomes: "Outcomes with no clear definition of cognitive function (eg, psychological health, psychological stress, depressive symptoms)"		• WAIS: Digit Symbol Substitution Test • Sternberg's selective attention tests • WAIS: digit symbol, block design, digit span and picture completion • Stroop Color and Word Test • Verbal learning test • Letter digit coding test • Word fluency test • Information, synonyms and analogies test • Figure logic, block design • Card rotations • Symbol digit and figure identification • Digit span • Picture memory • Names and faces • Embedded figures test • Category fluency • Number series • A Developmental English Proficiency Test (ADEPT) • Primary mental ability (PMA) • Verbal meaning test • Identical pictures test	<u>Occupational complexity</u> • *Level of cognitive functioning*: "Two studies of moderate quality … provided moderate evidence that a high complexity of main lifetime occupation improved cognitive function over a period ranging from 12 to 30 years." • *Rate of cognitive decline*: "We found weak evidence from one study of moderate quality … that complex work with people diminished decline of verbal ability in the period up until retirement and an accelerated decline of spatial ability after retirement." <u>Psychosocial work environment</u> • "We found no evidence that ***job strain*** was prospectively associated with lower levels of cognitive <u>function</u> and conflicting evidence as to

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Different uses test • 20 words free recall test • Alice Heim Test (AH4-I) • Mill Hill • ‘s’ words • ‘animal’ words • Word series • Educational Testing Services (ETS)	whether ***active jobs*** improved levels of cognitive <u>function</u>. … We found moderate evidence that ***job control*** improved <u>cognitive function</u> … and weak evidence that job control improved <u>cognitive ability</u> in a period of 14 years • “We found weak evidence that low ***organisational justice*** lead to lower <u>levels</u> of short-term memory, inductive reasoning and verbal fluency, but insufficient evidence with regards to cognitive <u>decline</u>.” • “We found weak evidence … that ***working long hours*** were prospectively associated with a lower <u>level</u> of inductive reasoning and an accelerated <u>decline</u> of inductive reasoning.” **Conclusion** • “This systematic review showed evidence that workers exposed to high

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					levels of ***mental work demands, occupational complexity or job control*** had higher levels of <u>cognitive function</u> when measured at midlife or late life, than workers exposed to low levels. Nevertheless, the evidence to clarify whether these psychosocial work factors also affected the rate of age-related <u>cognitive decline</u> was conflicting, weak or insufficient. • "We found no, and insufficient evidence, of an impact of ***job strain*** or ***active job*** on cognitive <u>function</u>." • "We found weak evidence that a ***low level of organisational justice*** leads to lower cognitive <u>function</u> and ***long working hours*** accelerated cognitive <u>decline</u>." • "The number of good quality studies examining cognitive <u>decline</u> was scarce and it remained speculative

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
					whether ***job control, job demands or occupational complexity*** protected against cognitive decline."
Pocuca 2020 **Objective** "… the aim of this systematic scoping review is to determine the current extent of the literature, summarize available findings, and identify gaps in knowledge regarding the effects of cannabis use on cognitive function in healthy aging."	**Databases searched** • PubMed • Embase • PsycINFO • Web of Science • Family and Society Studies Worldwide • CINAHL **Dates searched** • Inception - September 2019 **Supplementary searches** • "Grey literature (i.e., research not published as a peer-reviewed article), including conference abstracts and	**Inclusion criteria** • English-language articles • Studies examining "the effects of whole plant or phytocannabinoids (THC or CBD) on cognitive function in healthy, older adult humans (≥50 years) or animals (e.g., mice ≥12 months, the approximate equivalent to older adulthood in humans …" • Studies of either acute or non-acute effects of cannabis on cognition" • Studies that "include a baseline or comparison group not exposed to cannabis". **Exclusion criteria**	• Cannabis use	**Cognitive functions and/or abilities assessed** • Global cognition • Working memory • Episodic memory • Delayed memory • Vocabulary knowledge • Oral reading skills • Cognitive flexibility • Processing speed • Reaction time • Learning **Tests and/or methods of outcome assessment** • MMSE • NIH Toolbox Cognition Battery - Flanker inhibitory control and attention test	• Meta-analysis was not conducted. • "Human studies revealed largely null results, likely due to several methodological limitations." • "Better controlled rodent studies indicate that the relationship between Δ9-tetrahydrocannabinol (THC) and cognitive function in healthy aging depends on age and level of THC exposure. Extremely low doses of THC improved cognition in very old rodents. Somewhat higher chronic doses improved cognition in moderately aged rodents. No studies examined the effects of cannabidiol (CBD) or high-CBD cannabis on cognition."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
	dissertations (searched via ProQuest)" • "reference lists of included articles and relevant reviews" **Number of studies included** • 3 studies in humans • 3 studies in animals	• "Studies that focused exclusively on populations with underlying pathology or substance use disorders (other than cannabis use disorder), or that conflated cannabis with other substances and examined effects on cognition via a single, polysubstance use variable, were excluded."		• Picture sequence memory test • List sorting working memory test • Picture vocabulary test • Oral reading recognition test • Dimensional change card sorting test; • Pattern comparison processing speed test • Buschke–Fuld selective reminding test • Wechsler Memory Scale-II—Logical Memory I and II and Verbal Paired Associates I and II • Rey–Osterrieth complex figure • Trail-making test—Parts A and B • Stroop test • Wechsler adult intelligence Scale-III—digit symbol • Verbal Fluency FAS and animal naming tests • Immediate and delayed word recall • Animal naming test	• This systematic scoping review examined current research on the relationship between cannabis use and cognitive function in healthy aging and provides a starting point for future research. A systematic search of six large databases found only six articles satisfied the eligibility criteria for this review, thus confirming the paucity of research on the effects of cannabis use on cognition in healthy aging." • "The scant research in this area indicates that existing findings reported herein should be interpreted with caution, since replication and further research are required."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Letter-cancelation test	
Rafnsson 2013 **Objective** "To further inform the debate on the potential cognitive benefits of antioxidants, the aim of the present study was to systematically review findings from population-based cohort studies regarding the association between antioxidant nutrients and cognitive function in older people, while paying a special	**Databases searched** • Medline • Embase • Global Health • The Commonwealth Agricultural Bureau (CAB) abstracts • PsychINFO **Dates searched** • Medline: 1950–October week 3 2010 • EMBASE: 1980–week 43, 2010 • Global Health (1973–October 2010) • CAB abstracts: 1973–week 42, 2010 • PsychINFO: 1806–October week 4 2010	**Inclusion criteria** • "English language-based publication" • "Original research publication" • "Cohort study design" • "Population- based sample" • "Measurement of one or more major individual antioxidants (β-Carotene/other carotenoids, vitamin E, vitamin C, & selenium) or appropriate surrogate markers." • "Administration of one or more measures of cognitive function on two or more occasions e.g. at baseline and during follow-up (i.e. classical cohort studies) or only during follow-up (i.e. piggy-back studies)" **Exclusion criteria**	• Antioxidant nutrients (carotenes, flavonoids, selenium, vitamins C and E)	**Cognitive functions and/or abilities assessed** • Global cognition • Memory • Executive function • Attention • Psychomotor speed • Visual memory • Verbal fluency • Visuospatial attention **Tests and/or methods of outcome assessment** • Mini-mental state examination (MMSE) • Modified mini-mental state examination (3MS) • East Boston tests of immediate and delayed recall (EBMT) • Symbol digit modalities test (SDMT)	• Meta-analysis was not conducted. ["Substantial methodological heterogeneity was observed across studies which precluded a quantitative meta-analysis of the results."] • The main supportive evidence came from two studies, both judged to be of high quality: The first observed an accelerated decline in global cognition, attention, and psychomotor speed over 9 years, concomitant to a decrease in plasma selenium levels over the same period; the second study reported a slower rate of global cognitive decline over 3 years in persons in the highest quartile of intake of vitamins C, E, and carotenes. All associations persisted after adjustment for confounding factors."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
attention to the methodological quality of individual studies.”	**Supplementary searches** • “Reference lists of all full-text articles retrieved for further evaluation were also inspected.” **Number of studies included** • 10 studies	• “non-original studies” • “those based on non-human samples” • “those using other types of study designs (e.g., cross-sectional or case–control epidemiological study designs)” • “studies based on hospital inpatients or other selected patient samples” • “those without appropriate antioxidant nutrient data (e.g., • “studies lacking data on individual nutrients)” • “studies without information on cognitive performance assessed on more than one occasion (or those only having diagnostic information pertinent to cognition, for example, presence or absence of cognitive impairment or dementia)”.		• Short Portable Mental Status Questionnaire (SPMSQ) • Trail making test (TMTB) • Digit symbol substitution (DSS) • Finger tapping test (FTT) • Benton’s visual retention test (BVRT) • ‘‘Isaacs’’ set test (IST) • Zazzo’s cancelation test (ZCT) • Telephone interview for cognitive status (TICS) • Digit span backward (DSB) • Category fluency test (CFT)	• “Evidence in favor of beneficial associations of higher dietary intake of vitamin E and flavonoids, as well as higher serum beta carotene levels, came from further studies of only adequate quality.” • “Overall, there is some evidence, albeit from a limited number of high-quality investigations, in support of beneficial cognitive effects of antioxidant nutrients, highlighting the need for additional and longer investigations.”

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
Ramalho 2018 **Objective** "… this systematic review of literature aimed to synthesize the scientific evidence about the relationship between diverse sedentary behaviours and various psychological outcomes in older adults."	**Databases searched** • PubMed • PsycINFO • ISI Web of Knowledge • ScienceDirect **Dates searched** • January 2000 to November 30, 2016 **Supplementary searches** • Reference lists of identified studies **Number of studies included** • 15 studies, of which 4 observational studies (2 longitudinal and 2 cross-sectional) investigated the relationship	**Inclusion criteria** • "studies published in English-language and peer-reviewed journals" • "studies published from January 2000 to November 2016" • "empirical studies that investigated sedentary behaviours of the elderly and several psychological indicators … through observational (cross-sectional and longitudinal) quantitative studies and experimental studies (randomized controlled trials and quasi-experimental trials)" • studies that investigated associations between sedentary behaviours and several variables (e.g., physiological variables) but which	• Sedentary behaviors (assessed, for example, based on self-reported TV viewing, computer/internet use, reading habits, use of ActivPAL accelerometer)	**Cognitive functions and/or abilities assessed** • Global cognition • Verbal fluency • Semantic memory • Episodic memory • Working memory • Executive function/mental flexibility **Tests and/or methods of outcome assessment** • Cambridge Neuropsychological Automated Testing Battery • National Adult Reading Test • Mini Mental State Examination (MMSE) • Composite International Diagnostic Interview for the Elderly (CIDI65+) • Verbal fluency test	• Meta-analysis was not conducted. • This review suggests that sedentary behaviors are differentially associated with cognitive functioning. • Three studies that examined TV viewing demonstrated that this sedentary behavior was associated with lower cognitive functioning. • "… the evidences suggested that some sedentary behaviours (e.g. computer use, reading) may help maintain some cognitive functions in the elderly population, namely in different types of memory." • Overall conclusion [table 3 of the publication]: "Not all sedentary behaviours were associated with adverse mental health. Some behaviours may help maintain some cognitive functions."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
	between sedentary behaviors and cognitive functions	included psychological indicators” • “studies whose average age of the participants was equal to or greater than 65 years old and that the minimum age of the subjects was from 60 years old” • “studies that presented instruments of measurement on the total time of sedentary behaviours or the time spent in specific sedentary behaviours” • “studies whose instruments of psychological assessment presented adequate evidence of psychometric validation” **Exclusion criteria** • “studies published in congress proceedings, theses, book chapters		• Semantic memory test of the Neuropsychological Assessment (Lezak) • RI-48 episodic memory test • Work memory test • Delis-Kaplan Executive Function System mental flexibility test	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		and unpublished manuscripts” • “studies that investigated sedentary behaviours in the elderly with specific pathologies”			
Rodriguez 2020 **Objective** “The review focuses on the association between intelligence in early and mid-life on cognitive decline and the risk for developing ADRD later in life. The hypothesis is that people with higher intelligence experience less cognitive decline and a	**Databases searched** • PubMed • Web of Science • Scopus **Dates searched** • NR-June 4th, 2019 **Supplementary searches** • “references of the identified articles and related review articles” **Number of studies included**	**Inclusion criteria** • Population: “studies with samples from the general population” • Intervention or prognostic factor: “studies on intelligence and mental ability in childhood and mid-life” • Comparison: “longitudinal studies investigating cognitive decline and incident ADRD only” • Outcome: “studies on cognitive decline and on dementia in general or a specific type of dementia such as vascular dementia or Alzheimer's disease”	• Intelligence in childhood and mid-life [In studies of cognitive decline, intelligence was assessed at age 11 years or 15 years.]	**Cognitive functions and/or abilities assessed** • Verbal fluency • Verbal memory • Logical memory • Search speed • Visual search • Learning ability • Intelligence **Tests and/or methods of outcome assessment** • Raven's Progressive Matrices • Verbal Fluency test • Verbal Memory test • Logical Memory test • Wechsler Adult Intelligence Scale • Rey Auditory-Verbal Learning Test • Moray House Test	• Meta-analysis was not conducted. • “Associations between childhood intelligence and cognitive decline in old age were investigated by two studies using the NSHD and by eight studies using the LBS (adding to a total of n=9 publications because one study used both, the NSHD and LBS, cohorts).” • NSHD: National survey of health and development, Great Britain • LBS: Lothian Birth Cohort of 1921, Scotland • “In summary, although a few studies that used linear regression analysis

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
lower ADRD risk than people with lower intelligence."	• 14, including 9 studies of cognitive decline	**Exclusion criteria** • Population: "studies that focused on particular patient groups or clinical cohorts and studies that exclusively looked at specific subpopulations (e.g., patients with HIV or schizophrenia)" • Intervention or prognostic factor: "studies that used proxies for intelligence (e.g., school grades)" • Comparison: "studies that assessed intelligence in later life as amyloid beta begins to accumulate up to 20 years before disease onset, which might have biased the estimation of intelligence. … Case-control studies were excluded because it is unclear whether controls might have		• Search Speed test • Visual search test • Word list learning	demonstrated associations between childhood intelligence and cognitive decline in old age, the majority of the studies cannot confirm such an association. Notably, if studies repeated the analyses that were initially conducted via linear regression analysis with growth curve models, the results became nonsignificant. It is important to note that most of the evidence comes from the LBS study and incurred substantial loss to follow-up." • "The evidence underlying this review indicates that there seems to be little to no association between early- and mid-life intelligence and cognitive decline …" • "Overall, it seems that other lifestyle and environmental factors play a greater role in

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		premorbid dementia symptomatology in the brain that has not yet been detected at the time of the study and/or develop dementia soon after the point of the study so that the conclusions drawn based on the comparison might be biased." • Outcome: "studies that investigated only the level of cognitive functioning at one point of time because this did not provide information about resilience to age-related or pathological decline" • "… studies were also excluded when they were of poor quality due to their methodology."			determining cognitive health in old age than intelligence. Nonetheless, intelligence might play a role in so far that it can determine the effects of exposure to certain types of environmental risk factors or protectors – an aspect that has not yet received much attention in clinical health research." • "Further, it is important to be aware that people with higher intelligence are not exempt from developing dementia and are similarly affected by cognitive decline. However, initially better cognitive skills might mask cognitive deterioration for a longer period of time, so clinicians and general practitioners should also focus on declining cognitive abilities and not just obvious cognitive impairments."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
Roman-Caballero 2018 **Objective** "This paper describes the first systematic review and meta-analysis, to our knowledge, of the impact of musical practice on healthy neurocognitive aging."	**Databases searched** • PubMed • Scopus • Web of Science • TESEO **Dates searched** • Inception – August 2018[20] **Supplementary searches** • Google Scholar • "References from studies on this subject" • Grey literature search in Google Scholar and TESEO	**Inclusion criteria** • Empirical studies exploring the effects of musical practice • Include an assessment of cognitive functions and/or an assessment of brain status with a physiological recording and/or neuroimaging technique • Includes participants aged 59 years or older with no cognitive impairment or brain damage • Written in English or Spanish **Exclusion criteria** • NR	• Musical practice	**Cognitive functions and/or abilities assessed** • Processing speed • Attention • Inhibition • Verbal memory • Verbal working memory • Phonological verbal fluency • Verbal fluency (overall) • Naming • Flexibility • Semantic verbal fluency • Visuospatial ability • Visuoconstruction • Visual memory • Reasoning • Visual working memory • Verbal fluency	<u>Meta-analysis of observational studies (SMD - standardized mean difference)</u> • Processing speed (n=6 studies): SMD=0.32 (95% CI: 0.08; 0.55); I2=42.55% (p=0.12) • Inhibition (n=3 studies): SMD=1.77 (95% CI: 0.60; 2.93); I2=85.96% (p<0.01) • Attention (n=4 studies): SMD=0.44 (95% CI: 0.18; 0.71); I2=0% (p=0.53) • Verbal memory (n=6 studies): SMD=0.18 (95% CI: 0.07; 0.29); I2=0% (p=0.82) • Verbal working memory (n=6 studies): SMD=0.88 (95% CI: 0.03-1.72); I2=95.62% (p<0.01) • Phonological verbal fluency (n=5 studies): SMD=0.49 (95% CI: 0.20; 0.78); I2=50.25% (p=0.08) • Verbal fluency, overall (n=5 studies); SMD=0.42 (95% CI: 0.10; 0.74); I2=69.66% (p=0.2)

[20] Search "without any time restrictions"

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
	Number of studies included: 13 (9 observational; 4 experimental)			**Tests and/or methods of outcome assessment** • Digit-symbol of WAIS-III • d2 test • D-KEFS Trails 1 • D-KEFS Trails 4 • D-KEFS Stroop Color-Word • D-KEFS switching fluency • D-KEFS Verbal Fluency (total) • Trail Making Test A • Trail Making Test B • Trail Making Test difference B-A • Alphabet Coding Task-15 • Go RT • Total learning • Trials to criterion • 30-min recall • 24-h recall • Recognition accuracy	• Naming (n=3 studies): SMD=0.71 (95% CI: 0.21; 1.21); I2=56.26% (p=0.10) • Flexibility (n=3 studies): SMD=0.57 (95% CI: 0.00; 1.14); I2=72.3% (p=0.02) • Semantic verbal fluency (n=5 studies): SMD=0.29 (95% CI: -0.03; 0.61); I2=59.70 (p=0.04) • Visuospatial ability (n=3 studies): SMD=1.66 (95% CI: 0.40; 2.92); I2=91.81% (p<0.01) • Visuoconstruction (n=2 studies): SMD=0.38 (95% CI: -0.07; 0.83); I2=27.67% (p=0.24) • Visual memory (n=4 studies): SMD=0.23 (95% CI: -0.15; 0.60); I2=56.89% (p=0.07) • Reasoning (n=3 studies): SMD=0.34 (95% CI: -0.10; 0.78); I2=46.55% (p=0.16) • Visual working memory (n=3 studies): SMD=0.37 (95% CI: -0.19; 0.93); I2=66.77% (p=0.04) • “Results indicate that an involvement in this [musical]

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Delayed recall of the Signoret BEM-144'S 12 words • California Verbal Learning Test-II • Auditory Verbal Learning Test • Door test • Rey-Osterrieth Complex Figure • Visual Reproduction-I (immediate recall) of WMS-III • Visual Reproduction-II (delayed recall) of WMS-III • Brief Visuospatial Memory Test-R • Phonemic fluency • Semantic fluency • Letter fluency • Boston Naming Test • Wisconsin Card Sorting Task	activity (particularly early and long-term involvement) is associated with benefits in domain-specific functions (auditory perception) and in a wide range of domain-general functions. Although little evidence is available so far and further research is needed, the findings presented here suggest that musical practice is an effective tool for preventing the declines of healthy aging and making interventions in this regard."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Tower-total • Block Design of WAIS-III • Raven's progressive matrices test • Listening Span Test • No-go correct (%) • Digit span forward • Digit span backward • Digit span of WAIS-III • Digit span of WAIS-IV • Letter-Number Sequencing of WAIS-III • Corsi Forward • Corsi Backward • Visual Pattern Test Active • Spatial span of WMS-III • Short Embedded Figures Test • Short Mental Rotation Test • Benton Judgment of Line Orientation	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Benton Visual Form Discrimination • Paced Serial Addition Task • Symbol Digit Modalities Test • Symbol Digit Coding • Cued Color-Word Stroop Test • Stroop Color-Word • Continuous Performance Test • Non Verbal Reasoning Test	
Scott 2019 **Objective** "The purpose of this systematic review was to examine the current literature on the effects of cannabis on cognitive functioning in	**Databases searched** • PubMed • Scopus • PsycINFO • Cochrane Library **Dates searched** • Inception – June 3, 2019	**Inclusion criteria** • Studies in older adults with or without neurocognitive disorders • "whole-plant, purified, and synthetic cannabis-based products, regardless of the indication (i.e., recreational or medical use)".	Cannabis use	**Cognitive functions and/or abilities assessed** • Verbal memory • Processing speed • Executive functioning • Immediate memory • Delayed memory • Working memory • Reaction time • Global cognition • Attention	• Meta-analysis was not conducted. • "Although there is evidence of modest negative effects on cognition in this population, larger controlled trials using validated outcome measures are greatly needed to better understand the role of cannabinoids in cognitive aging, as small sample sizes and variability in study designs limit our ability to

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
older adults aged 50+ with and without neurocognitive disorders.”	**Supplementary searches** • “Reference lists of relevant articles and citing articles” **Number of studies included** • 7 studies on healthy aging	• Studies published in 2014 or later **Exclusion criteria** • NR		**Tests and/or methods of outcome assessment** • Rey Auditory Verbal Learning Test (AVLT) • Digit Symbol Substitution Test (DSST) • Stroop-Interference • California Verbal Learning Test (CVLT) • Symbol Digit Modalities Test (SDMT) • Digit backwards • Simple and choice reaction time tasks • Wechsler Test of Adult Reading Battery (WTAR) • MMSE • Buschke-Fuld Selective Reminding Test (SRT) • Wechsler Memory Test (WMS-II Logical Memory) • Verbal Paired Associates	draw definitive conclusions at this time.”

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Rey Complex Figure Test (RCFT) • Trail Making Test (TMT)-A • Trail Making Test (TMT)-B • Stroop-Word Reading • FAS [?] • Animals • NIH Toolbox Cognition Battery • Test for Attentional Performance—Alertness subtest	
Van den Noort, 2019 **Objective** "The aim of the present study is to provide an overview of the studies that have been conducted in	**Databases searched** • Medline • ScienceDirect • Scopus • ERIC **Dates searched** • NR-March 31, 2019	**Inclusion criteria** • "To be considered for inclusion, the study had to be published in a peer-review format." • "…we used a more inclusive definition of (neural) cognitive reserve, meaning that also patient studies without direct measures of brain structure (that would determine the	• Bilingualism	**Cognitive functions and/or abilities assessed** • Global cognition • Specific cognitive functions (NR) **Tests and/or methods of outcome assessment** • KCST (Katzman et al.'s cognitive screening test) • MMSE (Mini-Mental State Examination)	• Meta-analysis was not conducted. • "Several studies showed a protective effect whereas other studies failed to find it." • "We found some evidence for a protective effect of bilingualism against cognitive decline in aging, but the results are mixed. Several factors, such as immigration and individual experiences,

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
the field of bilingualism and the protection of individuals against cognitive decline."	**Supplementary searches** • NR **Number of studies included** • N = 25 original studies • N = 9 reviews • N=8 original studies of cognitive decline	degree of damage or pathology) were included" • Full data papers • Reviews **Exclusion criteria** • Commentary papers Case studies		• CASI (Cognitive Abilities Screening Instrument) • MoCA (Montreal Cognitive Assessment Test) • Stroop test • Letter-number sequencing • Matrix reasoning • Block design • Digit symbol • Symbol search • Digit span backward • Logical memory • Spatial span • Moray House Test • NART (National Adult Reading Test) • Verbal fluency • Mill Hill vocabulary scale • TMT (Trail Making Test) • Interview • Cerebrospinal fluid AD (Alzheimer's disease) markers • FCSRT (Free and Cued Selective Reminding Test) • Digit span test • BNT (Boston Naming Test)	seem to affect the extent of the cognitive reserve-enhancing effect of lifelong bilingualism" • "Research groups often use different experimental tasks to assess cognitive functioning in healthy older adults …; therefore, replication studies are warranted with the same methodology to make direct comparisons of the results among research groups possible." • "Lifelong bilingualism is a complex individual process, and many factors seem to influence this and need to be investigated further in large longitudinal studies with objective behavioral and neuroimaging measurements before the cognitive reserve-enhancing effect of lifelong bilingualism and the protection against dementia is proven."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• JLO (Judgement of Line Orientation test of Benton) • 15 object test • ROCF (Rey-Osterrieth Complex Figure copy) Diffusion tensor imaging	
Wu 2020 **Objective** "To review the evidence for latent classes of cognitive trajectories and to identify the associated predictors and outcomes."	**Databases searched** • Medline • Embase **Dates searched** • Inception – 6 November 2019 **Supplementary searches** • NR **Number of studies included:** 37	**Inclusion criteria** • Studies of adults (≥18 years) in the general population • Prospective/longitudinal studies investigating cognitive trajectories defined as "the course of cognitive function over time or age, including assessing cognitive function using three or more waves of data". • Studies that "have two or more classes of cognitive trajectories identified with a hypothesis-free and data-driven approach, rather than based on	• Demographics: age, gender, ethnicity • Socioeconomic: education, occupation, employment status, occupation, income, financial strain, social network/support/activity, living status (e.g., living with someone), marital status, religious activity/church attendance,	• "A cognitive trajectory was defined as assessing cognitive function using three or more waves of data." **Cognitive functions and/or abilities assessed** • Global cognition • Episodic memory • Executive function • Processing speed • Attention • Language • Visuospatial skills **Tests and/or methods of outcome assessment**	• Meta-analysis was not conducted. • "… three to four classes with progressively decreasing baseline and increasing rate of decline—a 'stable-high' class characterized as maintenance of cognitive function at high level, a 'minor-decline' class or 'stable-medium' class that declines gradually over time, and a 'rapid-decline' class with the steepest downward slope." **Predictors of class membership:** • 32 protective factors (predicting "higher odds of being in a better class or lower odds of being in a

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		any pre-specified factor (i.e., male versus female)". • No restriction on cognitive domains assessed or tests used for assessment. • No restriction on predictive factors (demographics, socioeconomic, lifestyle and health behavior, genetic, biomarkers) • Studies published in English **Exclusion criteria** • "Studies exclusively involving participants at high risk of unfavorable health outcomes or specific patient samples (e.g., individuals with dementia, cognitive impairment, cancer,	life purpose, volunteering, relocation, birthplace (e.g., rural) • Cognitive: baseline cognition, cognitive activity, AD or other dementias • Lifestyle/behavior: physical activity/exercise, smoking, drinking • Physical characteristics, physical and mental health: self-rated health, depression, activities of daily living (ADL),	• Mini-Mental State Examination (MMSE) • Modified MMSE (3MS) • Telephone Interview for Cognitive Status (TICS) • Short Portable Mental Status Questionnaire (SPMSQ) • Alzheimer's Disease Assessment Scale–Cognitive Subscale (ADAS-Cog) • Rey Auditory Verbal Learning Test (RAVLT) • Memory binding test (MBT) • Trails Making Test Part B (TMTB) • California Verbal Learning Test (CVLT)-II	worse class compared to the reference class"), 24 risk factors, 4 factors with inconsistent results depending on a study (age, female gender, baseline cognition, self-rated health) • Most commonly reported protective factors: higher education, social engagement, physical activity, physical function, cognitive activity, volunteering, higher BMI. • Most commonly reported risk factors: depressive symptoms, APOE ε4 allele, physical limitation, diabetes, higher amyloid burden, smoking • Factors with inconsistent results: 1) Older age predicted worse trajectory classes in ten of 16 studies. 2) Being female predicted better classes in eight studies and worse classes in two

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
		vascular or psychiatric diseases)”	instrumental ADLs (IADLs), disability, heart attack, heart diseases, hypertension, stroke, physical function, mobility, physical limitations, vision impairment, hearing problems, BMI, overweight, obesity, diabetes, chronic condition, pulse pressure, peak expiratory flow, handedness, grip strength,		studies. 3) Most studies demonstrated higher baseline cognition being predictive of better class membership; however, one study showed that better baseline episodic memory predicted declining memory. 4) Self-rated health predicted the best trajectory class in males in one study, whereas another study provided opposite findings in males and females. **Predictors within individual classes:** • Being married and church attendance beneficial across all classes • Older age, physical limitation and dementia detrimental across all classes • Higher education beneficial in the best class in one study and in the worst class in another study

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
			heart rate, gait, balance, sleep apnea, hospitalization, nursing home admission • <u>Genetic</u>: APOE status, single-nucleotide polymorphisms (SNPs) • <u>Biomarkers</u>: fasting glucose, high blood sugar, cytokine markers, triglycerides, total cholesterol, brain imaging data		• Depression detrimental in the best two classes • Social support beneficial in the worst class • Parkinson's disease detrimental for general cognition in the best class • Stroke detrimental for non-memory cognition in the worst class **Conclusion** • "Cognitive aging in late life is a dynamic process with significant inter-individual variability. However, it remains unclear whether similar patterns of cognitive aging are observed across all cognitive domains."
Zammit 2019 **Objective**	**Databases searched** • Embase	**Inclusion criteria** • "Used individual level data from ages 40 and	Grip strength as an indicator of upper body muscle strength	**Cognitive functions and/or abilities assessed** • Premorbid IQ/General intelligence	• Meta-analysis was not conducted. • "The main conclusion derived from this systematic

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
"Our aim was to synthesize and evaluate longitudinal research addressing whether changes in grip strength are associated with changes in cognitive function in healthy older adults."	• PsychINFO • PubMed • Web of Science **Dates searched** • Inception – April 2017[21] **Supplementary searches** • NR **Number of studies included:** 6	older in community-dwelling samples" • "Used objective measurements of both grip strength and cognitive function" • "Analyzed longitudinal data (ie, two or more measurement occasions) on grip strength and cognition" • "Reported original research in English" **Exclusion criteria** • Studies that did not meet the inclusion criteria • Intervention studies or trials		• Memory • Episodic memory • Semantic memory • Working memory • Crystallized IQ • Crystallized ability • Processing speed • Posychophysical speed • Reaction time • Reasoning • Fluid reasoning • Fluid intelligence **Tests and/or methods of outcome assessment** • Word recognition • Recall of three items, • Address Recall.	review is that despite the different analytic techniques and inconsistencies across results, all studies concluded that although cognitive function and grip strength decline on average in later life, their declines are not necessarily associated."

[21] "We did not use date restrictions since we expected the majority of the reports to be from around the year 2000 onwards."

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Vocabulary and Similarities (WAIS-R) • National Adult Reading Test. • Simple reaction time. • Choice reaction time • Symbol Letter Modalities Test (SLMT) • Raven's Standard progressive matrices • Letter series task • Computation span task • Word recall task • Fact recall task • 54-iten recognition vocabulary measures • Moray House Test No.12 • Matrix Reasoning • Block Design • Digit Span • Letter-Number Sequencing • Inspection time	

Reference Review Objective	Review Methods	Eligibility Criteria	Factors/ modifiers	Outcomes	Quantitative Results and Author-Reported Conclusion
				• Information Subtest from WAIS-R • Synonyms • Analogies • • Figure Logic • Card Rotation • Symbol Digit • Figure Identification • Picture Memory Task	

15 APPENDIX 4: Summaries of original studies for question 4

	Design	Population	Cognitive function measure	Clinical performance or competence measure	Findings	Derivation of a cognitive threshold?
Del Bene and Brandt (2020)	Cross-sectional	**Referred group** • 30 physicians of different specialties referred for neuropsychological evaluations • 33% had known neurological, 20% had known psychiatric, and 27% had suspected cognitive disorders • Some were still practicing while others were on medical leave of absence, or suspended, or retired due to age or disability. • 26 men, 4 women • Mean age 64.27 (SD 12.53) years **Comparison group**	**Nine variables derived from seven cognitive and motor tests:** • Wonderlic personnel test (WPT-IQ) for general cognitive ability • Symbol digit modalities (SDMT) test for visual scanning, attention, processing speed, graphomotor control • Grooved pegboard test (GPT) for manual speed and dexterity • Hopkins verbal learning test (HVLT)–revised • Brief visuospatial memory test (BVMT) – revised • D-KEFS trail making test for multiple,	Referral for assessment due to quality-of-care infractions or deficiencies, or concern of their healthcare professionals about their neurocognitive wellbeing	• "Impaired" test score was defined as that below the 5th percentile of the control physicians' performance. • An impaired score on more than five of the nine key variables was suggested as a cut-off to identify impaired physicians. • Using this cut-off, 14 referred physicians were categorized as "impaired" and 16 as "ambiguous." <u>Mean (SD) neuropsychological test scores of the comparison group (community urologists), "impaired" and "ambiguous", respectively</u> • WPT IQ: 129.20 (8.47); 105.50 (9.55); 120.93 (16.26) • SDMT-Written: 56.87 (7.58); 33.29 (6.68); 47.00 (8.04)	Questionable

	Design	Population	Cognitive function measure	Clinical performance or competence measure	Findings	Derivation of a cognitive threshold?
		• 39 currently practicing community urologists with no known or suspected neurological, psychiatric, or cognitive disorders • Mean age 48.51 (SD 8.71) years • 35 men, 4 women	simultaneous tracking and motor speed • D-KEFS tower test for planning and non-verbal problem solving.		• SDMT-Oral: 63.92 (11.09); 38.93 (9.54); 55.29 (11.23) • GPT-Dominant hand: 62.68 (8.38); 110.64 (42.72); 77.14 (18.53) • GPT-Non-dominant hand: 67.79 (9.07); 136.43 (64.91); 84.43 (17.97) • HVLT-Delayed Recall: 9.95 (1.85); 5.43 (3.57); 7.79 (3.73) • BVMT-Delayed Recall: 10.03 (1.70); 4.71 (3.15); 8.64 (3.37) • D-KEFS Tower test: 18.63 (3.17); 14.64 (2.65); 17.29 (1.82) • D-KEFS Trail Making Test, Trial 4 Switching: 60.21 (26.05); 178.14 (68.95); 81.07 (32.70)	
Korinek et al. (2009)	Cross-sectional	**Competency group** • 267 physicians referred for competency evaluation to the Center for Personalized Education for Physicians program	**MicroCog for assessment of five domains (see table 3)**: • Attention/mental control • Reasoning/calculation • Memory • Spatial abilities • Reaction time	Referral for competency evaluations; no details provided	Mean (SD) scores on the MicroCog summary measures for the comparison group and competency group, respectively • Processing speed: 108.94 (11.011); 96.55 (17.284); p<0.001	No

	Design	Population	Cognitive function measure	Clinical performance or competence measure	Findings	Derivation of a cognitive threshold?
		and who completed the evaluation from January 1997 to January 2004 • Specialties: primary care (47.2%); surgical (36.7%); other (16.1%) • 83.5% male physicians • Age 30-80, mean 51.5 (SD 9.1) years **Comparison group** • 68 physicians of similar age with no competency concerns recruited from a metropolitan area in 2004 and 2005 • Specialties: primary care (42.6%); surgical (23.5%); other (33.9.1%) • 60.3% male physicians • Age 31-74, mean 49.4 (SD 12.5) years	**Three summary scores on the MicroCog** • Accuracy summary score • Processing speed summary score • Cognitive proficiency summary score [weighted accuracy and speed information from all the subtests in the five cognitive domains.]		• Processing accuracy: 105.94 (10.635); 98.93 (10.991); p<0.001 • Cognitive proficiency[22]: 109.62 (9.126); 95.83 (12.575); p<0.001 • More physicians in the competency group (24% vs. 0% in the comparison group; p<0.001) had cognitive difficulty defined as a cognitive proficiency score more than 1 SD below the mean, or any two index scores more than 1 SD below the mean. • When scores for physicians whose performance suggested cognitive difficulty were removed from the analyses, the competency group still scored significantly lower [101.1 (SD 8.897)] than the comparison group [109.62	

[22] Cognitive proficiency score was defined as a cognitive summary measure that included weighted accuracy and speed information from all subtests in the five cognitive domains.

	Design	Population	Cognitive function measure	Clinical performance or competence measure	Findings	Derivation of a cognitive threshold?
					(SD 9.126)] in cognitive proficiency (p<0.001) Mean (SD) scores on the MicroCog for specific cognitive domains for the comparison group and competency group, respectively • Attention/mental control: 110.07 (9.09); 97.82 (11.82); p<0.001 • Reasoning/calculation: 106.87 (12.27); 99.70 (14.17); p<0.001 • Memory: 110.41 (10.54); 101.43 (13.79); p<0.001 • Spatial abilities: 108.79 (8.26); 99.72 (10.87); p<0.001 • Reaction time: 105.93 (7.85); 104.34 (12.21); p=0.191	
Perry and Crean (2005)	Cross-sectional	**Study Group** • 235 consecutive physician referrals between September 1997 and December 2001 to the PACE program.	**24 subsets derived from four batteries:** • Wechsler Adult Intelligence Scale-Revised: Information, Digit Span, Vocabulary, Similarities, Picture	Reasons for referral: Misdiagnosis (25.8%); Surgical complications (20.3%); Case mismanagement (18.6%);	• Physician participants scored significantly lower than the normative reference sample: WAIS-R Picture Arrangement ($t(147) = -2.1$, $P < .05$), measures of non-verbal complex figure learning ($t(147) = -8.0$, $P < .001$), Trail Making Test Part A subtest of	No

	Design	Population	Cognitive function measure	Clinical performance or competence measure	Findings	Derivation of a cognitive threshold?
		• Only data on 148 physicians whose primary language was English are reported.) • Participants were primarily Caucasian (77.7%), male (93.2%) and had a mean age of 54.4 (range 32-83) years. • Specialties: family medicine (24.3%); OB/GYN (10.1%); internal medicine (9.5%); Surgery (8.8%); Plastics/cosmetics (6.8%); anesthesiology (6.1%) Pediatrics (3.4%); other (31.0%) **Comparison group** • The neuropsychological test performance of the physicians was compared to	Arrangement and Block Design subtests • Reading subtest from the Wide Range Achievement Test-3 • California Verbal Learning; the Category Test • Neuropsychological Screening Battery, broad range of cognitive abilities and includes 16 subsets	Prescription (10.2%); Interpretation (5.1%); Billing/financial (4.7%); Documentation (3.8%); other (11.5%). (No physician was referred due to current alcohol or substance abuse.)	the NSB ($t(147)= -5.6$, $P < .001$), but performed significantly faster than the normative sample on Trails B ($t(147)=2.0$, $P < .05$), numerical attention time ($t(147) = 8.7$, $P < .001$), symbol digit modality ($t(147) = -4.9$, $P < .001$) and total words learned over the five repeated CVLT trials ($t(147) = -2.2$, $P < .05$). • Other CLVT measures were not significantly different from the normative reference sample. • To assess the depth of the impaired performance of these physicians they calculated the percentage of physicians who scored 1 standard deviation (S.D.) below the normative sample for each of the variables. A cut off of 1 S.D. was selected as it has been shown to yield the most balanced levels of sensitivity and specificity.	

	Design	Population	Cognitive function measure	Clinical performance or competence measure	Findings	Derivation of a cognitive threshold?
		normative reference samples.			• Although the neuropsychological performance of PACE physicians was in the average range on most measures of the assessment battery, sixty-one percent of the physicians scored at least 1 S.D. below expectations on three or more of the neuropsychological measures and 51% scored 1 S.D. below the normative sample on four or more of the neuropsychological measures.	
Turnbull et al. (2000)	Cross-sectional	**Study group** • 27 physicians referred to a competency assessment program, the Physician Review Program (PREP), between 1996 and 1997 **Comparison group**	Problem solving (verbal and visual/spatial), concept formation, reasoning • Wechsler Adult Intelligence Scale-Revised (WAIS-R) [similarities, comprehension, picture completion, picture arrangement]	Performance in the PREP program. • The PREP program includes multiple-choice questions, simulated patients, and chart-stimulated recall.	• Individual results for all 27 physicians (PREP rating and all test scores) are reported in table 1 of the publication. • "Of the eight physicians who scored well in the PREP assessment (categories I or II), seven had no or minimal or mild cognitive impairment."	No

	Design	Population	Cognitive function measure	Clinical performance or competence measure	Findings	Derivation of a cognitive threshold?
		• Internal comparisons (Cognitive test performance of physicians who scored well on the PREP assessment was compared with that of physicians who scored poorly.]	• Wisconsin Card Sorting Test (WCST) • Rey Osterrieth Complex Figure (CFT) [copy only] Learning, memory • Weschler Memory Scale—Revised (WMS-R) [passages with 30-minute delayed recall] • California Verbal Learning Test (CVLT) Attention, complex mental tracking and verbal productivity (fluency) • Trail Making Test • Stroop Color Word Interference • Paced Auditory Serial Addition Task (PASAT)	• Each participant receives a summary grade based on the results of all tests. • Six levels of competency have been defined: categories I and II include physicians with no or minor deficiencies; categories III and IV include physicians with moderate to major difficulties; category V comprises physicians unsafe to practice without direct	• “Of the 19 physicians who scored poorly at PREP (categories III, IV, V), six (32%) had moderate or severe cognitive impairment.”	

	Design	Population	Cognitive function measure	Clinical performance or competence measure	Findings	Derivation of a cognitive threshold?
			• Verbal Fluency (FAS and animal naming)	supervision; category VI comprises physicians unsafe to practice in any setting.		
Turnbull et al. (2006)	Cross-sectional (Follow up to Turnbull et al. (2000)	**Study group** • 45 participants of a physician competency assessment program, the Physician Review Program (PREP), between 1997 and 2001. • 18 of the 45 physicians were reassessed at PREP because of poor initial performance. **Comparison group** • Internal comparisons (The neuropsychological test performance of physicians who scored poorly on the PREP	**13 tasks covering five domains** • Verbal problem solving: Wechsler Adult Intelligence Scale-Revised (similarities, comprehension,) • For Visual-spatial problem solving: Wechsler Adult Intelligence Scale-Revised (picture completion, picture arrangement), Wisconsin Card Sorting and Rey Osterrieth Complex Figure (copy)	The PREP program has previously been described in Turnbull et al. 2000). [The PREP scores reasonably divide into satisfactory (categories 1 and 2) and unsatisfactory (categories 3, 4, and 5).]	• The scores were given as age-adjusted and age-independent. • Of the 14 physicians scoring well, 12 had no or minimal or mild cognitive impairment using age-adjusted reference norms • Of the 31 physicians scoring poorly at PREP, 12 (38%) had cognitive impairment: moderate (7 physicians) or severe (5 physicians), likely sufficient to explain their poor performance. • The best predictor of the PREP score was the age-independent global rating (Pearson correlation = 0.57),	No

	Design	Population	Cognitive function measure	Clinical performance or competence measure	Findings	Derivation of a cognitive threshold?
		assessment was compared to that of physicians who scored well)	• For Learning and memory Domain: Wechsler Memory Scale- Revised[10] (passages with 30 minute recall) and California Verbal Learning Test • Verbal Fluency (FAS[12] and animal naming) for fluency • For Attention and Mental tracking, Trail making test, Stroop color word interference and Paced auditory serial addition task		while the age-adjusted global rating was less predictive (0.39).	

16 APPENDIX 5: Modified AMSTAR 2

16.1 Modified AMSTAR 2 for reviews of non-intervention studies.

Main questions Assessment conditions	**Critical question**
1. Did the research question and inclusion criteria specify the population and outcome under study? • Population, and • Outcome	**No**
2. Did the review authors use a comprehensive literature search strategy? • Searched at least 2 relevant databases, and • Keywords/search strategy, and • Searched the reference lists of included studies, and • Included/consulted content experts, and • Searched for grey literature, and • Conducted search within 24 months of completion of the review	**Yes**
3. Did the review authors perform study selection in duplicate? • At least two reviewers independently agreed on selection of eligible studies and achieved consensus on which studies to include • Two reviewers selected a sample of eligible studies and achieved good agreement (at least 80 percent), with the remainder selected by one reviewer	**Yes**
4. Did the review authors perform data extraction in duplicate? • At least 2 reviewers achieved consensus on which data to extract, OR • Two reviewers extracted data from a sample of eligible studies and achieved good agreement (at least 80%)	**No**
5. Did the review authors provide a list of excluded studies and justify the exclusions? • Provided a list of all potentially relevant studies that were read in full text form (level 2) but excluded from the review, AND • Justified the exclusion from the review of each potentially relevant study (level 2)	**No**

Main questions Assessment conditions	**Critical question**
6. Did the review authors describe the included studies in adequate detail?	**Yes**
• Described populations, and • Described outcomes, and • Described research designs	
7. Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?	**Yes**
• Confounding, and • Selection bias, and • Methods for ascertaining measures of risk factors/exposures and outcomes, and • Selection of the reported results	
8. Did the review authors report on the sources of funding for the studies included in the review?	**No**
• Reported on (or looked for) the sources of funding for the studies included in the review?	
9. If meta-analysis was performed did the review authors use appropriate methods for statistical combination of results?	**No**
• The authors justified combining the data in a meta-analysis • AND they used an appropriate weighted technique to combine study results, adjusting for heterogeneity if present • AND they statistically combined effect estimates from studies that were adjusted for confounding, rather than combining raw data, or justified combining raw data when adjusted effect estimates were not available • AND they reported separate summary estimates for RCTs and other studies separately when both were included in the review • OR No meta-analysis conducted	
10. If meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?	**No**
• If the pooled estimate was based on studies at variable RoB, the authors performed analyses to investigate possible impact of RoB on summary estimates of effect, OR • No meta-analysis conducted	
11. Did the review authors account for RoB in individual studies when interpreting/discussing the results of the review?	**Yes**
• Review included only low risk of bias (RoB) studies, OR	

Main questions Assessment conditions	**Critical question**
• Review included studies (moderate/high RoB), and discussed the likely impact on the results	
12. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review? • There was no significant heterogeneity, OR • Heterogeneity was present, and the authors investigated its sources and discussed the impact the results of the review	**No**
13. If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review? • Performed graphical or statistical tests for publication bias and discussed the likelihood and magnitude of impact of publication bias, OR • No meta-analysis conducted	**No**
14. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review? • The authors reported no competing interests, AND • The authors described their funding sources and how they managed potential conflicts of interest	**No**

16.2 Rubric for classifying reviews as high, moderate, or low quality.

Level of quality	Requirements
High quality (level 1):	All conditions for all critical questions are fully met
Moderate quality (level 2):	Not meeting requirements for levels 1 and 3
Low quality (Level 3):	Conditions for 2 or more critical questions are unmet or partially met

17 APPENDIX 6: Details of risk of bias assessment

17.1 Questions 1 to 3

Risk of bias results for included reviews using a modified AMSTAR 2 tool.

Citation (1st Author, Year)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Final
Adhikari 2021	Yes	No	Yes	Yes	No	Yes	Yes	No	No MA	No MA	No	No	No MA	No	Low
Akintola 2015	Yes	No	Yes	No	No	Yes	No	No	No	No	Yes	Yes	No	Yes	Low
Anstey 2008	Yes	No	Yes	No	No	Yes	No	No	No	No	No	Yes	No	No	Low
Armstrong 2017	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	Yes	Yes	No	Low
Arwert 2005	Yes	No	Yes	Yes	No	Yes	No	No	No	No	No	Yes	No	No	Low
Bubu 2020	Yes	No	Yes	Yes	No	Yes	Yes	No	No MA	No MA	Yes	Yes	No MA	Yes	Moderate
Cervera-Crespo 2017	Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Yes	Low
Chapko 2018	Yes	No	Yes	Yes	No	Yes	No	No	No MA	No MA	No	Yes	No MA	Yes	Low
Chinnappa-Quinn 2020	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	No	Low
Cross 2017	Yes	No	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	No	Low
Demnitz 2016	Yes	No	Yes	No	No	Yes	No	No	No	No	No	Yes	Yes	Yes	Low
Dotson 2020	Yes	No	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Low
Duggan 2020	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No MA	No MA	Yes	Yes	No MA	Yes	Moderate

Citation (1st Author, Year)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Final
Engeroff 2018	Yes	No	Yes	Yes	No	Yes	No	No	No MA	No MA	No	No	No MA	Yes	Low
Evans 2019	Yes	No	Yes	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Low
Forte 2020	Yes	No	Yes	No	No	Yes	Yes	No	No MA	No MA	No	Yes	No MA	Yes	Low
Fusi 2021	Yes	No	Yes	No	No	Yes	No	No	No MA	No MA	No	No	No MA	No	Low
Gifford 2013	Yes	No	Yes	No	No	No	No	No	No	No	No	Yes	No	Yes	Low
Gu 2019	Yes	No	Yes	Yes	No	No	No	No	No MA	No MA	No	Yes	No MA	Yes	Low
Hudon 2020	Yes	No	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Low
Issa 2006	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No MA	No MA	Yes	Yes	No MA	No	Moderate
Jaroslawska 2019	Yes	No	Yes	No	No	No	No	No	No	No	No	Yes	No	No	Low
Kelly 2017	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No MA	No MA	No	Yes	No MA	Yes	Low
Lee 2018	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Moderate
Lei 2019	Yes	No	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Low
Loughrey 2017	Yes	No	Yes	Yes	No	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	Low
Loughrey 2018	Yes	No	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Low
Lourida 2013	Yes	Yes	Yes	Yes	No	Yes	No	No	No MA	No MA	Yes	Yes	No MA	Yes	Moderate
Meng 2017	Yes	No	Yes	No	No	Yes	No	No	No MA	No MA	Yes	No	No MA	Yes	Low

Citation (1st Author, Year)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Final
Nexo 2016	Yes	No	Yes	No	No	Yes	Yes	No	No MA	No MA	Yes	Yes	No MA	Yes	Moderate
Pocuca 2021	Yes	Yes	Yes	Yes	No	No	No	No	No MA	No MA	No	No	No MA	Yes	Low
Rafnsson 2013	Yes	No	Yes	Yes	No	Yes	Yes	No	No MA	No MA	Yes	Yes	No MA	Yes	Moderate
Ramalho 2018	Yes	No	Yes	Yes	No	Yes	Yes	No	No MA	No MA	Yes	Yes	No MA	Yes	Moderate
Rodriguez 2020	Yes	No	Yes	No	Yes	Yes	No	No	No MA	No MA	Yes	Yes	No MA	Yes	Low
Roman-Caballero 2018	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No	Yes	No	Yes	Low
Scott 2019	Yes	No	Yes	Yes	No	Yes	Yes	No	No MA	No MA	Yes	Yes	No MA	No	Moderate
Vallesi 2021	Yes	No	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Low
van den Noort 2019	Yes	No	Yes	Yes	No	No	No	No	No MA	No MA	Yes	Yes	No MA	Yes	Low
Wu 2020	Yes	No	Yes	Yes	Yes	Yes	No	No	No MA	No MA	Yes	Yes	No MA	Yes	Low
Zammit 2019	Yes	No	Yes	Yes	No	Yes	No	No	No MA	No MA	No	No	No MA	Yes	Low

Yes	Criteria was met.	No MA	No Meta-analysis was conducted.
No	Criteria was not met.		Critical Question.

17.2 Question 4

[Adapted from NHLBI (2013)]

	Del Bene and Brandt (2020)	(Korinek et al., 2009)	Perry and Crean (2005)	Turnbull et al. (2000)	Turnbull et al. (2006)
1. Was the research question or objective in this paper clearly stated?	Yes ["This study sought to establish and validate an approach to detecting neuropsychological impairment among physicians."]	Yes ["The purpose of this study was to compare the cognitive abilities between a group of physicians referred for competency evaluations and a control group."]	Yes ["The aim of this paper is to characterize the neuropsychological profiles of physicians referred for assessment using a comprehensive neuropsychological battery."]	Yes ["The authors sought to determine whether physicians with impaired competency had neuropsychological impairment sufficient to explain their incompetence and their failure to improve with remedial continuing medical education (CME)."]	Yes ["Remediation of incompetent physicians has proven difficult and sometimes impossible. The authors wished to determine whether such physicians had neuropsychological impairment sufficient to explain their incompetence and their failure to improve after remedial continuing medical education (CME)."]
2. Was the study population clearly specified and defined?	No	• Yes, for the study group [data for all physicians who completed competency evaluations at CPEP from January 1997 to January 2004] • No for the comparison group	Yes, [148 physicians whose primary language was English of 235 consecutive physician referrals to the PACE program between September 1997 and December 2001]	Yes [27 physicians who underwent PREP assessments in 1996–1997]	Yes [data on 27 PREP assessments in 1996–1997 and 20 PREP assessments in 18 physicians in 2000–2001 (two physicians were reassessed within the study).]
3. Was the participation rate reported?	No	Yes • 100% for the study group • 49% for the comparison group (47% completed the assessment)	Yes [Data on all 148 English-speaking physicians were analyzed]	Yes [It appears that data on all assessments in 1996-1997 were analyzed.]	Yes [It appears that data on all assessments in 1996-1997 and 2000-2001 were analyzed.]
4. Were all the subjects selected or recruited from the same or similar	No	No	No [Data on physicians were compared with normative data and not	Cannot determine	Cannot determine

	Del Bene and Brandt (2020)	(Korinek et al., 2009)	Perry and Crean (2005)	Turnbull et al. (2000)	Turnbull et al. (2006)
populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?		• Timelines for recruitment: Jan 1997-Jan 2004 (study group); 2004-2005 (comparison group) • Significant difference between the groups in the proportion of female to male physicians and in the proportions of physicians' specialties • Visual, hearing, or physical impairment was applied as an exclusion criterion only to the comparison group • The authors acknowledge that the comparison group may have comprised higher functioning physicians than the general physician population, thus accentuating the difference between the two physician groups	with a control group of physicians]		
5. Was a sample size justification, power description, or variance and effect estimates provided?	Yes [The authors discuss the statistical power of the study and acknowledge the small sample size.]	Yes (effect estimates)	No	No	No

	Del Bene and Brandt (2020)	(Korinek et al., 2009)	Perry and Crean (2005)	Turnbull et al. (2000)	Turnbull et al. (2006)
6. For the analyses in this paper, was cognitive decline measured prior to performance or competence?	No	No	No	No	No
7. Did the study examine different levels of the cognitive scores as related to performance or competence?	Yes [Scoring on 3, 4, 5, or 6 of the 9 neuropsychological measures were examined in the process of derivation of the cut-off for impairment]	No	No	No	No
8. Were the cognitive ability measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	Yes	No ["The two groups of physicians were tested under different personal circumstances. The referred physicians were involved in an evaluation that could ultimately have a significant impact on their career and their livelihood. The anxiety and pressure created by that scenario could have negatively impacted their performance. This group of physicians would also be highly motivated to perform well on the test."]	Yes	Yes	Yes
9. Was cognition assessed more than once over time?	No [cross-sectional study]	No [cross-sectional study]	No [cross-sectional study]	No [cross-sectional study]	No [cross-sectional study]

	Del Bene and Brandt (2020)	(Korinek et al., 2009)	Perry and Crean (2005)	Turnbull et al. (2000)	Turnbull et al. (2006)
10. Were performance or competence measure (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	No [Mixed reasons for referral, including inferior clinical performance, as well as known or suspected neurological, psychiatric, or cognitive disorders]	No [referral for competency concerns]	No [Mixed reasons for referral]	Yes	Yes
11. Were the performance or competence assessors blinded to the cognition status of participants?	No [Clinical performance status was known prior to the cognitive assessment.]	No [Clinical performance status was known prior to the cognitive assessment.]	No [Clinical performance status was known prior to the cognitive assessment.]	No [Clinical performance status was known prior to the cognitive assessment.]	No [Clinical performance status was known prior to the cognitive assessment.]
12. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between cognition and performance or competence?	No	No [measured but not accounted for in the statistical analysis]	No	No	No

18 APPENDIX 7: Cognitive Instruments

The table contains the classification of the preferred elderly physicians assessment instruments, as discussed in section 7 (Question 6) and suggestions from Devi et al. (2021), Del Bene and Brandt (2020) and Cooney and Balcezak (2020) (Section 7.9) by cognitive domains and content.

Table: Cognitive instruments and their content classified by cognitive domains.

Domains / Cognitive Function	Tests / Content	Tool / Instruments	Norms			Duration (Min)	Test Modality	Source
			Age	Education	Sex			
Executive Function/ Processing Speed	Trail Making Part A-B^	Devi, MOCA	Yes	Yes	No	<10	Paper/ Computer	
	The Stroop Color and Word Test^	Devi	Yes	No	No	<5	Paper/ Computer	
	Colour Word Interferance, Delis-Kaplan Executive Function System (D-KEFS)	Devi	Yes	No	No	<3	Paper/ Computer	
	Digit Symbol Coding, Wechsler Ault Inteligence Scale IV (WAIS-IV)^	Devi, RBANS, ANAM-GNS	Yes	Yes	Yes	<5	Paper/ Computer	(Devi et al., 2021)
	Letter-Number Sequencing	Devi	Yes	Yes	Yes	10	Paper/ Computer	
	Digit Span, Wechsler Ault Inteligence Scale III (WAIS-III)/ Welchsler Memory Scale-III (WMS-III)	Devi, MicroCog, MoCA, RBANS, SLUMS	Yes	Yes	Yes	11	Paper/ Computer	
	Similarities, Wechsler Ault Inteligence Scale III (WAIS-III)	MicroCog	Yes	Yes	Yes	2-6	Paper/ Computer	(Axelrod, 2001; Mitchell et al., 2013)
	Category test, Wisconsin Card Sorting Test (WCST)	MicroCog	Yes	Yes	No	12-20	Paper/ Computer	(Kohli & Kaur, 2006; Moving Ahead Centre

Domains / Cognitive Function	Tests / Content	Tool / Instruments	Norms: Age	Norms: Education	Norms: Sex	Duration (Min)	Test Modality	Source
								of Research Excellence, n.d.)
	Arithmetic, The Wechsler Ault Inteligence Scale III (WAIS-III)	MicroCog	Yes	Yes	Yes	3-7	Paper/ Computer	(Longman, Saklofske, & Fung, 2007; Ryan, Sattler, & Lopez, 2000)
	Serial 7 Subtractions	MoCA, SLUMS, ACE-III	Yes	Yes	Yes	2	Paper/ Computer	(Bristow, Jih, Slabich, & Gunn, 2016; Pennington, 1947)
	Calculation Story Problem	SLUMS	NIF	NIF	NIF	6-10	Paper/ Computer	(Patnode et al., 2020)
	Logical Relations - Symbolic	ANAM-GNS	Yes	Yes	Yes	NIF	Paper/ Computer	(Meyers & Vincent, 2020)
	Mathematical Processing	ANAM-GNS	Yes	Yes	Yes	NIF	Paper/ Computer	(Meyers & Vincent, 2020)
	Tower Puzzle	ANAM-GNS, DB&B (D-KEFS)	Yes	Yes	No	Dependent~	Paper/ Computer	(NeuroMite, 2011)
	Wonderlic Personnel Test (WPT)	DB&B	Yes	Yes	Yes	12	Paper/ Computer	(Beat the Wonderlic, 2017; McKelvie, 1989)
	Symbol Digit Modelises Test (SDMT)	DB&B	Yes	Yes	Yes	5	Paper/ Computer	(Kiely, Butterworth, Watson, & Wooden, 2014; WPS, 2022)
	Trail Making, Delis-Kaplan Executive Function System (D-KEFS)	DB&B	Yes	Yes	Yes	1	Paper/ Computer	(Fine, Delis, & Holdnack, 2011;

Domains / Cognitive Function	Tests / Content	Tool / Instruments	Norms: Age	Norms: Education	Norms: Sex	Duration (Min)	Test Modality	Source
								Yochim, Baldo, Nelson, & Delis, 2007)
	Flanker Test	NIHTB-CB	Yes	Yes	Yes	1	Paper/ Computer	(Sanders, Hortobagyi, Balasingham, Van der Zee, & van Heuvelen, 2018)
	Dimensional Change Card Sort (DCCS)	NIHTB-CB	Yes	Yes	Yes	5	Paper/ Computer	(Kohli & Kaur, 2006; Zelazo, 2006)
	Pattern Comparison Processing Speed (PCPS)	NIHTB-CB	Yes	Yes	Yes	3	Paper/ Computer	(Carlozzi, Beaumont, Tulsky, & Gershon, 2015)
Attention/ Concentration	Letter cancellation, Trail Making test	MicroCog	Yes	Yes	Yes	1	Computer	(Fernandez & Marcopulos, 2008)
	A list trials 1–5, California Verbal Learning (CVLT), A list trials 1–5	MicroCog	Yes	Yes	Yes	NIF	Computer	(Kramer et al., 2020)
	Recognition, California Verbal Learning (CVLT)	MicroCog	Yes	Yes	Yes	NIF	Computer	(Norman, Evans, Miller, & Heaton, 2000)
	"Tapping A" Test	MoCA, ANAM-GNS	Yes	Yes	Yes	NIF	Computer	(Vincent, Roebuck-Spencer, Gilliland, & Schlegel, 2012)
	Go/No-Go	ANAM-GNS	Yes	Yes	Yes	NIF	Computer	(Vincent et al., 2012)
	2-choice reaction time	ANAM-GNS	Yes	Yes	Yes	NIF	Computer	(Vincent et al., 2012)

Domains / Cognitive Function	Tests / Content	Tool / Instruments	Norms Age	Education	Sex	Duration (Min)	Test Modality	Source
	Simple Reaction Time	ANAM-GNS	Yes	Yes	Yes	NIF	Computer	(Vincent et al., 2012)
	Procedural Reaction Time	ANAM-GNS	Yes	Yes	Yes	NIF	Computer	(Vincent et al., 2012)
	Running Memory	ANAM-GNS	Yes	Yes	Yes	NIF	Computer	(Vincent et al., 2012)
	Rapid Visual Information Processing (RVP)	CANTAB	Yes	Yes	Yes	7	Computer	(R. A. Abbott et al., 2019; Ebaid & Crewther, 2019)
	Reaction Time (RTI)	CANTAB	Yes	Yes	Yes	3	Computer	(R. A. Abbott et al., 2019)
Language/ Processing Speed	Animals Naming	Devi, SLUMS, RBANS, ACE-III	Yes	Yes	No	<2	Paper/ Computer	(Devi et al., 2021)
	Fruits Naming	Devi, RBANS	Yes	No	No	<2	Paper/ Computer	
	Vegetables Naming	Devi, RBANS	Yes	No	No	<2	Paper/ Computer	
	CFL (Naming)	Devi	Yes	Yes	Yes	<5	Paper/ Computer	
	FAS (Naming)	Devi, MoCA	Yes	Yes	No	<5	Paper/ Computer	
	Naming starting with a letter	ACE-III	NIF	NIF	NIF	NIF	Paper/ Computer	
	Sentence Repetition	MoCA, ACE-III	Yes	Yes	Yes	NIF	Paper/ Computer	(Meyers, Volkert, & Diep, 2000)

Domains / Cognitive Function	Tests / Content	Tool / Instruments	Norms: Age	Norms: Education	Norms: Sex	Duration (Min)	Test Modality	Source
	Hopkins Verbal Learning Test (HVLT)	DB&B	Yes	Yes	Yes	15-25	Paper/ Computer	(Benedict, Schretlen, Groninger, & Brandt, 1998)
	Reading-Language	NIHTB-CB	Yes	Yes	Yes	4	Paper/ Computer	(R. C. Gershon et al., 2014)
	Vocabulary-Language	NIHTB-CB	Yes	Yes	Yes	5	Paper/ Computer	(R. C. Gershon et al., 2014)
	Performing instructions	ACE-III	NIF	NIF	NIF	NIF	Paper/ Computer	
Memory	Rey Auditory Verbal Learning Test (15 words)^	Devi	Yes	No	Yes	12 with 20 delay	Paper/ Computer	(Devi et al., 2021)
	Word List (10 words), Consortium to Establish a Registry for Alzheimer's Disease (CERAD)	Devi, RBANS	Yes	Yes	Yes	7 with 10 delay	Paper/ Computer	
	6-Trial Selective Reminding Test (SRT)	Devi	Yes	Yes	Yes	12 with 15 delay	Paper/ Computer	
	California Verbal Learning 2nd Edition (CVLT-II) Short Form (9 words)	Devi	Yes	Yes	Yes	7 with 10 delay	Paper/ Computer	
	Logical Memory I, Welchsler Memory Scale-III (WMS-III)	MicroCog, RBANS	Yes	Yes	Yes	5	Paper/ Computer	(Axelrod, 2001; Stebbins, 2007)
	Logical Memory II, Welchsler Memory Scale-III (WMS-III)	MicroCog	Yes	Yes	Yes	4	Paper/ Computer	(Axelrod, 2001; Stebbins, 2007)
	Naming Images	MoCA, RBANS, SLUMS, ACE-III	Yes	Yes	Yes	NIF	Paper/ Computer	(Laiacona, Barbarotto, Baratelli, & Capitani,

Domains / Cognitive Function	Tests / Content	Tool / Instruments	Norms: Age	Norms: Education	Norms: Sex	Duration (Min)	Test Modality	Source
								2016; Navarrete, Arcara, Mondini, & Penolazzi, 2019)
	3/5-Word Instant and Recall Memory	MoCA, SLUMS, ACE-III	Yes	Yes	Yes	6 with 4 delay	Paper/ Computer	(Patnode et al., 2020; Pontón et al., 1996)
	Orientation	MoCA, SLUMS, ACE-III	Yes	Yes	Yes	6 with 4 delay	Paper/ Computer	(Guerrero-Berroa et al., 2009; Patnode et al., 2020)
	One orally presented story, 3 questions	SLUMS	NIF	NIF	NIF	6 with 4 delay	Paper/ Computer	(Guerrero-Berroa et al., 2009; Patnode et al., 2020)
	Figure Recall	RBANS	NIF	NIF	NIF	NIF	Paper/ Computer	
	Memory Retrograde (Recall)	ACE-III	NIF	NIF	NIF	NIF	Paper/ Computer	
	Matching to Sample	ANAM-GNS	Yes	Yes	No	5 with 20 delay	Paper/ Computer	(Oscar-Berman & Bonner, 1985)
	Picture Sequence Memory Test (PSMT)	NIHTB-CB	Yes	Yes	Yes	NIF	Paper/ Computer	(Carlozzi et al., 2017)
	List Sorting	NIHTB-CB	Yes	Yes	Yes	NIF	Paper/ Computer	(Tulsky et al., 2014)
	Paired Associates Learning (PAL)	CANTAB	Yes	Yes	Yes	8	Paper/ Computer	(R. A. Abbott et al., 2019)

Domains / Cognitive Function	Tests / Content	Tool / Instruments	Norms: Age	Education	Sex	Duration (Min)	Test Modality	Source
	Spatial Working Memory (SVM)	CANTAB	Yes	Yes	Yes	4	Paper/ Computer	(R. A. Abbott et al., 2019)
Visuospatial Function	Rey-Osterrieth Complex Figure (ROCF)	Devi, RBANS, ACE-III	Yes	No	No	3 with 20 delay	Paper/ Computer	
	Clock Drawing	Devi, Microcog, MoCA, SLUMS, ACE-III	Yes	Yes	Yes	3	Paper/ Computer	(Devi et al., 2021)
	Benton Visual Form Discrimination (BVFD)	Devi, SLUMS	Yes	Yes	Yes	<10	Paper/ Computer	
	Cube Drawing	MoCA, ACE-III	Yes	No	Yes	6-10	Paper/ Computer	(Mathew, Renjith, & Mathuranath, 2018; Patnode et al., 2020)
	Trail Making Part-B	MoCA	Yes	Yes	No	6-10	Paper/ Computer	(Patnode et al., 2020; Tombaugh, 2004)
	Line Orientation	RBANS	Yes	Yes	No	NIF	Paper/ Computer	(Wilk et al., 2004)
	Spatial Processing	ANAM-GNS	NIF	NIF	NIF	NIF	Paper/ Computer	
	Brief Visuospatial Memory Test - Revised (BVMT)	DB&B	Yes	Yes	Yes	45 with 25 delay	Paper/ Computer	(J. Powell, Blake, Wyman-Chick, & Daniel, 2022)
	Dot Counting	ACE-III	NIF	NIF	NIF	NIF	Paper/ Computer	

Domains / Cognitive Function	Tests / Content	Tool / Instruments	Norms			Duration (Min)	Test Modality	Source
			Age	Education	Sex			
	Fragmented Letters	ACE-III	NIF	NIF	NIF	NIF	Paper/ Computer	
Motor Function	Grooved Pegboard Test	Devi, DB&B	Yes	No	No	<5	Grooved Pegboard	(Devi et al., 2021)

Devi: Devi et al. 2020

DB&B: Del Bene & Brant et al. 2020

Cooney and Balcezak (2020) consists of one test of Accuracy, Processing Speed, Self regulation,concentration & working memory 2 tests of eye movement pursuit tracking, visual analysis with reasoning, verbal fluency, visual & verbal memoryand orienttion, and 3 tests of executive functioning. The content of the test is confidential, therefore could not be included in the table.

NIF: No information Found

^Gold Standart Tests for NIH ToolBox

~ The duration of the Tower Puzzle is dependent on amount of the moves and move are related on amount of disks(n). The minimum number of moves is 2^n-1.

Tracking Progress while Ensuring Performance: Monitoring CPSA's Accelerated Registration Program for International Medical Graduates

Background

On Jan. 16, 2023, CPSA launched a 5-year pilot project to condense the Practice Readiness Assessment process for eligible international medical graduates (IMGs). This pilot program is meant to expedite IMGs independently practising in their identified communities faster, while still ensuring competent physician performance and patient safety.

CPSA's Practice Readiness Assessment (PRA) is the final step to independent practice in Alberta for IMGs who meet eligibility criteria and secured a sponsorship through Alberta Health Services. The PRA process consists of 2 parts:

1. A 3-month Preliminary Clinical Assessment – the candidate works under direct observation in the medical practice of a CPSA-approved assessor
2. A 3-month Supervised Practice Assessment (SPA) – the candidate practises independently in their identified community, providing medical services to Albertans.

The 5-year pilot project waives the first 3-month requirement for eligible IMGs, who can now go directly to their identified communities and begin practising independently while completing their SPA. Other requirements, such as clinical review exams, are also waived.

While the aim of this program is to enable qualified, trained physicians to enter into independent practice in Alberta quickly; as the medical regulator CPSA must also ensure that these IMG pilot physicians are practising at the same level of performance as other registered physicians in Alberta; thus protecting the public.

Goal

To develop processes and metrics that monitor the success of the IMG pilot program, that is, to ensure high-quality care to Albertans.

Objectives

Assess IMG pilot participants' performance in their first 5 years of practice in Alberta and identify any areas for improvement; as compared to randomly-selected CPSA-registered physicians on the general register.

Hypothesis

- Physicians who started their practice under the new pilot IMG registration process perform as well as other physicians in the community (i.e. randomly-selected physicians on CPSA's general register).

Methods

As required by the HPA, CPSA's Continuing Competence department routinely performs individualized reviews of physician practices. One such review is the Physician Assessment & Feedback (PAF) review. For this intervention, trained nurses and Senior Medical Advisors review some of the physician's charts to assess adherence to standards of practice and other protocols. At the end of the PAF, feedback is given to physicians and, in some rare instances, a more detailed and thorough assessment to address performance issues, an Individual Practice Review (IPR), is performed.

In 2021 CPSA designed protocols for PAF selection. To better utilize limited resources, "high risk" physicians (based on the REVU risk scores – "high risk" of having a complaint(s) and/or risky prescribing flags) are selected among others that are randomly chosen. As 0f 2023, among the high-risk group, approximately 50% require an IPR after their PAF review; while for the randomly-chosen physicians only 5% require IPR after PAF.

IMG physicians who join the provincial workforce through the expedited pilot program will also be subject to a PAF review. By monitoring the percentage of pass/fail (e.g., those not requiring/requiring further IPR) of the pilot physicians we can monitor if the program participants meet the same % threshold as randomly-selected Alberta physicians. If IMGs from the pilot program are failing the PAF more than 5%, this might indicate that their performance is not up to par with most CPSA physicians on the general register.

Analysis plan

- Descriptive analysis of PAF results
- Comparative measures between the IPR pilot program participants, randomly-selected physicians and high-risk physicians

Potential significance of study findings

The results of this study will contribute to CPSA's constant monitoring of the Accelerated Registration Programs (IPR pilot program). Our findings can help guide decision makers in the Registration department and other stakeholders regarding the future and progress of the pilot program.

Briefing Note:

Discrimination Screening in Competence Assessments at CPSA

May 2023

BACKGROUND:

Equity, diversity, and inclusion are three intertwined values CPSA holds in its ongoing work in the interest of the public, consisting of persons of different gender, race, sexual orientation, abilities, race, and ethnicity.

The Truth and Reconciliation Commission (TRC) of Canada disseminated its findings in 2015 with seven calls to action in the area of health. Notwithstanding, more work needs to be done: a recently published study[1] from Alberta documented significant explicit and implicit bias among AB physicians. Unrecognized implicit bias may lead to risk to patients; for example, a physician's bias regarding who uses substances might lead to underassessment of patients who do not fit the stereotype. Implicit bias may also lead to inappropriate triage scores as another recent Alberta study has shown[2].

CPSA continues building substantive and authentic connections with Indigenous Peoples and towards becoming an anti-racism and anti-discrimination organization.

WHAT IS CONTINUING COMPETENCE (CC) DOING?

CC recently added a trial screening question to detect bias and its effects on patient care to our QA assessments. The question is posed to the Practice Visitor after completion of their comprehensive mandate. The question utilizes language obtained from Canada's Human Rights Act:

"Did you detect any bias (implicit or explicit) on the basis of race, national or ethnic origin, colour, religion, age, sex, sexual orientation, gender identity or expression, marital status, family status, genetic characteristics or disability when conducting this practice review? If so, please provide examples of what was observed, or how care was conducted differently (if so) for different groups".

The purpose of adding this question is to determine if there currently exists a material degree of bias in the practices of members undergoing QA interventions. Where bias / discrimination is detected, the competence team will discuss the most appropriate intervention(s) to change behavior in order to improve outcomes. Any information will be handled sensitively and confidentially to avoid introducing bias in assessing the member's overall competence.

NEXT STEPS:

Anonymized data will be collected for 6-12 months, and reviewed to evaluate to determine if a material degree of bias is present. Following broader consultation, the scope of screening may be refined / expanded in future. Findings could be used to support appropriate educational and other interventions and to further support CPSA's work in becoming an anti-discrimination, anti-racism organization.

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[1] Roach P, Ruzycki SM, Hernandez S, et al Prevalence and characteristics of anti-Indigenous bias among Albertan physicians: a cross-sectional survey and framework analysis. *BMJ Open* 2023;13:e063178.

[2] First Nations status and emergency department triage scores in Alberta: a retrospective cohort study. McLane P, Barnabe C, Mackey C, et al. *CMAJ* 2022, 194 (2) E37-E45.

CPSA Business Activity Update

For the Period Ending March 31, 2023

Status Options	
	White - Complete
	Green – Exceeding/Meeting Target
	Yellow - Below target at this time; plan to be on target by year end
	Red – Significant Delay

Learning Organization Strategy

Definition: A learning organization is an innovative organization that anticipates future trends and takes pro-active steps to prepare. A learning organization takes calculated risks and uses learnings from past successes and failures to continually improve processes.

KPI #	KPI's	2023 Target	Accountability	Owner	Status	Results YTD (Enter % - actual results compared to target)	Detailed Explanation	Q1 2023 UPDATE
LOS001	Departments are engaged in CQI	75%	Prescribing Analytics	CINO	Exceeding/Meeting Target	25%		CQI ongoing in PC, AIR and revisiting possibility of resuming work in Registration.

Action #	Global Name	2023 Action/Tactics	Expected Results	KPI (Please list the KPI #s that are relevant to the corresponding Action	Accountability	Owner	Status	Progress (Enter % - actual results compared to target)	Detailed Explanation	Q1 2023 UPDATE
A301	CPSA CQI	CQI of all processes ongoing – start stretching goals	Regular reporting on results and action plans Processes improve across CPSA		Prescribing Analytics	CINO	Exceeding/Meeting Target	20%		Development of department reporting framework to share CQI work.
A302	Bluebird Project – Skill Enhancement	Integration of Informal Resolution techniques in the Early Resolution Workstream. Training is part of a 3 year plan to improve the communication and mediation skills of the existing staff. Ongoing investigator training to improve quality of investigations.	Enhanced mediation skills to negotiate and support both the public and physicians to consensually resolve concerns (new process) and complaints in a timely fashion with minimal investigation. To improve investigator quality of investigations.		Complaints & Discipline	Professional Conduct Director	Exceeding/Meeting Target	25%	Intake Resolution Officers to complete one course in ADRIA Communications or similar communication/mediation/negotiation course by Dec 2023 - ongoing. Early Resolution work stream to design and deploy concern process and establish consensual resolution process by Dec 2023. Investigators and SMA Investigators to complete two courses in investigation processes and/or techniques to improve quality of investigations by Dec 2023 - ongoing.	Work ongoing with i-Sight for portal and concern process design. Investigation work stream engaged in planning for training and quality improvement work.
A303	Governance Review	Governance Review implementation (Year 2)	Revised processes and structure based on the outcome of the review in 2022.		Office of the Registrar	Chief of Staff	Exceeding/Meeting Target	25%		OTR and Governance Committee are currently working on the recruitment/selection of Council members, changes to committee structures, non-voting members, & communications planning.
A304	History of CPSA	Roll out and implementation of the history project.	Final vehicle of history project determined.		Office of the Registrar	Chief of Staff	Significant Delay		At the December 2022 meeting Council approved pausing the history project, bringing it back for Council Discussion in December 2023, as a possible project for 2024 or 2025.	On hold

Organization Presence & Influence

Definition: CPSA is a respected and credible organization that promotes high quality healthcare for all Albertans and is recognized as a key stakeholder in the Alberta and Canadian healthcare scene. As an innovative and forward thinking regulator, CPSA is and is sought out to participate in health related initiatives provincially, nationally and internationally.

KPI #	KPI's	2023 Target	Accountability	Owner	Status	Results YTD (Enter % - actual results compared to target)	Detailed Explanation	Q1 2023 UPDATE
ORG001	• Improve media sentiment score Sentiment Score is calculated: A positive story is scored as 3, neutral at 2 and negative at 1. We take the average of all articles each month that related to CPSA. A 67% score means an average of neutral	Average media sentiment score of 69%	Communications	Communications Director	Exceeding/Meeting Target	70%		70% sentiment score

Action #	Global Name	2023 Action/Tactics	Expected Results	KPI (Please list the KPI #s that are relevant to the corresponding Action	Accountability	Owner	Status	Progress (Enter % - actual results compared to target)	Detailed Explanation	Q1 2023 UPDATE
A301	Disruptive Physicians	Continue bilateral initiative with Alberta Health Services (AHS) regarding disruptive physicians.	Develop a plan with AHS to address disruptive physicians building on the work of PROactive		Office of the Registrar	Chief of Staff	Significant Delay		This is not in the current workplan for 2023 and will not be actioned until after the Deputy Registrar is named and established in their role.	No change
A304	Communication/ Brand Strategy	Continue Communications Strategy Brand Strategy, engagement, media and marketing	Media monitoring, brand implementation projects for all depts, ongoing communications support and Physician and Albertan engagement initiatives.		Communications	Communications Director	Exceeding/Meeting Target	25%		25% complete
A305	Project Bluebird - overview	Project Bluebird - transformation of Complaints Process Three Year Strategy; establishment of appropriate metrics and measurements for ongoing measurement into the future of the department;	Improved and transparent metrics established; improved engagement with public and members; identification and transparency around processes related to discipline and other remedial activities.		Complaints & Discipline	Professional Conduct Director	Below Target	25%	KPI's have been established for 2023, the ability to extract the data and reliably report remains a challenge. Expected i-Sight reporting to have started in January 2023 but now delayed until June 2023 with manual data tracking occurring in the interim. i-Sight Complaint portal delayed to June 2023 due to challenges with vendor completion of expected designs. Website, brochure and other communications efforts are ongoing and on track for 2023.	Ongoing work with CPSA IT, Program Manager, Project Coordinator and Director with i-Sight vendor provider. Meetings with Communications and work is underway on website and communication improvements. Work ongoing with REVU for data analyst support in 2024
A309	Provincial quality Work	Contribute to provincial initiative to promote physician quality improvement. Collaboration with AHS, AH, University faculties.	Operationalize the actions from the implementation plan.	QMS002	Continuing Competence	Assistant Registrar Continuing Competence	Exceeding/Meeting Target		This is continuous collaborative work through CPD Provincial Network	Work Continues with CPD Provincial Network through CPSA representations on Steering Committee and Working Groups
A310	Choosing Wisely	Support provincial initiative for Choosing Wisely.	Establish physician practice improvement expectations alignment among provincial partners and stakeholders.		Continuing Competence	Assistant Registrar Continuing Competence	Below Target	0%	The scope of this Steering Committee is to increase awareness and adoption of Choosing Wisely Alberta more widely, starting with medical education. Beyond awareness, the Committee will provide specific recommendations and tools to Alberta physicians, including patient engagement strategies. This work will create alignment of health system partners in setting priorities with regards to appropriateness and quality of care delivery.	Work being transitioned to AR Continuing Competence for 2023.

Organizational Culture and Capacity Strategy

Definition: To develop a culture where our people are intrinsically invested in our work, our teams, and each other. To develop a capacity and mix of staff to meet current and adaptable future needs to address a changing regulatory landscape.

KPI #	KPI's	2023 Target	Accountability	Owner	Status	Results YTD (Enter % - actual results compared to target)	Detailed Explanation	Q1 2023 UPDATE
OCC001	Exemplary Employee engagement as reported on the employee engagement survey	Pulse survey to ensure progress	People & Culture	People & Culture Director	Exceeding/Meeting Target	25%		Pulse check survey has been delayed until Fall 2023 to allow time for various culture initiative to progress.

Action #	Global Name	2023 Action/Tactics	Expected Results	KPI (Please list the KPI #s that are relevant to the corresponding Action)	Accountability	Owner	Status	Progress (Enter % - actual results compared to target)	Detailed Explanation	Q1 2023 UPDATE
A301	Performance Management	Crucial conversations training			People & Culture	People & Culture Director	Exceeding/Meeting Target	25%	Crucial conversations is a 15 hour training which will provide participants with the tools and skills to manage their team members and have difficult conversations with team members across the organization. Over the coming years, all staff will have the opportunity to participate.	Train the trainers selected and will complete the training in Q2
A302	Talent Pipeline	Leadership development, talent pipeline training			People & Culture	People & Culture Director	Exceeding/Meeting Target	20%	Providing PD streams for team members to develop their skills based on various growth paths.	
A303	Staff training	Equity, Diversity & Inclusion special events			People & Culture	People & Culture Director	Exceeding/Meeting Target	25%	EDI training for staff in development. Unconscious bias training to be hosted in May.	
A304	Mentorship Program	Develop mentorship program	Mentoring program completed.		People & Culture	People & Culture Director	Below Target	10%	Creating a formal program where team members can apply to be mentored or provide mentorship.	Delayed due to other priorities in 2023 Q1.
A305	Employee Engagement/Living our culture	Follow-up on employee engagement survey result.- Follow-up based on results	Follow up completed.		People & Culture	People & Culture Director	Exceeding/Meeting Target	25%	A variety of work aimed at improving our team experience by addressing the growth areas in the engagement survey.	Culture crew is formed and beginning their work to address various culture related concerns.
A306	Staff Professional Development Fund	Continuation of Supplemental PD funding			People & Culture	People & Culture Director	Exceeding/Meeting Target	25%	Four intakes annually to assess supplemental funding request and distribute the funds.	Funding rubric created and first intake completed.
A307	Total Compensation Review	Review impact to salaries following total compensation survey results.	Total compensation in line with CPSA compensation philosophy.		Admin	CFO	Completed	100%		2023 salary grids implemented for changes due to compensation review based on approved budget. Last market adjustment for inflation Oct. 1, 2022.
A308	Employee Benefits	Roll out possible changes in employee benefits	Total compensation in line with CPSA compensation philosophy.		Admin	CFO	Exceeding/Meeting Target	30%		Staff survey and focus groups conducted by People & Culture. Analysis in progress by payroll and people & culture. RFP for health & group benefits started with benefit broker in March 2023.
A309	License Portability Framework for MRAs	Measure the effectiveness and impact of the framework for improved license portability and fast track license option. This is turning into the Labour Mobility Act but details to follow.	Framework proven to be effective.		Registration	Registration Director	Exceeding/Meeting Target	100%		Mobility Act is not enacted yet, but info meetings taking place.
A310	Bill 21 Compliant (Alberta Health Care Insurance Act)	Implement any changes required due to Bill 21 (Alberta Health Care Insurance Act)	Compliant with Bill 21 Alberta Health Care Insurance Act by Jan 1, 2022		Registration	Registration Director	Exceeding/Meeting Target	100%		Not enacted yet, no news
A311	Fair Registration Act	Continue implementation of Field Law review suggestions for compliance - begins in 2021	Compliant with Fair Registration Act and mobility act		Registration	Registration Director	Exceeding/Meeting Target	100%		Deloitt audit complete, draft results received, waiting for final report.

Action #	Global Name	2023 Action/Tactics	Expected Results	KPI (Please list the KPI #s that are relevant to the correspondin g Action	Accountability	Owner	Status	Progress (Enter % - actual results compared to target)	Detailed Explanation	Q1 2023 UPDATE
A312	Document Drop Zone	Continue work from 2021: Develop tool for document submission.1) Develop Functionality on CPSA website for online form submission2) XML functionality required to import document properties from website online forms to be reviewed by dept and uploaded into QUEST. 3)Receive payment online in a secure manner for transactions other than physician and PC annual billing	Streamlined tool for customers submitting documents. Reduced staff time for manual data entry of document scanning, entering document properties, and uploading documents to QUEST. Reduced department staff time for manual entry into DOC.		Admin	CFO	Below Target	15%		Analysis completed for next set of registration documents that could move to online capture of information via OATS tracking or Submission Review Center. Analysis with IT considering how to centralize documents received from external parties.
A313	Complaint Portal	Ongoing software development and training (iSight) for complaints	Case Management tool for improved reporting allow a portal for complainants to view the status of their complaint.		Complaints & Discipline	Professional Conduct Director	Significant Delay	20%	Expected live roll-out for January 2023 has been delayed to June 2023 due to technical challenges and design delays.	Deployment delayed until June 2023.
A314	Project Bluebird – External reviewers	External Investigator Program (Medical and Non-Medical) and transcription services - scalable contract resources to facilitate high volume periods to process investigations in a timely fashion and to incorporate transcription services for interviews and social media as part of investigation. Focused on boundary or high risk medical matters to eliminate backlog.	Improved timeliness of boundary and complex medical investigations. Clean up of backlogged investigation files not yet assigned an investigator.		Complaints & Discipline	Professional Conduct Director	Below Target	25%	There was a delay in the first quarter as we onboarded new team members to manage the process. Expect to see progress in next quarter.	Onboarding of new team members underway and progress shown in engaging experts. Progress seen with investigation contractors concluding investigations. Recruitment of positions outstanding.
A315	Project Bluebird - consultants	Project Bluebird - Quality Improvement Specialist support required; currently sharing same QI individual with REVU	To continue to support the change management of the department as part of the Bluebird Project.		Complaints & Discipline	Professional Conduct Director	Exceeding/Meeting Target	25%	Ongoing support and education through monthly department meeting. Consultant is working with some of the Program Managers on leadership coaching to support the improvement work.	In progress - meetings held monthly.
A316	Project Bluebird – Transition LTC roles to permanent	Transition LTC roles to perm (one LTC remaining; SMA 0.8 FTE and complaint navigator deferred to 2024)	Continued efforts in addressing complaint backlog and to meet established KPI's for 2023		Complaints & Discipline	Professional Conduct Director	Exceeding/Meeting Target	60%	Budgeted and planned positions have been approved with permanent offers in place. Recruitment is ongoing for some vacancies which are planned to fill in second quarter. One new position remains outstanding and under P&C analysis.	In progress recruitment for vacant investigator and vacant administrative assistant for early resolution.
A317	Customer service initiative	Implement new Customer Relationship Management and Knowledge Management systems to support the front line team responding to phone calls and general emails to CPSA.	Improve access to information for CPSA's team so they can provide a better customer experience.		People & Culture	People & Culture Director	Exceeding/Meeting Target	25%	CX Pilot project is runs from Oct 2022 to March 2023 to assess if this model works well for CPSA.	The new team is up and running and are already responding to 92% of call without a transfer.
A318	Software enhancements - committee expenses	Develop an expense portal to align with the Committee Administration Program (CAP) to streamline submission of committee expenses.	Streamlined processing of committee expenses		Admin	CFO	Exceeding/Meeting Target	5%		Project planned for Q3
A319	Software enhancements - staff expenses	Implement the expense module to streamline processing of CPSA team member expenses	Streamlined processing of staff expenses		Admin	CFO	Exceeding/Meeting Target	5%		Project planned for Q3
A320	Software enhancements - SP committee sites	Enhance SharePoint committee sites to integrate reporting on key performance indicators.	Enhanced reporting capabilities		Admin	CFO	Below Target	1%		Key performance indicators to be developed by departments.
A321	Staffing - Programmer role moving permanent	Contract programmer role moving permanent.	Engaged & retained staffing.		IT	CIO	Completed			
A322	Staffing - SMA increase FTE (AIR)	Increase existing SMA from 0.6 FTE LTC to 0.7 FTE perm; existing SMA from 0.4 FTE to 0.5 FTE	Engaged & retained staffing.		Prescribing Analytics	CINO	Completed			Ewan moved to .8 FTE but seconded to CIHI for .4 FTE until Feb 2024. Mark changed his mind and stayed at .4 FTE

Action #	Global Name	2023 Action/Tactics	Expected Results	KPI (Please list the KPI #s that are relevant to the corresponding Action	Accountability	Owner	Status	Progress (Enter % - actual results compared to target)	Detailed Explanation	Q1 2023 UPDATE
A323	Staffing - Assessment coordinator (Registration) + SMA	New 1.0 FTE LTC assessment coordinator role for the registration dept.; new 0.5 FTE SMA	Engaged staff; balanced work load		Registration	Registration Director	Completed	100%		LTC assessment coordinator hired; utilizing SMA capacity from Continuing Competence.
A324	Staffing - SMA increase FTE + Admin support (PHM)	Increase SMA 0.6 FTE; not renewing program manager 1.0 FTE; increase Admin support 0.5 FTE	Engaged & retained staffing.		Physician Health Monitoring	PHM Director	Completed	100%		SMA hired; 0.5 FTE Admin hired
A325	Staffing - People & Culture	Hire People & Culture Assistant on perm basis.	To manage the recruitment and People & Culture regular operations and projects.		People & Culture	People & Culture Director	Completed	100%		Staff hired
A326	Staffing - Continuing Competence	Program Manager retiring (0.8 FTE) and replace with one administrator (1.0 FTE)	To provide program support for the administration and delivery of clinic registration under IPAC and also the delivery of PAF.		People & Culture	People & Culture Director	Below Target	10%	Currently recruiting for administrator	Program manager retired. Reassessing corporate staffing needs. 1.0 FTE administrator not required in Continuing Competence. Need in OTR/ HDO office.

Quality Mandate Strategy

Definition: This strategy has two key elements:
• To ensure all physicians meet minimum standards expected of the profession.
• To foster and support the highest quality of medical/health care through collaboration and cooperation with key stakeholders.

KPI #	KPI's	2023 Target	Accountability	Owner	Status	Results YTD (Enter % - actual results compared to target)	Detailed Explanation	Q1 2023 UPDATE
QMS001	High risk individual physicians are assessed in QA	200 regulated members assessed (2% of membership)	Continuing Competence	Continuing Competence Director	Exceeding/Meeting Target	25%		50 assessments have been initiated this year.
QMS002	CPSA has engaged regulated members in QI	80% of regulated members in clinical practice self-report as engaging in Physician Practice Improvement	Continuing Competence	Continuing Competence Director	Exceeding/Meeting Target	80%		80% regulated members self reported participation in at least one PPIP activity on 2023 RIF.
QMS003	Practice enhancement assessment/ remediation is outsourced	Up to 70% QA IPR outsourced	Continuing Competence	Continuing Competence Director	Below Target	1%	There has been a decrease in referrals to IPR and we expect this downward trend to continue to the end of 2023.	Only 1 IPR outsourced in Q1.

Action #	Global Name	2023 Action/Tactics	Expected Results	KPI (Please list the KPI #s that are relevant to the corresponding Action	Accountability	Owner	Status	Progress (Enter % - actual results compared to target)	Detailed Explanation	Q1 2023 UPDATE
A301	Accredit newly opening community medical clinics	SOP requiring non-accredited community medical clinics to register at CPSA approved by Council and ready for implementation. Communication plan begins to ensure SOP and expectations are recognized and understood by membership. Begin to trial adherence and monitoring process. (Year 2 of 2)	Membership recognizes SOP and expectations. Collaborative partners such as AH support SOP and agree to contribute to success. Trial begins using online tool.		Continuing Competence	Continuing Competence Director	Exceeding/Meeting Target	50%	We are consulting with legal counsel and there is a possibility of not moving forward with a SOP for this strategic project. The trial has already begun to register clinics and providing needed assessment support. We have gained collaboration from AH.	We are reviewing the possibility of updating SOP to support this project and the possibility of moving forth without SOP changes. We are mapping a strategy to meet the project objective using existing RIF data.
A302	Members Participate in QI Programs	100% membership reports on CQI engagement using RIF. CPSA continues to provide CQI support to member physicians with our QI programs. Implement and evaluate a process for auditing 20% of membership annually on adherence to quality mandate.	Auditing process proven effective. 80% members engage in CQI.		Continuing Competence	Continuing Competence Director	Exceeding/Meeting Target	80%		80% regulated members self reported participation in at least one PPIP activity on 2023 RIF. We have selected a pool for auditing.

Action #	Global Name	2023 Action/Tactics	Expected Results	KPI (Please list the KPI #s that are relevant to the corresponding Action	Accountability	Owner	Status	Progress (Enter % - actual results compared to target)	Detailed Explanation	Q1 2023 UPDATE
A303	Quality Assurance Factors Work	Apply factors to refer physicians to quality assurance programs, in addition to existing referrals from other sources such as Complaint.	Approximately 2% of membership will be referred to QA programs in total.	QMS001	Continuing Competence	Continuing Competence Director	Exceeding/Meeting Target	25%		50 assessments have been initiated this year.
A304	CQI support for physicians	Providing support for member physicians practice improvement (PPI) by investing in the development of Peer Coaching program, Learning Management System and courses. The U of C will make available these program and courses for all physicians in Alberta.	Tools and courses to support Physician Practice Improvement are accessible for all Alberta physicians through U of C.		Continuing Competence	Continuing Competence Director	Exceeding/Meeting Target	100%	Development support and work are completed. Peer Coaching program, Learning Management System and remedial courses are now available to Alberta physicians to access.	Funding and development completed.
A305	High Functioning Members	Recognize high functioning members and seek their support for colleagues.	Engage high performers based on continuum in our quality mandate work.		Continuing Competence	Continuing Competence Director	Exceeding/Meeting Target	100%	This is a continuous action item.	Continuous.
A306	Alberta Surgical Initiative	Develop framework/strategic plan for NHSF program management of Alberta Surgical Initiative (ASI) Phase 3 - 2022-2023 (expansion of procedures to new NHSFs)	Program able to manage all Phase 3 service increases		Accreditation	Accreditation Director	Exceeding/Meeting Target	90%	The Alberta Surgical Initiative has increased pressure on the NHSF program to maintain accreditation activities for increased surgery volume and procedures.	Have procured a grant for $120,000 to support the human resources needed to keep up with ASI initiatives. Without new facilities coming on we have no fee increases to support the programs in the interim.
A307	Systematic Review - physician health factors	Continue literature review of health conditions relevant to the Physician Health Monitoring program (year 3 of 3)	Extraction of identified literature; Creation of review document		Physician Health Monitoring	PHMP Director	Exceeding/Meeting Target	80%		Waiting for final report

Submission to:	**Council**

Meeting Date:	Submitted by:		
May 25, 2023	Levonne Louie and Daisy Fung, Co-Chairs FAC		
Agenda Item Title:	Finance & Audit Committee - Audited Financial Statements		
Action Requested:	☒ The following items require approval by Council See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☐ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	Council approve the audited financial statements: 1) College of Physicians & Surgeons of Alberta financial statements for the year ended December 31, 2022 2) Summary financial statements for College of Physicians & Surgeons for the year ended December 31, 2022 3) Pension Fund for Employees of College of Physicians & Surgeons of Alberta financial statements for the year ended December 31, 2022		
Background:	FAC engaged PricewaterhouseCoopers LLP (PwC) for the audit of CPSA's financial statements for the year ended December 31, 2022. In addition, CPSA is required to have an audit of the pension fund assets available for benefits for the registered defined benefit pension plan. The detailed explanation for the variances from budget for 2022 are contained in the FAC Summary Report contained in the Consent Agenda. FAC met with the auditors in November 2022 to review the audit plan for the 2022 audit. The PwC audit team was led by Mr. Robert Newton, the audit partner, and Ms. Sarah Burgess, Manager. The audit procedures included additional testing over expense claims from management and Council members to ensure compliance with the policies and procedures in place. No issues were identified.		

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The audit was conducted under a combination of remote work and also in-person at CPSA office, allowing PwC secured access to CPSA accounting records and systems. In addition, PwC has a SharePoint tool called PwC Connect where working papers are uploaded to a secure site. The planning and interim testing was conducted Nov 21 – Dec 2, 2022 and the year end field work occurred April 17 – May 5, 2023.

FAC met with the auditors on May 12, 2023 to receive the audit results and had the opportunity to ask questions about the audit.

The role of an auditor is to issue an opinion as to whether the financial statements are free of material error. Materiality is set at a level PwC believes would reasonably influence users of the financial statements. The materially for the audit was $900,000 (2.5% of revenues), and for the pension fund audit was $1,230,000 (2.5% of net assets).

PwC designs their audit procedures to account for aggregation risk; thus, they design the nature, timing and extent of their audit procedures at a lower level of materiality. The reporting threshold was $90,000 for the CPSA audit and $123,000 for the pension fund audit.

Results of the audit
PwC reported one item that was communicated to management and subsequently corrected in the CPSA financial statements. The item related to an adjustment for the gain on pension obligations for the defined benefit pension plan. The error was a calculation provided by our actuary. Management has reviewed the error with the actuary and reviewed the change in procedures the actuary will be implementing going forward so that the error does not recur in the future.

PwC will be issuing clean audit opinions for the financial statements following Council's approval of the draft audited financial statements.

CPSA's summary audited financial statements are included in CPSA's Annual Report. PwC will be reviewing the draft Annual Report the week of May 15th. Their role is to consider whether the content or manner of presentation is materially consistent with the financial information covered by their auditor's report. Upon completion of their review, PwC will approve their audit report and the summary financial statements in the Annual Report.

CPSA's pension fund financial statements are required to be filed with the pension regulator.

	FAC has reviewed PwC's summary audit results and is satisfied with the results of the audit and the clean audit report. **Recommendation** FAC is seeking Council's approval of the audited financial statements: 1) College of Physicians & Surgeons of Alberta financial statements for the year ended December 31, 2022 2) Summary financial statements for College of Physicians & Surgeons for the year ended December 31, 2022 3) Pension Fund for Employees of College of Physicians & Surgeons of Alberta financial statements for the year ended December 31, 2022
Next Steps:	1) Management will provide signed management representation letters to PwC. 2) PwC to conduct final subsequent event procedures May 12, 2023 (the date of the FAC meeting) to May 25 (date of the Council meeting). 3) PwC to prepare the final audited financial statements with their audit report. 4) Management to file the Pension Fund financial statements with the pension regulator prior to the deadline of June 30, 2023.
List of Attachments:	
Watch for the approved financial statements to be published on the CPSA Website and included in the Annual Report	

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Submission to:	Council

Meeting Date:	Submitted by:		
May 25-26, 2023	Governance Committee		
Agenda Item Title:	Governance Structure and Committees		
Action Requested:	☒ The following items require approval by Council See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☐ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation:	That the Governance Committee recommends Council approves the attached Governance Structure and Committees Policy, effective at the date that the Bylaws revisions related to the Governance Review are approved.		
Background:	The Governance Review Final Report by John Dinner, included the following principles about Committees: • Committees exist because Council does not have the time to give direct oversight. • Committees serve to spread out the work of Council. • Committees do Council work, reflecting Council's oversight/governance role. • Committees are accountable to Council for reporting on activities. • Committees make recommendations for Council consideration and approval. • Committee structure is typically reflective of or aligned with Council responsibilities. • Committees do not tread into responsibilities within Staff's purview. • Committees are supported by Staff; Staff are not accountable to Committees they support. • Committee membership is limited to Council members. • Committee membership is driven by skills and other attributes aligned with the Committee's mandate.		

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	• The optimal Committee membership complement is 3 – 5 individuals. • The Committee Chair role should be consistent with that of the President's (Chair's). These principles provided by the external consultant, helped to inform the Governance Review Committee's recommendation to Council regarding CPSA's governance structure. Council approved a Governance Structure with the Governance Review Implementation Plan at the September 2022 Council meeting. At its March and April meetings, the Governance Committee considered and made adjustments to the attached Policy, which builds out the approved Governance Structure. Bylaw amendments are forthcoming, and some policies may come back to Council for adjustments following the 2023-2024 Bylaw Review. Approving a policy now will help to inform revisions to Committee Terms of Reference documents which will be reviewed by the Committees and other Committee processes for 2024. Proposed changes will be especially relevant to Operational Committees as they will need to consider succession planning for Committee Chair positions for 2024 as they will no longer have Council members on these Committees.
Next Steps:	• Relevant changes will be made to the Bylaws and Committee Terms of Reference over the coming months to reflect the approved Governance Review recommendations.
List of Attachments:	
1. Governance Structure and Committees Policy	

CPSA Governance Structure and Committees

Policy Title:

CPSA Governance Structure and Committees

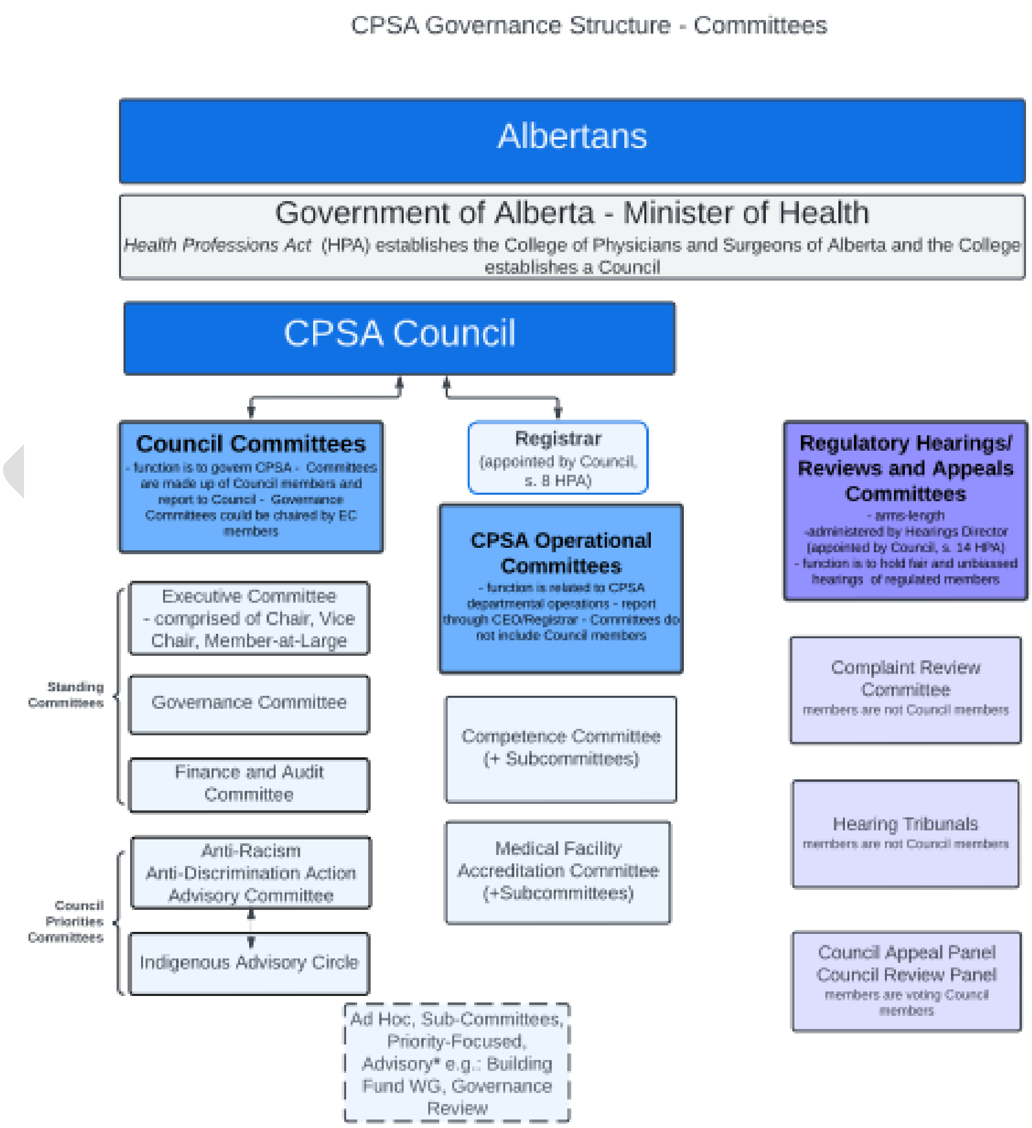
Intent:

The establishment of a governance structure provides a visual representation of the decision-making structure and lines of authority for CPSA Council which helps ensure decisions are made effectively and are aligned with the mandate of CPSA.

Scope:

Committees created under the *Health Professions Act* (HPA) and Committees and subcommittees created under CPSA Bylaws.

Structure:



<u>Council Committees</u> are of three types and they provide advice and recommendations to Council**:**

> **Standing Committees** are directly concerned with governance of CPSA, and are comprised of Council members. They include: Executive Committee, Governance Committee and Finance and Audit Committee.
>
> **Priorities Committees** provide advice and recommendations to Council regarding strategic priorities that are set out in the CPSA Strategic Plan. Priorities Committees include a mix of Council members, regulated members, and other members at large with expertise (including lived experience) in the strategic priority area.
>
> **Ad Hoc and/or Sub- Committees** may also be established by CPSA Council, and these may be established as a new Council Committee or sub-committee. This type of Committee is generally comprised of Council members, however exceptions can be made to include members at large when required.

<u>Operational Committees</u> provide advice and recommendations to the Registrar/CEO (or delegate) on matters that support the department and program functions of CPSA. Council members do not sit on these Committees.

> **Regulatory Committees** include: Competence Committee [1] and Medical Facility Accreditation Committee[2]. Committee members are appointed by Council, upon recommendation of the Registrar/CEO. The Registrar/CEO, has authority to manage these Committees, with updates brought to each Council meeting. Where Council decisions are necessary, the Registrar/CEO makes recommendations to Council.
>
> **Ad Hoc Committees** may be established by CPSA Council to address timely regulatory work. The term for Ad Hoc Committees will be stated in their Terms of Reference.

<u>Regulatory Hearings/Reviews and Appeals Committees</u> are established pursuant to the *Health Professions Act* to ensure fair and unbiased proceedings. The Hearings Director Office (HDO) oversees Complaint Review Committees and Hearings Tribunals and is responsible for the recruitment and appointment of physician members for both Complaint Review Committees and Hearings Tribunals. Public members for Complaint Review Committees and Hearings Tribunals are appointed by Order in Council. The Hearings Director operates independently from the Complaints Director. The HDO also receives requests for reviews and appeals and appoints voting members of Council for these panels.

Committee Resources

Council approves the budget of all CPSA Committees. Committee members are paid an honorarium and are reimbursed for their expenses as per CPSA's Honoraria and Expense Policy.

Council Committee secretariat supports are assigned by the Office of the Registrar, and include professional and administrative staff. The Registrar, Chief of Staff or designate will attend all Committee meetings. Other CPSA staff members may attend or present at Committee meetings as needed to provide specific knowledge or expertise on matters before Committees.

Operational Committee secretariat supports are assigned by the Assistant Registrar responsible for the Committee, and include professional and administrative staff. The Registrar or designate may attend Committee meetings in an ex

[1] See the HPA, s. 10 for the authority to establish the Competence Committee.
[2] See the HPA, Schedule 21, s. 8 for the authority to establish the Medical Facility Accreditation Committee and advisory committees.

officio role. Other CPSA staff members may attend or present at Committee meetings as needed to provide specific knowledge or expertise on matters before Committees.

Regulatory Hearings/Reviews and Appeals Committees are supported by the Hearings Director Office.

Council Committees and Operational Committees Processes:

Terms of Reference

Each Committee will have a Terms of Reference that outlines the Purpose, Membership, Roles and Responsibilities and Authority of the Committee and Confidentiality requirements.

As necessary, and at least every three years, the Governance Committee will review and recommend Council Committee Terms of Reference to Council.

Operational Committees will be provided a Terms of Reference template, and may recommend changes that are in alignment with the HPA, CPSA Bylaws and this policy, to the Registrar.

Committee Annual Reports

At the end of each year, Committees will approve an annual report that summarizes accomplishments in fulfilling the Committee mandate. Annual Reports will be filed with Council at latest in September of the following year.

Committee Members and Chair Appointments

Council appoints the members of Council and Operational Committees for a three year term which is renewable once.

Committee Chairs are appointed by Council for a one year term, and may be renewed annually for no more than six years.

Council Priorities Committees and Operational Committees will recommend Committee members and Chairs for these Committees to Council for approval.

Each Committee may appoint a Co-Chair or Vice-Chair at its discretion, based on the needs of the committee and the leadership styles of those being considered for such roles.

Frequency

Committees meet at least once a year or at the call of the Chair, normally four (4) times per year in advance of Council meetings.

Procedures

Committees may determine procedures to be used at meetings.

Committees may meet in person, by teleconference or by any other communications technology that permits all persons participating in the meeting to communicate with each other.

Items requiring approval by Council will be brought forward at the next Council meeting as a recommendation from the Committee.

Committee Decisions

Quorum shall be 50% of voting Committee members. Where one-half of the committee is not a whole number, quorum shall be taken as the whole number which is closest to and greater than one-half.

Committee decisions may be made by consensus or motion and majority vote.

Decisions by Consensus: Following discussion, all members of the Committee agree with a proposed motion. The Committee Chair will determine agreement or not. A motion approved by consensus that requires approval of Council, will be forwarded to Council as a Committee recommendation. If there is not consensus, the Chair will facilitate a majority vote.

Decisions by Majority vote: Motions are made, discussed and voted on. A majority vote of Committee members present and not abstaining from voting at a meeting decides a vote. If the vote is tied, the motion is defeated. A motion carried that requires approval of Council, will be forwarded to Council as a Committee recommendation.

Committee Records

Minutes shall be recorded for all meetings and will be approved by the Committee at its next meeting. Minutes of Council Committees will be made available to all Council members through an online records-sharing portal.

Subcommittees

CPSA Bylaw 16(2) states that Committees may appoint a sub-committee or ad hoc committee to assist in the fulfillment of the Committee's roles and responsibilities. A sub-committee will have specific, defined tasks and deliverables and will have an end date.

Approval:

CPSA Council approves this policy.

Authority Documents:

HPA and Regulations, CPSA Bylaws

Supporting Documents:

Committee TORs to be linked.

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Submission to:	Council

Meeting Date:	Submitted by:		
May 25-26, 2023	Governance Committee		
Agenda Item Title:	Council Competency Matrix and Council Selection		
Action Requested:	☒ The following items require approval by Council See below for details of the recommendation.	☐ The following item(s) are of particular interest to Governance Committee Feedback is sought on this matter.	☐ The attached is for information only. No action is required.

AGENDA ITEM DETAILS

Recommendation:	That Council approves a consultation with regulated members and other stakeholders with the following objectives: • obtain comments regarding the proposed transition away from an election of physician members to CPSA Council, and to a nominations and selection process that is based on competencies required to assemble a Council that is focused on achieving the regulatory mandate of CPSA, to protect the public. • inform regulated members about the governance review, and some of the changes that Council is undertaking.
Background:	John Dinner of Board Governance Services was engaged in February 2022 to carry out the Governance Review for CPSA. Based on the recommendations, Council approved an implementation plan that included the development of a competency-based model to populate positions on CPSA Council. John Dinner was again contracted to highlight considerations and provide recommendations for Governance Committee's consideration for a model that could be used. The following points frame John Dinner's second report about a competency-based nominations model for CPSA Council: • An outcomes focus that strengthens how CPSA is governed in tangible and impactful ways; • A commitment to clarity and transparency as to how the process works for both regulated members and public

members of Council and what each nominee to Council should possess in terms of needed skills, knowledge, experience and other attributes;
- Focused accountability on the achievement of CPSA's legislated mandate and other organizational and strategic foundations.

The recommended competencies fall into 2 categories:

- Core competencies: soft skills expected of all Council members. … There is a need to equip Council with critical soft skills that counter human tendency toward biased decision-making and self-interest and CPSA's mandate and commitment to the fundamental goals in serving Albertans first and foremost.
- Functional competencies relate to specialized expertise needed to give informed oversight that will be required by a subset of Council. It is important to note that not all Council members are expected to have each of the functional competencies. Rather, Council as a whole, should possess the required competencies.

Once the competencies are agreed upon, Mr. Dinner outlines two options for selecting and appointing regulated members to CPSA Council. One option is to establish a Nominating Committee (with the assistance of a third-party assessor) that reviews and recommends regulated Council members to CPSA Council. The other option is to establish a Nominations Committee that conducts the competency-based review of applicants/nominees for enhanced vetting of individuals (again with the assistance of a third-party assessor), and then to move to an election by the regulated members of CPSA.

Governance Committee is recommending that regulated members be consulted with the following aims:

- obtain their comments regarding the proposed transition away from an election of regulated members to CPSA Council, and to a nominations and selection process that is based on competencies required to assemble a Council that is focused on achieving the regulatory mandate of CPSA, to protect the public.
- an opportunity to inform regulated members about the governance review, and some of the changes that Council is undertaking.

	The consultation process would be similar to the process undertaken for new or revised Standards of Practice, and CPSA regulated members would be asked to submit comments online, by mail or by email. Governance Committee also discussed broadening the audience to include First Nations and Indigenous organizations, and pending Council approval of the Committee's recommendation, this could be considered when a consultation plan is developed.
Next Steps:	• Develop consultation plan and implement it over the summer. • Governance Committee to make its recommendation about the process of selecting regulated members for Council, based on the information received through the consultation.

List of Attachments:
N/A

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Submission to:	Council

Meeting Date:	Submitted by:		
May 25, 2023	Levonne Louie and Laurie Steinbach, Co-chairs, Governance Committee		
Agenda Item Title:	Outcome of Executive Election Nomination Process for Council Chair		
Action Requested:	☒ The following items require approval by Council See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☐ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	It is recommended that Council approves the following motion relative to the conclusion of nominations for the position of Council Chair: 1. That, Jaelene Mannerfeldt be confirmed as the unopposed candidate for the position of Chair for a term of one year commencing Jan. 1, 2024.		
Background:	Nominations for Council Chair closed on April 28, 2023. One nomination was received from Jaelene Mannerfeldt. As such, she is acclaimed as Council Chair for 2024.		
Next Steps:	The outcome of the election is formalized with the request for Council to pass a motion confirming the result. Given that an election was not required, the outcome and motion are being presented for approval as part of the public session. Elections for the position of Vice Chair and Member-at-Large will be conducted at the September Council meeting.		
List of Attachments:			

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Submission to:	**Council**

Meeting Date:	Submitted by:		
May 25-26, 2023	Governance Committee		
Agenda Item Title:	Alberta Health and Alberta Health Services and CPSA Council		
Action Requested:	☒ The following items require approval by Council See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☐ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation:	That Governance Committee recommends that Council not add additional non-voting members to Council.		
Background:	At the February 2023 Council meeting, a suggestion was made by a Council member to invite Alberta Health and Alberta Health Services to be offered non-voting membership on CPSA Council. The *Health Professions Act* states the following about the composition of governing bodies of health professional regulatory bodies: • the regulated members as set out in the bylaws. • non-voting members provided for in the bylaws. • public members appointed by the Lieutenant Governor in Council to a minimum of 50% of the voting members. The CPSA Bylaws state that there are 7 regulated members, 7 public members, and a total of 4 non-voting members. Non-voting members are specified as: • Deans of the U of A and U of C Faculties of Medicine (2), • 1 observer from the Professional Association of Resident Physicians of Alberta, and • 1 observer from one of the two university medical schools. The Bylaws state that non-voting members are at the discretion of Council.		

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	A review of the websites of other health professions regulators in Alberta shows that no Council includes AH and AHS in its membership as non-voting Council members. Further, CPSA is the only health professions regulatory body in Alberta that has non-voting members on its Council. The March 15 Governance Committee discussion included the following points: • There is potential that Council conversations would be stifled by the presence of government officials at Council meetings, in particular because some Council members are employees of AHS. • Dr. McLeod has been empowered by Council to develop relationships with AH and AHS and there is evidence to support that this has been carried out effectively. • The right connections are being made at the right levels within CPSA and the other organizations. • The Registrar's Report to Council is an opportunity to share more information about CPSA's regular interactions with AH and AHS.
Next Steps:	• Council to consider Governance Committee's recommendation. • Governance Committee continues to consider non-voting roles on Council, and this may be considered in CPSA's Bylaw Review project, which will be undertaken in 2023/2024.

List of Attachments:
N/A

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Submission to:	Council

Meeting Date:	Submitted by:		
May 25-26, 2023	Dr. Gordon Giddings		
Agenda Item Title:	Psychedelic Assisted Psychotherapy Accreditation Standards		
Action Requested:	☒ The following items require approval by Council See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☒ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	The Medical Facilities Accreditation Committee (MFAC) recommends approval of the new Psychedelic-Assisted Psychotherapy Accreditation Standards		
Background:	In October 2022, Alberta's government introduced new requirements for psychedelic-assisted therapy through an amendment to the *Mental Health Services Protection Regulation*. These requirements came into effect on January 16, 2023. Psychedelic-assisted psychotherapy is defined in the Regulation as "*Services to treat a psychiatric disorder with psychotherapy and one or more designated psychedelic drugs, whether or not the administration of the drug and the psychotherapy are provided on the same day or on different days*". Emerging evidence shows that psychedelic-assisted therapy can lead to improvements for people with certain psychiatric disorders, including PTSD and treatment-resistant depression. This field of practice is evolving with promise and challenges and Accreditation needs to be in the space. Psychedelic drugs include psilocybin, psilocin, MDMA, LSD, mescaline (peyote), DMT, 5 methoxy DMT and ketamine. As psychedelic drugs carry health and safety risks, proper safeguards and expert medical oversight are required to ensure patient safety. CPSA Council, at their December 1, 2022 meeting, approved bylaw changes to include Psychedelic-Assisted Psychotherapy as a prescribed health service. This allowed the CPSA Accreditation		

	Department to begin developing standards for the accreditation of facilities that would provide this service. The CPSA Psychedelic-Assisted Psychotherapy (PAPT) Accreditation Standards are the foundation of the PAPT accreditation program and were developed through a robust, consultative and consensus building process involving multiple stakeholders: • Internal Accreditation Department drafting began in January of 2023. • An Expert Working Group was convened and held two meetings in February 2023 to gain input from key thought-leaders to review and revised the first draft. • The revised draft went out in mid-March for a wider community engagement and consultation. • Submissions from the consultation were adjudicated early April. • Based on the actioned proposed amendments and additions from the consultation, a revised draft was submitted for MFAC review and approval. • The PAPT standards were approved without amendments by MFAC at their April 26th meeting. • MFAC recommends CPSA Council grant final approval. CPSA has developed these standards to ensure the safety and quality of these services for Albertans and does not endorse the efficacy of the treatments. Physicians providing these treatments must be appropriately credentialed and compliant with the Practicing Outside of Conventional Medicine Standard and Part 3 of the *Mental Health Services Protection Regulation* (AR114/2021) and associated service standards.
Next Steps:	Distribution of the Psychedelic-Assisted Psychotherapy Accreditation Standards by the Accreditation Department and accreditation of facilities providing this prescribed health service.
List of Attachments:	

Submission to:	**Council**

Meeting Date:	Submitted by:		
May 25-26, 2023	Daisy Fung, Chair ARADAAC		
Agenda Item Title:	Meeting Report from the Anti-Racism Anti-Discrimination Action Advisory Committee		
Action Requested:	☐ The following items require approval by Choose an item. See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☒ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	N/A		
Background:	The Anti-Racism Anti-Discrimination Action Advisory Committee met on Thursday, May 4, 2023. The Committee discussed: • the scope for a framework to guide CPSA's work for strategic direction 4 (anti-racism anti-discrimination or equity, diversity and inclusion). The Committee considered the benefits and drawbacks of broad versus targeted approaches. Their perspectives will be shared with CPSA leadership for consideration; • the most recent draft of an Advice to the Profession document on guidance for anti-racism and anti-discrimination. The Committee provided feedback on specific questions from the department, as well as on content and structure. Another iteration will be drafted with the Committee and the Indigenous Advisory Circle's feedback incorporated; • questions that could be posed/added to the RIF related to race and gender. This conversation followed up on concepts presented at the February meeting. This topic will be explored further at a subsequent meeting. The new timeline for inclusion of these questions will be with the 2025 RIF which is developed in spring/summer 2024; • considerations for recruitment to the Committee; • the Committee Annual Report, the report on Committee recruitment, and feedback on the AtP have been sent to		

	Committee members to capture their perspectives prior to the next meeting.
Next Steps:	The committee will meet again on July 28, 2023, with some follow-up and review of documents in between meetings. The next Committee meeting will include a presentation by CPSA's Complaints Director/Professional Conduct Department.

List of Attachments:
N/A

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Submission to:	**Council**

Meeting Date:	Submitted by:		
May 25-26, 2023	Tyler White, Circle Co-Chair		
Agenda Item Title:	Meeting Report from the Indigenous Advisory Circle		
Action Requested:	☐ The following items require approval by Choose an item. See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☒ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	N/A		
Background:	The Indigenous Advisory Circle (Circle) met on Tuesday, May 9, 2023. The Circle discussed: • learning and education ideas focused on Indigenous Peoples, Indigenous Communities and Health Care in Alberta to share with Governance Committee. These ideas will be used to inform Council's learning in 2024 and future years; • the most recent draft of an Advice to the Profession document on guidance for anti-racism and anti-discrimination. The Circle strongly encouraged CPSA to develop content focused on Indigenous-specific racism and discrimination, either in a separate document or as a section in the drafted Advice to the Profession; • an in-person day of meeting, sharing and learning for the Circle. Members were supportive of this and the secretariat will work on the logistics; • considerations for recruitment to the Circle; and • CPSA updates, including the Annual Review to be submitted to the Governance Committee, the next *Standards of Practice* consultation, and upcoming content on the CPSA website.		
Next Steps:	The committee will meet again on August 22, 2023, with follow-up, review and planning in between meetings.		
List of Attachments:			
N/A			

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Submission to:	**Council**

Meeting Date:	Submitted by:		
May 25, 2023	Dr. Michael Caffaro		
Agenda Item Title:	Alberta Sponsorship Model for Practice Readiness Assessments		
Action Requested:	☐ The following items require approval by Choose an item. See below for details of the recommendation.	☒ The following item(s) are of particular interest to Council Feedback is sought on this matter.	☐ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	N/A		
Background:	An overview of the proposed expanded sponsorship model for PRA is appended, identifying details as to a phased approach to the model, criteria and application for sponsors, oversight, tracking and additional CPSA resources that would be required.		
Next Steps:	• Finance and Audit Committee will review proposed resources in preparation for CPSA's 2024 Business Plan and Budget. • Staff will finalize the sponsor application process to allow CPSA to begin accepting applications from interested parties.		
List of Attachments:			
1. Briefing Note: Alberta Sponsorship Model for Practice Readiness Assessments			

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To: Council

Date: May 25, 2023

RE: Alberta Sponsorship Model for Practice Readiness Assessments

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Issue:

Council requested an update on the approach to the sponsorship expansion model approved at the February 2023 Council Meeting.

Purpose:
To provide Council with an overview of the CPSA sponsorship expansion model and proposed criteria.

Background:
- The Physicians, Surgeons, Osteopaths and Physician Assistants Regulation allows the Registrar to approve a sponsorship agreement that meets certain conditions.
- In 2015, CPSA Council approved Alberta Health Services (AHS) to be the only sponsor of regulated members in Alberta.
    - Prior to this, any regulated member could sponsor a regulated member to practice in Alberta.
    - The current practice readiness assessment process, including AHS sponsorship, is outlined in Appendix A.
- In 2022, Council requested the department assess the benefit of a non-AHS sponsorship model, to complement and augment the AHS model.
- At its February 2023 meeting, Council decided to expand Alberta's physician sponsorship to include non-AHS sponsors as part of the CPSA Practice Readiness Assessment (PRA) program.
    - Council also delegated authority to the Registrar to approve/decline sponsor applications in the CPSA model.
    - The details of the CPSA sponsorship expansion model are in Appendix B.

Analysis:
- There continues to be challenges addressing physician resourcing for the province (i.e., in geographic areas) and the changing needs of the province (e.g., effects of the COVID-19 pandemic).
    - Given the global shortages of health care professionals, including physicians, increasing options for sponsorship may be one way to attract more professionals to Alberta.
- AHS has been increasingly supportive of sponsoring candidates with no AHS affiliations through the request for sponsorship on DoctorJobsAlberta.com, however this is not really their responsibility.
    - The perception of physician resourcing needs continues despite this.
    - AHS is looking at opening up urban clinic sponsorships.
- The current sponsorship process costs AHS approximately $120,000 per physician.
    - This cost includes CPSA assessment costs ($35,000) along with AHS recruitment, visa, relocation costs, physician incentives, etc. (approx. $85,000).
- Current AHS criteria for sponsored eligible positions includes:

    - the availability of the proposed clinical services (whether in AHS facilities or in the community);
    - the number of physicians/practices accepting new patients within the service area;
    - wait times for the proposed services;
    - the number of graduating Alberta residents in the specialty (presently and on a historical basis for 3 years) and whether there are concerns for residents finding positions within Alberta;
    - the physician resource plan; and
    - any other information deemed pertinent.
- The key criteria above that AHS uses when assessing each sponsorship request is the number of physicians/practices accepting new patients within the service area.

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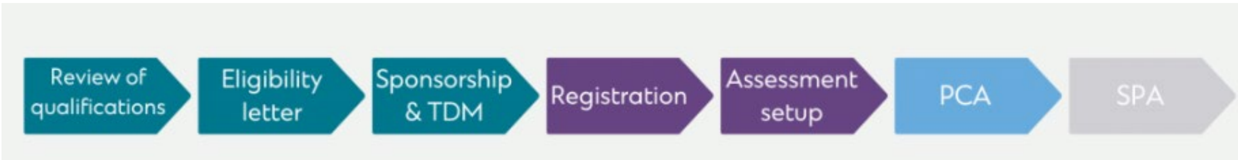
Appendix A: CPSA's Current Practice Readiness Assessment Process



Appendix B: CPSA Sponsorship Expansion Model

Model Elements	Details

Description and Phases	• Phased over three-years, the CPSA model will support individuals, corporations or organizations becoming sponsors to an increasing scope of candidates.
	   o Year 1 (2023-2024): candidates from only family medicine
	   o Year 2 (2025): candidates from family medicine and specialities in need
	   o Year 3 (2026): candidates from family medicine and all specialties
	• Successful sponsors are approved for a 1-year term.
	   o Multiple candidates may be put forward during this term.

Sponsor Criteria	• Demonstrate financial ability, at the time of application, to adequately cover the costs of:
	   o Total costs - $38,500 + GST
	   o The sponsor application fee – 10% of assessment costs
	   o Assessment costs of successful candidates - $35,000 +GST max/applicant
	(Note: these costs do not include: physician incentives, recruitment, visa, relocation costs, etc., and these costs are not CPSA's responsibility, but the responsibility of the sponsor)
	• Proof of a CPSA regulated physician member assigned as clinical oversight to the candidate.
	• Commitment from the Sponsor and clinical oversight member to:
	   o Orientate/support a candidate for their duration on the Provisional Register,
	   o Family medicine candidates are integrated into paneled patient care,
	   o Follow CPSA's Standards of Practice and Code of Ethics and Professionalism superseding arrangements made between a candidate and the sponsor,
	   o Manage patient volumes that support the delivery of safe and comprehensive care.
	• Demonstrate ability to provide quarterly reporting to CPSA
	• An established Clinical Alternative Relationship Plan (ARP) or Fee For Service (FFS) with Alberta Health

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<table>
<tr><td>Clinical Oversight</td><td>A regulated physician member who is:
On the General Register
In good standing
Competent in candidate’s scope of practice</td></tr>
<tr><td>Application Process</td><td>Potential sponsor fills out the application and pays the application fee.
Business case includes:
# of candidate positions they are seeking
Demonstrated need
Details of location, scope, and practice type
Yearly Application fee: 10% of assessment costs
Sponsors must apply annually to remain an approved sponsor
Application is assessed by CPSA staff; recommendation made to Registrar for decision.</td></tr>
<tr><td>Tracking and Evaluation</td><td>The following numbers will be tracked for the first 6-9 months, with recommendations for targets to be made to Council after that time.
Number of sponsor applications
Number of candidate sponsorships
Number of filled sponsorship positions (total or per sponsor)
number of physicians working in their sponsored community post-assessment
Number of applications per zone</td></tr>
<tr><td>Estimated Additional CPSA Resources</td><td>Operational resources required based on 50% increase in assessments:
1 x Assessment Coordinator
1 x Administrative Assistant
0.5 x Senior Medical Advisor
Other departments
Communications
Customer Service
IT
Legal
Finance</td></tr>
</table>

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Submission to:	Council

Meeting Date:	Submitted by:		
May 26, 2023	Scott McLeod		
Agenda Item Title:	Strategic Plan		
Action Requested:	☒ The following items require approval by Council See below for details of the recommendation.	☐ The following item(s) are of particular interest to Choose an item. Feedback is sought on this matter.	☐ The attached is for information only. No action is required.
AGENDA ITEM DETAILS			
Recommendation (if applicable) :	**That Council approves the approach for reporting on the 2024 Key Performance Indicators (KPI) and targets.**		
Background:	After the Council meeting in March of this year CPSA staff have presented a new option for presenting the overall performance of the organization to Council that better captures the big picture of regulatory performance. This plan was presented to a subgroup of Council including Stacey Strilchuk, Patrick Etokudo, and Daisy Fung. With their support to move forward we have developed a reporting structure that goes beyond just the Strategic Plan and now also included the financial status of CPSA, the wellbeing of the CPSA workforce and the regulatory requirements. Each of the four KPIs of Regulation, Finance, People and Strategy will have many sub metrics that will be used to determine the status of the main performance indicator. If all indicators are green it will mean that CPSA is meeting the expectations of Council For example, under the regulation indicator there will be indicators for each regulatory department including Professional Conduct, Continuing Competence, Registration, Physician Health and Accreditation. Each of those departments will be measuring their performance based on a more detailed breakdown of their work. Professional Conduct for instance will report on their overall targets of meeting the processing times for complaints as their departmental KPI, but they will have indicators for each subcomponent such as outright dismissal, consensual resolution, investigations and dismissal or investigations that lead to a hearing. If any of those measures are below their expected target times then that would result in a lowering of the overall reporting grade and thus lower the number reported to Council.		

To illustrate the reporting to Council we would use an indicator such as the following:

REGULATION

This indicator would then have sub indicators that Council would agree on as important measures of performance and be able to see the results at each meeting if required. They would look something like the following:

Registration

Professional Conduct

Continuing Competence

Accreditation

Below each one of those would be the core indicators of them achieving their legislative mandate or targets set by Council. If we were to use Registration as an example it could look something like the following:

	 Time to Process applications.  Registration Appeals upheld.  Human Rights Complaints We believe this type of reporting will provide Council with a high-level report on the organizations performance that can also drill into the details that may be required if we are not hitting our targets.
Next Steps:	With Council's approval of this approach, additional work will be undertaken to develop the departmental KPIs which will feed into the four main performance indicators.
List of Attachments:	
1.	