Science and AI: Building a Toolbox

MUNI FACULTY OF SOCIAL STUDIES

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Lecture outline

- Part 1: How science works and academic ethics → the basis for ethical AI use.
- Part 2: Toolbox and practical examples.
- Part 3: Literature review.

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Part 1: Science

What is Science?

- **Common basis for all disciplines** (Gauch, 2003):
  - Evidence-based.
  - Use of inductive (qualitative) and deductive logic (hypotheses testing).
  - Probability.
  - Parsimony.
- **Principles of science**:
  - Empirically testable.
  - Replicable.
  - Objective/non-personal.
  - Transparent/controlable (by other scientists).
  - Falsifiable/confirmable (inferences must relate to observed evidence).
  - Logical Consistency.
  - Broader context.

Important criteria

- Validity and reliability – favours quantitative.

- What about qualitative?
- **Mason (1996):** rigour, quality and potential for generalizability.
- **Le Compte and Goetz (1982):** external reliability (replicability) and validity (generalizability), internal reliability (among observers) and validity (aligning data and theory).
- **Guba and Lincoln (1981):** Trustworthiness set: credibility (via triangulation), transferability (to different case), dependability (due dilligence? + audit trail), confirmability (on whose side are we? We cannot do impartial research; transparencyt).

Ethics – why?

- Keeping the trust in science.
- Citations – author contribution acknowledgement.
- Effective system of vast knowledge management.
- Transparency -> auditability.

- Can you think of any other reasons?

Academic hell

- Sloppy science – archiving, collecting, storing etc.
- Fabrication of data and conclusions.
- Wrong use of scientific methods.
- Big ego.
- Not upholding scientific principles.
- Plagiarism.

Student-centered principles (UTS, 2023)

1. Students understand the significance of GenAI for society, careers, and studies.
2. Students understand legitimate use of GenAI in their studies.
3. Students are equipped to engage critically and ethically with GenAI.
4. Students experience GenAI's strengths and limitations as aids to learning.
5. Students are assessed on what they need to know in an AI world.

Open Universities Australia (2023)

DO:

- ask for research guidance before writing an essay
- use it when brainstorming
- ask questions about study material you don’t understand
- use it to proofread your work
- cite any AI assistance in your reference list

DONT:

- ask AI software to write essays for you
- blindly trust AI-generated information
- do anything that violates your university’s academic integrity policy

How to cite ChatGPT? APA

- “**When prompted with** “Is the left-brain right brain divide real or a metaphor?” **the ChatGPT-generated text indicated** that although the two brain hemispheres are somewhat specialized, “the notation that people can be characterized as ‘left-brained’ or ‘right-brained’ is considered to be an oversimplification and a popular myth” (OpenAI, 2023).“ (McAdoo, 2023)

- **Reference**
  - OpenAI. (2023). ChatGPT (Mar 14 version) [Large language model]. https://chat.openai.com/chat

Threats to ethics and their mitigation

- **Plagiarism** - especially unintentional - models are fielded on data from scientific papers, among others (Kim, 2024; Khalif et al., 2023) → do not generate (larger) text, use reliable AI tools.

- AI often **hallucinates** (fabricates) citations (Buriak et al., 2024; Zeer et al., 2023) → use reliable AI, check everything thoroughly directly in the cited text.

- **Misinformation** - inaccurate or biased results (Buriak et al., 2024; Kim, 2024), AI suffers from a lot of biases! → triangulation of sources and personal verification of given information.

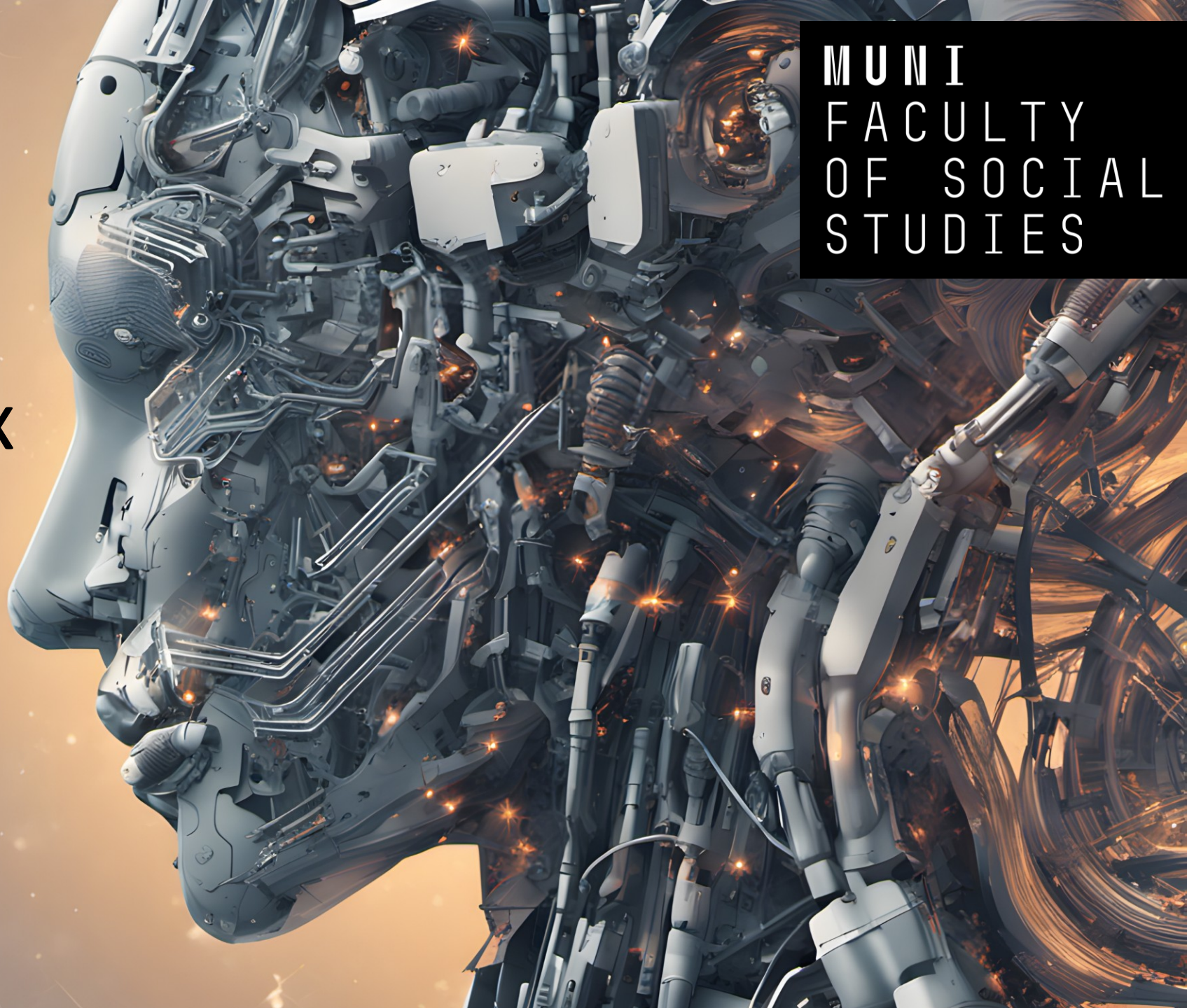
Practical examples

- OK: consultation of methods, theories and overall design of the paper, including occasional proofreading; literature search (Consensus, SciSpace, Research Rabbit, etc.) - but it should be complementary to the traditional search!
- Problematic: whole-text proofreading, small-scale content generation (e.g. statistical results).
- Inacceptable: large-scale content generation.

Good practices (Buriak et al., 2023, Khalifa & Albadway, 2024, Khlaif et al., 2023)

- Acknowledgements section - **acknowledge the use of AI** and transparently list the parts of the text affected, possibly including prompts or transcripts in Supplementary files.
- Constantly keep in mind - the **output from gen AI** is only an initial draft and **needs significant polishing** and rewriting.
- Don't use the literal and unedited output of gen AI - remember it cannot generate new, original ideas, on par with **ghostwriting**.
- Don't let AI tools diminish your creativity and thinking à introspection à use them for exactly the opposite purpose!
- AI-generated content **should never replace critical thinking**, human and expert insight and literature review.
- All outputs must be thoroughly checked.
- Do not input personal, sensitive, or otherwise **protected data and text into AI**.

Part 2: Toolbox



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Generative AI and study companions

- **Claude** – LLM like ChatGPT, but higher limit (only in USA and UK).
  - + ChatGPT and Bard.
  - + ChatGPT cheat sheets.
- **Revision.ai** – Flashcards from pdf notes.
- **Easy-Peasy AI** – GPT-4 model based AI + image gen.
- **Quillbot** – paraphraser, MS Word plugin.
- **Forefront.ai** – GPT-3.5, Claude, input tokens, internet search, file uploads
- **PromptGPT** – web with prompts and jailbreaks.
- **Prompt-genie** – 14 days free trial.
- **Scholarcy** – summary cards of small/medium documents.
- **MAXQDA** – Open AI plugin – text analysis client-based SW.
- **Penseum** – study companion, temporary halt on new accounts.
- **Perplexity.ai** – ChatGPT + Google
- **Lens.org** – Better Google
- + Testing of SCOPUS Copilot and WoS AI Assistant

Literature review

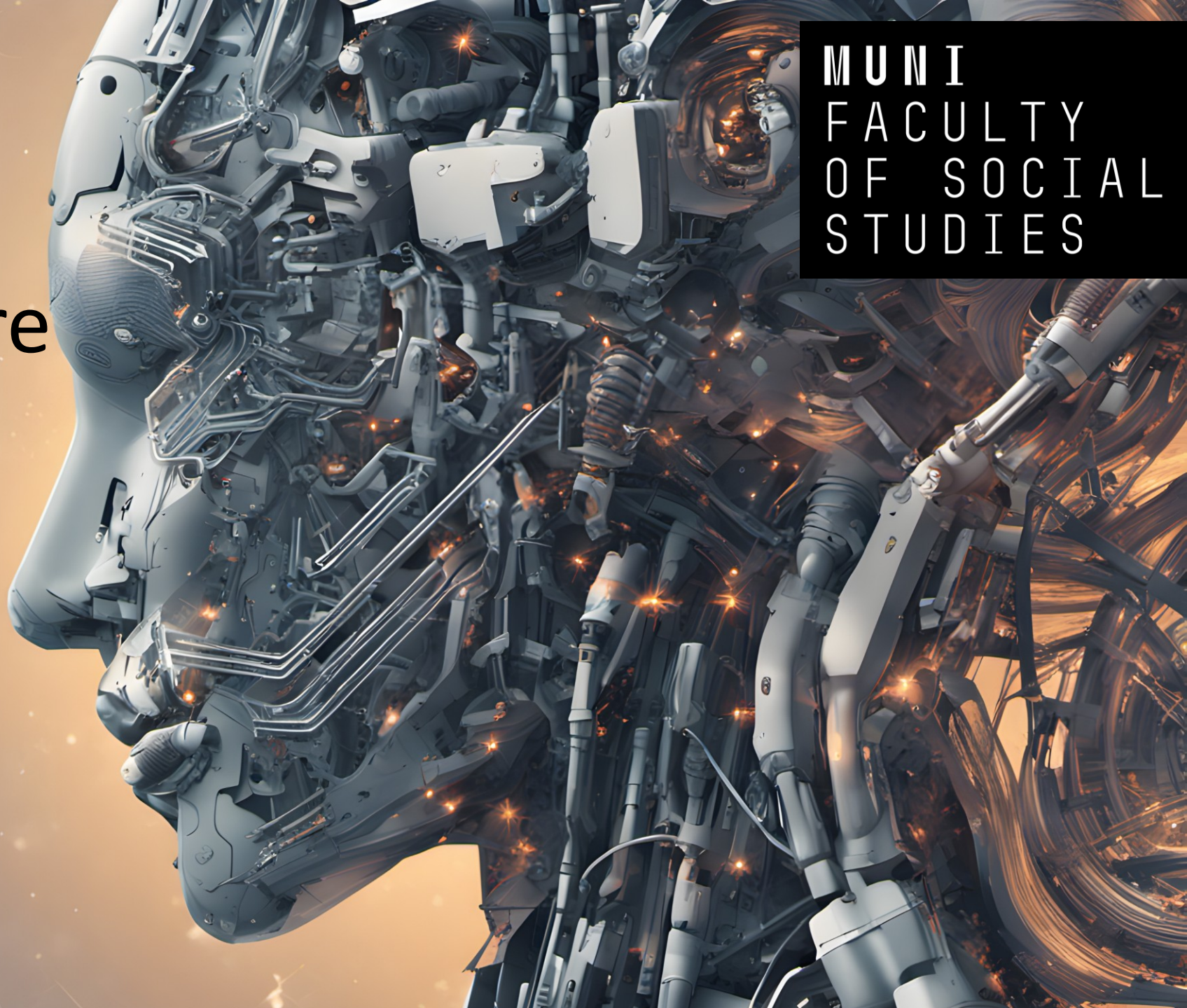
- **Elicit** – summarizing, comparing studies free (5k credits) -> paid.
- **Scispace** – pdf TLDR, summaries, chat.
- **Research Rabbit** – vizualisation.
- **Connected Papers** – vizualisation.
- **Open Knowledge Maps** – visualisation.
- **Consensus** – outputs based on a research question.
- **VOSViewer** – client-based SW, visualisation, text mining capabilities.
- **Sourcerly** – find sources.
- **Jenni AI** – writing co-pilot using papers.
- **Litmaps** – lit finder and vis.

Data visualisation and analysis

- **Flourish**.
- **Datawrapper.**
- **BioRender** – life sciences visualisations.
- **Bard** – „write a Python/R code for data visualisation“ → paste data sample → export code → use the code in R studio
- **Text analysis** (Claude/ChatGPT – Grounded Theory coding) → sensitizing concepts + Leximancer (free trial) → analysis.
  - Slow adoption of AI for qualitative analyses – see study.
- **GPT Excel** – MS Excel formulas generator and companion.

- **There is an AI for that –** find Ais using AI.

Part 3: Literature review



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Literature review – a little bit of theory (Jesson, Matheson and Lacey, 2011)

- Systematic (structured) vs. traditional (unstructured) → continuum!

Traditional	Systematic
Random process guided by researcher (bias)	Rigorous, structured process driven by scientific principles and methods.
Implicitly/explicitly subjective.	Objective, balanced, less biased.
Lack of scientific method(s).	Method is focused, explicit and transparent.
Identification of topic, topic recon, support for arguments, introduction.	Systematic overview of every relevant piece of knowledge – **available**.

- Cannot be ever complete – esp. with the problem of GRAY LITERATURE.

Table 1| **Checklist of items to include when reporting a systematic review or meta-analysis**

Section/topic	Item No	Checklist item	Reported on page No
Title			
Title	1	Identify the report as a systematic review, meta-analysis, or both	
Abstract			
Structured summary	2	Provide a structured summary including, as applicable, background, objectives, data sources, study eligibility criteria, participants, interventions, study appraisal and synthesis methods, results, limitations, conclusions and implications of key findings, systematic review registration number	
Introduction			
Rationale	3	Describe the rationale for the review in the context of what is already known	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS)	
Methods			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (such as web address), and, if available, provide registration information including registration number	
Eligibility criteria	6	Specify study characteristics (such as PICOS, length of follow-up) and report characteristics (such as years considered, language, publication status) used as criteria for eligibility, giving rationale	
Information sources	7	Describe all information sources (such as databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched	
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated	
Study selection	9	State the process for selecting studies (that is, screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis)	
Data collection process	10	Describe method of data extraction from reports (such as piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators	

Source: Moher et al., 2009, p. 5-6

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Data items	11	List and define all variables for which data were sought (such as PICOS, funding sources) and any assumptions and simplifications made
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis
Summary measures	13	State the principal summary measures (such as risk ratio, difference in means).
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (such as I^2 statistic) for each meta-analysis
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (such as publication bias, selective reporting within studies)
Additional analyses	16	Describe methods of additional analyses (such as sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified
Results		
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram
Study characteristics	18	For each study, present characteristics for which data were extracted (such as study size, PICOS, follow-up period) and provide the citations
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome-level assessment (see item 12).
Results of individual studies	20	For all outcomes considered (benefits or harms), present for each study (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see item 15)
Additional analysis	23	Give results of additional analyses, if done (such as sensitivity or subgroup analyses, meta-regression) (see item 16)

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Thank you for your attention!

Questions?

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