Basics of Planning a Systematic Review

Prof. Maheeka Seneviwickrama
Department of Community Medicine
Faculty of Medical Sciences
University of Sri Jayewardenepura

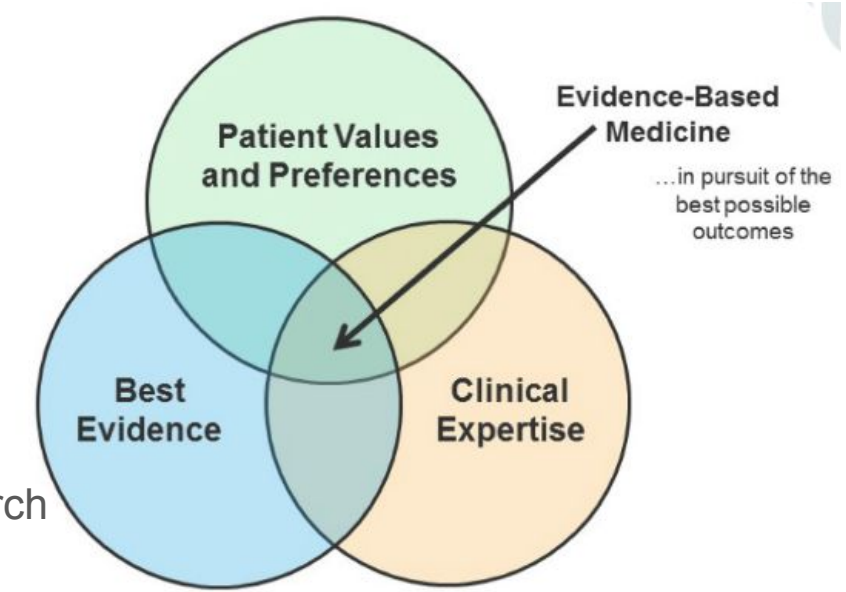
Contents

How we made decisions?

Eminence based- relies on the opinions of “experts’
Vehemence based- relying on forceful or strong arguments
Eloquence based- silver-tongued

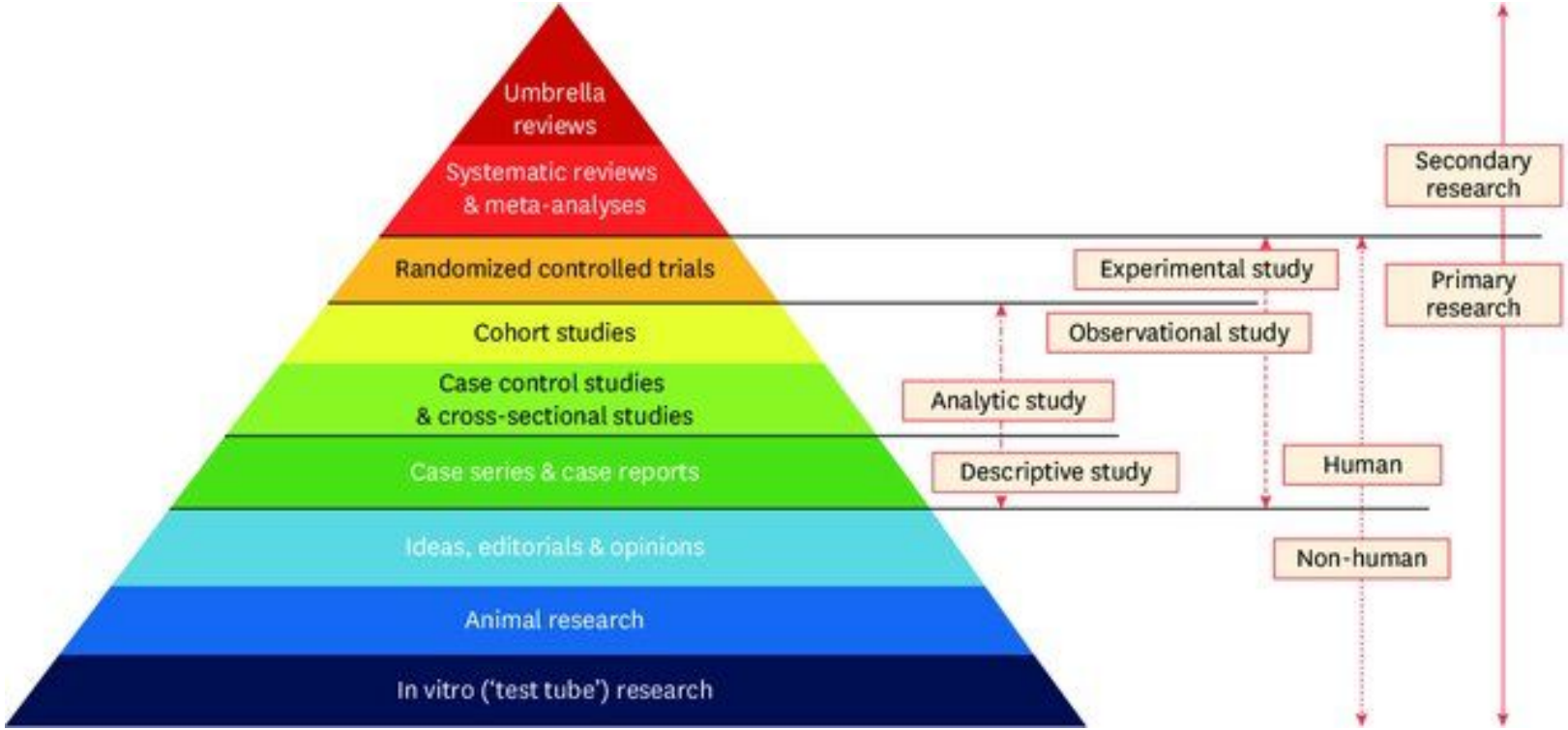
Evidence based medicine

EBM- integration of best research evidence with clinical expertise and patient values



What is evidence?

Hierarchy of evidence



Source: Choi et al., 2023

What is systematic review?

- A structured, reproducible method to synthesize research evidence
- Involves a comprehensive, transparent, and reproducible approach to identifying, selecting, and synthesizing all relevant studies on a specific research question
- Considered the gold standard in evidence synthesis because of their rigorous methodology and emphasis on transparency and reproducibility

What is the need for a systematic review?

- Over 2 million articles published annually
- Scattered through 20,000 journals
- Difficult to go through all these

SR brings together a number of separately conducted studies, sometimes with conflicting findings & synthesize their results

Advantages of systematic reviews

- Reduce bias
- Replicability
- Resolve controversy between conflicting studies
- Identify gaps in current research
- Summary measure of available evidence
- Provide reliable basis for decision making

Traditional review vs systematic review

Systematic reviews provide an answer to a specific research question using a robust, reproducible, and transparent methodology whereas traditional reviews offer broader insights but may be prone to bias and lack replicability

Traditional review vs systematic review- contd.

Aspect	Traditional Review	Systematic Review
Objective	Broad overview	Specific, focused question
Methodology	Narrative, less rigorous	Structured, protocol-driven, explicit eligibility criteria
Search Strategy	Limited, non-exhaustive	Comprehensive, multi-database, includes grey literature
Bias Control	Higher risk of bias	Lower risk; standardized methods, quality assessment
Reproducibility	Difficult to replicate	High reproducibility due to transparency

Classification of reviews

- Literature Review
- Scoping Review
- Rapid Review
- SR with meta-analysis
- SR without meta-analysis (SWiM)
- SR with meta-synthesis
- Umbrella Review

Choosing the right review type

Type	Purpose	When to Use?
Traditional Review	Comprehensive synthesis of evidence	When in-depth analysis is needed
Scoping Review	Mapping literature and identifying gaps	For broad research questions
Rapid Review	Quick evidence synthesis	When time is limited
Meta-Analysis	Quantitative aggregation of data	When statistical pooling is feasible
Meta-Synthesis	Qualitative thematic integration	For synthesizing qualitative research
Umbrella Review	Summarizing multiple reviews	When multiple systematic reviews exist

Systematic review process

- Formulates a clear, focused research question
- Conducts an exhaustive literature search across multiple databases and sources
- Applies strict inclusion and exclusion criteria to select studies
- Critically appraises the quality of the included studies
- Synthesizes the evidence, either quantitatively (meta-analysis) or qualitatively (meta-synthesis)
- Follows a pre-defined protocol
  - minimize bias
  - ensure findings are reliable, valid and reproducible

Systematic review process- contd.

Who should do a SR?

- Undertaken by a team
  - spreads the effort
  - minimizing the likelihood of errors in screening, data extraction and QA
- First-time review authors are encouraged to work with others who are experienced in the process
- Both topic and methodological expertise is needed to ensure a good mix of skills, knowledge and objectivity
- ?Conflict of interests
- Involving consumers and other stakeholders

Basic steps in a systematic review

- Formulate the research question (different frameworks ex: PICO, PECO, PCC, PICo)
- Develop a search strategy & register the protocol
- Literature search: Comprehensive search across multiple databases
- Screening: Identify and select relevant studies
- Data extraction: Collect key information from studies
- Quality assessment: Evaluate the methodological rigour
- Summarizing evidence: Perform narrative synthesis, meta-analysis, or meta-synthesis
- Reporting: Draft and publish findings according to guidelines

Basic steps in a systematic review- contd.

Step 1: Define the research question

Based on a framework- ex: PICO, PECO, PCC, PICo

PICO framework

- **Population:** Who is the study about?
- **Intervention:** What is being done?
- **Comparison:** What is the intervention compared against?
- **Outcome:** What are the expected results?

Example: "In elderly patients with osteoarthritis (Population), how does a structured exercise programme (Intervention) compared to standard care (Comparison) in a community setting (Context) affect pain and mobility (Outcome)?"

Step 1: Define the research question- contd.

PECO framework-

- **Population:** Who is the study about?
- **Exposure:** What is the exposure or risk factor?
- **Comparison:** What is the intervention compared against?
- **Outcome:** What are the expected results?

Example: "Among adults (Population), does exposure to air pollution (Exposure) compared to low exposure levels (Comparison) increase the risk of respiratory diseases (Outcome)?"

Step 1: Define the research question- contd.

PCC framework- Scoping reviews

- **Population:** Who is the study about?
- **Concept: the core concept examined by the scoping review**
- **Context:** Under what circumstances or setting?

Example: "What are the healthcare access experiences (Concept) of immigrant women (Population) in urban areas (Context)?"

Step 1: Define the research question- contd.

PICo- Qualitative SR

- **Population: Who is the study about?**
- **phenomena of Interest:**
- **Context:** Under what circumstances or setting?

What are the experiences of family caregivers (Population) providing palliative care for adult cancer patients (phenomena of Interest) in LMICs (Context)?

Step 1: Define the research question- contd.

- Choosing the right framework depends on your research question and the type of review being conducted
- Each framework tailors the question to best address the study's focus

Activity 1

Formulate a research question using one of the frameworks we discussed

Step 2: Develop a search strategy & register the protocol

- Search strategy:

  A planned approach to find relevant information, encompassing the selection of search terms, databases, and techniques to maximize the retrieval of pertinent articles or studies.

- Protocol:

  a detailed, pre-defined plan that outlines the objectives, methods, and procedures for conducting a review, aiming to ensure transparency, reproducibility, and minimize bias in the review process.

Steps in developing a search strategy

1. **Identify the main concepts and alternative terms from your question that you can use to search:**

Research Question Example: *"In middle aged **women** suffering **migraines**, is B**otulinum toxin type A** compared to placebo effective at decreasing migraine frequency?"*

Main concepts & synonyms

- Women, Woman, Female
- Botulinum toxin type A, Botulinum toxins, Clostridium botulinum toxins
- Migraine, Migraine disorders, Migraine headaches

Steps in developing a search strategy- contd.

- Use truncation e.g. educat* to look for all possible endings to that root… educate, educated, education, educational or educator
- Use wildcards # or ?
  - e.g. wom?n for woman or women
  - e.g. colo#r for color (US English) and colour (UK English)
- Phrase searching e.g. “migraine headache”
- Key words & MeSH (Medical Subject Headings) terms

Steps in developing a search strategy- contd.

2. Combine Terms Using Boolean Operators: AND, OR, NOT

- OR to broaden/ AND to narrow/ NOT to exclude terms
- Synonyms of same concepts combined using OR
- Different concepts are combined using AND

Example of a PubMed Search String:

("osteoarthritis"[MeSH Terms] OR osteoarthritis[tiab] OR "degenerative arthritis"[tiab])

AND ("exercise"[MeSH Terms] OR exercise[tiab] OR "physical activity"[tiab])

AND ("elderly"[MeSH Terms] OR elderly[tiab] OR "older adults"[tiab])

Steps in developing a search strategy- contd.

3. Decide on relevant databases:

General Databases:

- MEDLINE/PubMed
- Cochrane Library
- Embase
- Web of Science

Subject-Specific Examples:

- PsycINFO (Psychology)
- CINAHL (Nursing)
- IEEE Xplore (Engineering)

Steps in developing a search strategy- contd.

4. Apply filters:

Publication date range, human studies, language restrictions, etc.

5. Document the strategy:

Save search strings, database names, date of search, and any filters applied.

6. Decide on inclusion criteria:

population, intervention/context, outcome, study design

7. Refine the strategy:

Sensitivity (Generic MeSH terms, truncation, wild cards, synonyms, spelling variations, tiab)

Precision (title only text word search, major MeSH terms, phrase search, Boolean operators NOT, ADJ)

Activity 2

Develop a brief search strategy for the research question you formulated

Step 3: Screening

1. Duplicate removal
2. Apply inclusion criteria to select relevant studies
    i. Title and abstract screening
    ii. Full text screening
3. Two independent reviewers
4. Address discrepancies
5. Prepare the PRISMA flow diagram

A visual representation of the study selection process, showing records identified through database searches, records screened, excluded, and included in the final review

available at: https://www.prisma-statement.org/prisma-2020-flow-diagram

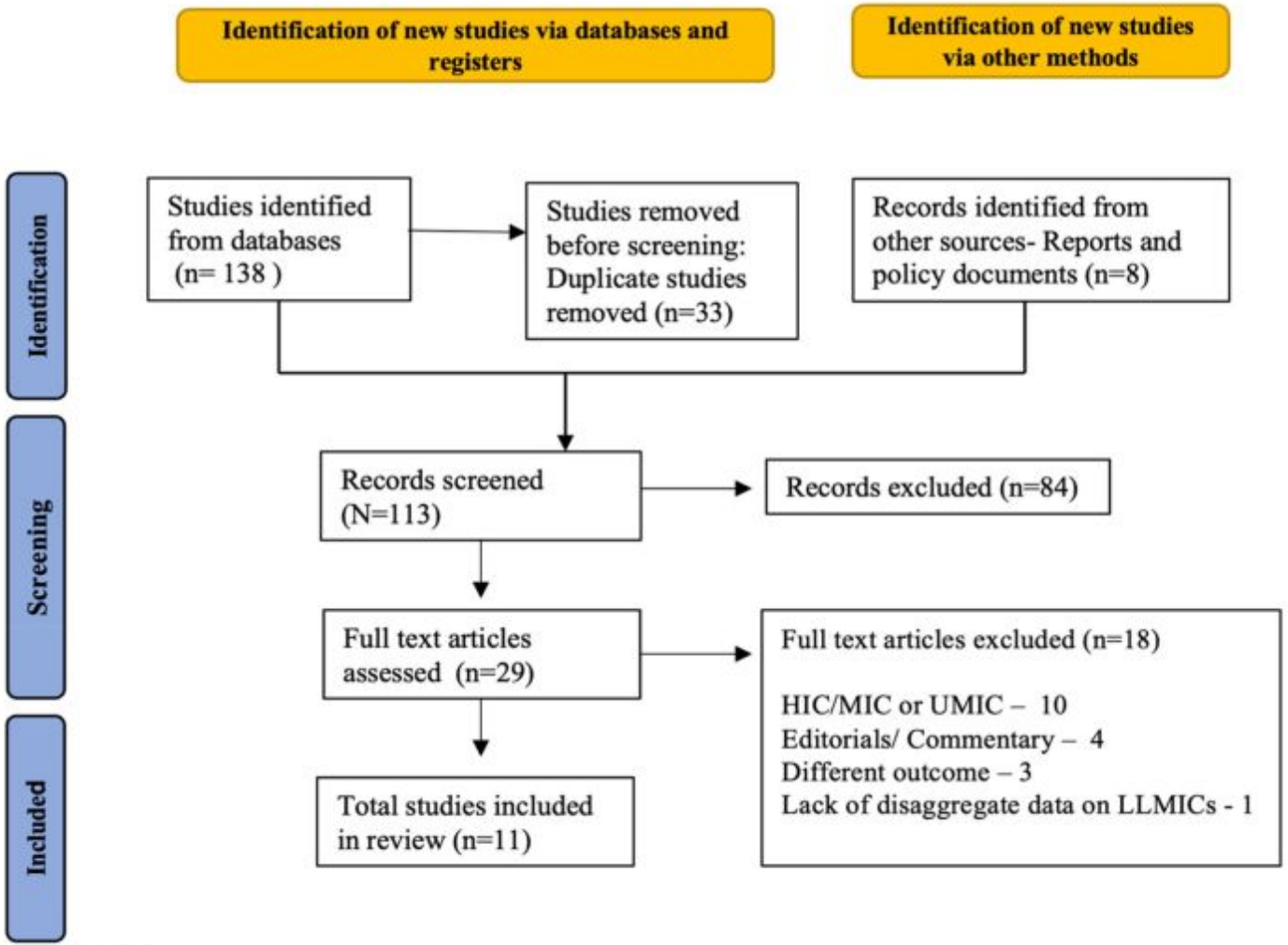


Fig. 2 PRISMA flow diagram

Step 4: Data extraction

- Collect key information from studies
- What data the reviewers plan to extract
- Standardized data extraction tool

  Authors & year of publication, population, context, culture, geographical location, study methods (study design, sample size, tools used), intervention/ phenomena of interest relevant to the review question and specific objectives, findings

- Two independent reviewers
- Address discrepancies

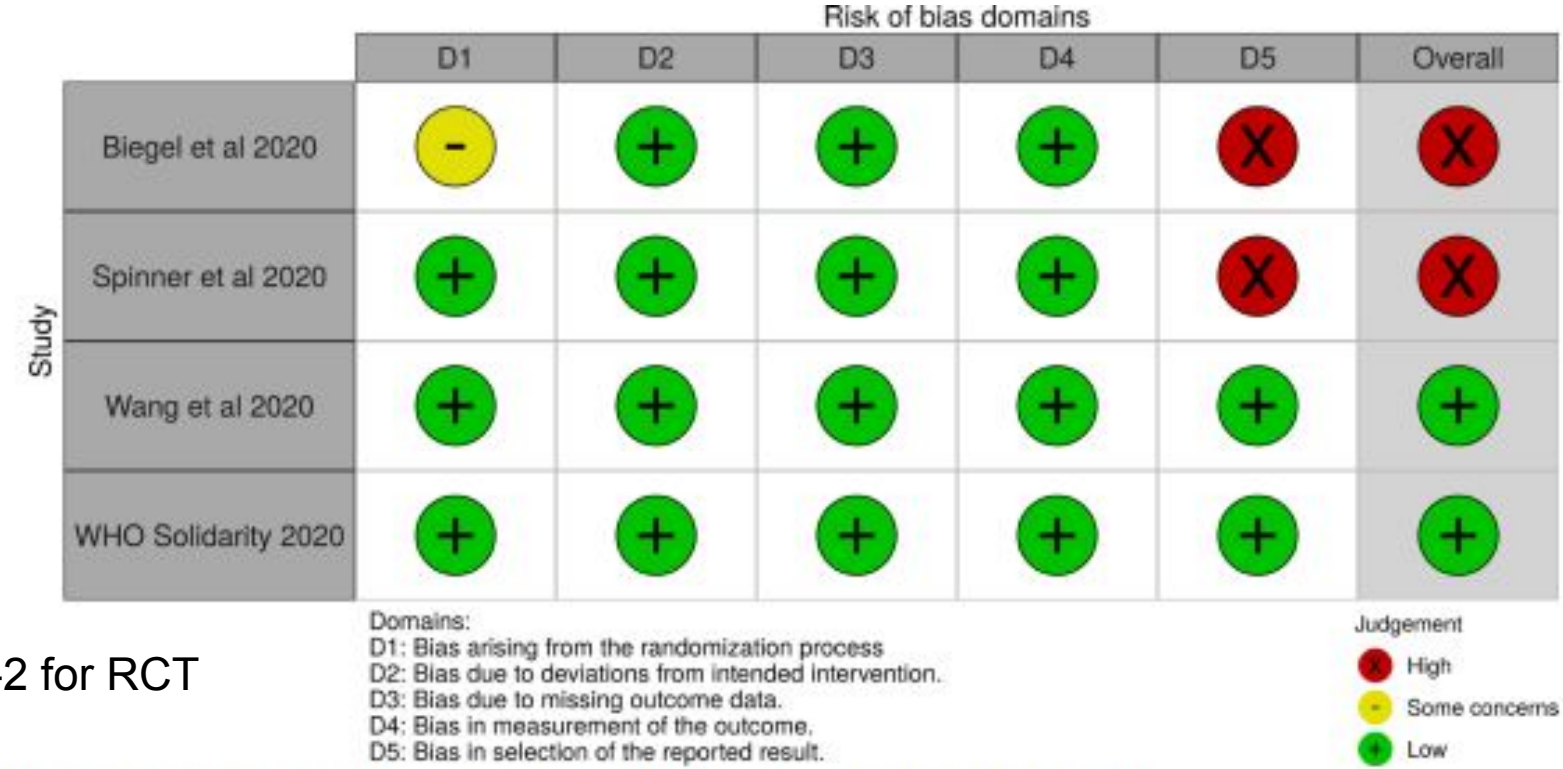
Step 5: Quality assessment

- Critical appraisal/ risk of bias assessment
- Evaluate the methodological rigor
- Different tools based on studies being reviewed
- Low risk/ high risk- cut off values
- Whether to include into evidence synthesis or not

Step 5: Quality assessment- contd.

- Quality assessment tools
  - RoB 2 (Revised Cochrane Risk of Bias Tool)- randomized trials
  - ROBINS-I (Risk of Bias in Non-Randomized Studies of Interventions)
  - AMSTAR 2 (A MeaSurement Tool to Assess systematic Reviews)- SR on randomised/ non-randomised studies of healthcare intervention
  - MMAT (Mixed Methods Assessment Tool)- Qual, Quan & Mixed
  - NOS (Newcastle-Ottawa Scale)- case-control & cohort
  - Hoy et al.'s risk of bias tool- cross-sectional/ prevalence
  - JBI (Joanna Briggs Institute) critical appraisal tools- multiple tools
  - CASP (Critical Appraisal Skills Programme)-multiple tools

Step 5: Quality assessment- contd.



ROB-2 for RCT

igure 2 ROB-2: risk of bias in RCT evaluating remdesivir for treatment of COVID-19.

Source: Singh, et al. BMJ Open 2021;11:e048416. doi:10.1136/bmjopen-2020-048416

Step 5: Quality assessment- contd.

STUDY	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5	Domain 6	Domain 7	Domain 8	Domain 9	Domain 10
Ahlmen 2005	+	+	+	+	-	-	+	+	+	+
Arthur 2004	+	+	+	-	-	-	+	-	+	+
Blake 2013	+	+	+	-	+	+	+	-	+	+
Dures 2016	+	+	+	-	+	+	+	+	+	+
Flurey 2013	+	+	+	+	+	-	+	+	+	+

CASP quality appraisal tool

1. Was there a clear statement of the aims of the research?
2. Is qualitative methodology appropriate?
3. Was the research design appropriate to address the aims of the research?
4. Was the recruitment strategy appropriate to the aims of the research?
5. Was the data collected in a way that addressed the research issue?
6. Has the relationship between researcher and participants been adequately considered?
7. Have ethical issues been taken into consideration?
8. Was the data analysis sufficiently rigorous?
9. Is there a clear statement of findings?
10. How valuable is the research?

+ = Low risk of bias

- = High risk of bias

CASP tool for qualitative studies

Step 6: Summarizing evidence

1. Meta-Analysis:
- Quantitative synthesis using statistical methods
- Key Components: Effect size, forest plots, heterogeneity analysis

2. Meta-Synthesis:
- Qualitative integration of findings from qualitative studies
- Techniques for thematic synthesis
- Meta-aggregation

Step 6: Summarizing evidence- contd.

1. Meta-Analysis:

- The statistical pooling of data across studies to generate summary estimates of effects
  - OR
  - RR
  - Risk difference
- Pooling of effect measures across studies
  - Pooling is a process of computing weighted averages
  - Larger studies are assigned more weight in the computations of average

Step 7: Reporting

- **Reporting Guidelines:**
  - PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)
- **Methodological Guides:**
  - Cochrane Handbook for Systematic Reviews
  - Joanna Briggs Institute (JBI) Guidelines

Protocol registration:

- Avoids duplication
- PROSPERO, CDSR, OSF, JBI, Campbell

References

- Aromataris E, Lockwood C, Porritt K, Pilla B, Jordan Z, editors. JBI Manual for Evidence Synthesis. JBI; 2024. Available from: https://synthesismanual.jbi.global
- Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.5 (updated August 2024). Cochrane, 2024. Available from https://training.cochrane.org/handbook/current

Thank you!