



Systematic Reviews

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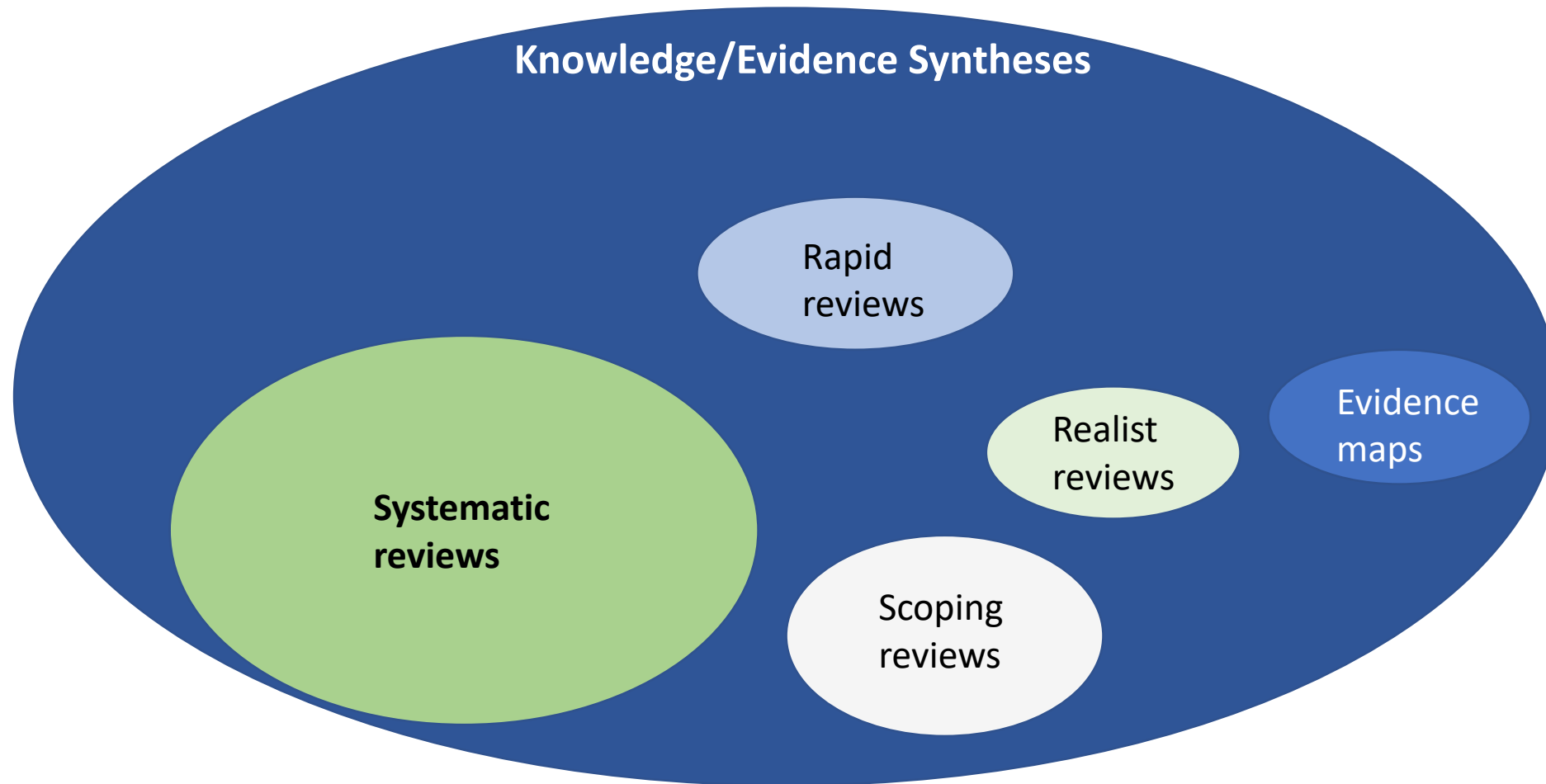
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Carnegie Mellon University

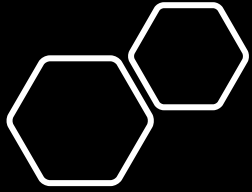
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Cochrane: “A systematic review attempts to **identify, appraise and synthesize** all the empirical evidence that meets pre-specified **eligibility criteria** to answer a **specific research question**. Researchers conducting systematic reviews use **explicit, systematic methods** that are selected with a view aimed at **minimizing bias**, to produce more reliable findings to inform decision making.”

Knowledge synthesis: Types of reviews



For information on other review types, see: Sutton, A., Clowes, M., Preston, L., & Booth, A. (2019). Meeting the review family: exploring review types and associated information retrieval requirements. *Health Information & Libraries Journal*, 36(3), 202-222. <https://doi.org/10.1111/hir.12276>



Systematic versus Scoping Reviews

Systematic Review = narrow focus

may be undertaken to confirm or refute whether or not current practice is based on relevant evidence, to establish the quality of that evidence, and to address any uncertainty or variation in practice that may be occurring.

Scoping Review = broader focus

to determine the scope or coverage of a body of literature on a given topic and give clear indication of the volume of literature and studies available as well as an overview (broad or detailed) of its focus.

| | Traditional Literature Reviews | Scoping reviews | Systematic reviews |
|---|--------------------------------|-----------------|--------------------|
| A priori review protocol | No | Yes (some) | Yes |
| PROSPERO registration of the review protocol | No | No ^a | Yes |
| Explicit, transparent, peer reviewed search strategy | No | Yes | Yes |
| Standardized data extraction forms | No | Yes | Yes |
| Mandatory Critical Appraisal (Risk of Bias Assessment) | No | No ^b | Yes |
| Synthesis of findings from individual studies and the generation of 'summary' findings ^c | No | No | Yes |

Figure from: Munn, Z., Peters, M. D., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). [Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach](#). *BMC medical research methodology*, 18(1), 143.

Comparing review types

Evidence Synthesis Organizations: Conducting guidance documents

Cochrane: [Cochrane Handbook for Systematic Reviews of Interventions](#)

Campbell Collaboration: [MECCIR Conduct Standards](#)

Center for Reviews and Dissemination: [CRD's guidance for undertaking reviews in health care](#)

Collaboration for Environmental Evidence: [Guidelines and Standards for Evidence Synthesis in Environmental Management. Version 5.0](#)

Joanna Briggs Institute: [JB I Manual for Evidence Synthesis](#)

Systematic reviews: Reporting standards

Reporting standards identify the minimum amount of information that should be reported in a manuscript.

It helps to make your research transparent and reproducible.

PRISMA: [Preferred Reporting Items for Systematic Reviews and Meta-analysis](#)

JARS - Quant: [Quantitative Meta-Analysis Article Reporting Standards](#)

How are we doing in terms of methods?

2013

[Meta-analytic research in International Business and International Management](#) (Buckley, Devinney & Tang, 2013)

- Studies were limited in breadth and depth of literature examined
- Majority of studies did not report key terms or combinations

2020

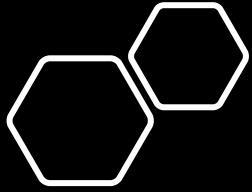
[Literature searches in systematic reviews and meta-analyses: A review, evaluation, and recommendations](#) (Harari, Parola, Hartwell & Riegelman, 2020)

- 56% reported a full list of search terms, but only 24% reported the use of Boolean terms
- Using a non-comprehensive set of studies in a meta-analysis would lead to incorrect conclusions

[The reporting quality of systematic reviews and meta-analysis in industrial and organizational psychology: A systematic review](#) (Schalken & Rietbergen, 2017)

- Only 3 of 120 articles used a reporting guidelines (PRISMA or MARS)
- Study selection reporting was poor. It was not possible to evaluate the risk of bias.

2017



Systematic reviews are research

A systematic review is research – not just a literature review.

- Should be held to the same standards as other scientific research: rigor, transparency, replicability, etc.

Typical steps for a systematic review

→ Define a question

→ Set eligibility criteria

→ Create a protocol

→ Search for studies

→ Select studies

→ Extract study data

→ Appraise the studies

→ Synthesize the data

→ Disseminate findings

Systematic reviews: Defining the question

The research question needs to be well-defined.

Use a question framework such as:

PICO: Population, Intervention, Comparison, Outcome¹

CIMO: Context, Intervention, Mechanisms, Outcomes²

1. Richardson, W. S., Wilson, M. C., Nishikawa, J., & Hayward, R. S. (1995). The well-built clinical question: A key to evidence-based decisions. *ACP Journal Club*, 123(3), A12.

<https://doi.org/10.7326/ACPJC-1995-123-3-A12>

2. Denyer, D. & Tranfield, D. (2009). [Producing a systematic review](#). In D. Buchanan & A. Bryman (Eds.), *The SAGE handbook of organizational research methods*: 671-689. London: SAGE Publications Ltd.



Literature pre-scan



How: Quick search using known keywords in one or two databases or Google Scholar.



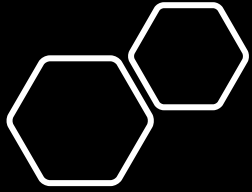
Collect: a few diverse but representative references to papers that would meet your inclusion criteria



Use: These references/abstracts can be used to identify methods/study types for this topic area, and to check how outcomes tend to be reported in the abstracts. They also help find keywords and subject headings, can be used to create and pilot your data extraction template, etc.

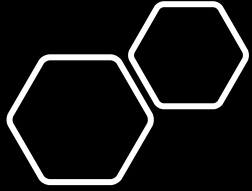


Reflection: You cannot design a fishing net if you don't know what kind of fish you are interested in catching; know your fish!



Systematic reviews: Determining eligibility criteria

- Eligibility criteria (aka: inclusion/exclusion criteria) need to be pre-defined before data collection.
- They help define the boundaries of your review and help determine which studies will and will not be included in your review.
- Can use PICO/CIMO to help:
 - Ex: population characteristics, geographic region(s), setting, study design, sample size, etc.



Systematic reviews: Creating a protocol

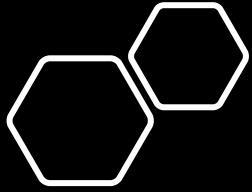
A primary study would never be conducted without a research plan; similarly, evidence synthesis should not be undertaken without a research protocol.

A protocol describes the planned methodology and intended process for each step of your review, including:

- The research question
- Data collection/search strategy
- Eligibility criteria and study selection process
- Data extraction
- Critical appraisal
- Synthesis and/or meta-analysis

PRISMA-P: a reporting guideline for protocols of systematic reviews and meta-analysis

Exemplar: Rousseau, DM., Beck, D., Kim, B., Splenda, R., Young, S. (2019) PROTOCOL: Does executive compensation predict publicly traded firms' financial performance or inaccurate financial reporting? Campbell Systematic Reviews, 15, e1064. <https://doi.org/10.1002/cl2.1064>



Systematic reviews: Publishing your protocol

Publishing a protocol **a priori** shows that you did not hypothesize after you knew the direction of the effect or the results.

It reduces the opportunity for reporting bias.

- [Open Science Framework](#) - You can pre-register your protocol on the Open Science Framework registry. It can be embargoed for a set period of time (maximum 4 years).
- [PROSPERO](#) - This is an international database of prospectively registered systematic reviews. Their disciplinary coverage includes: health, social care, welfare, public health, education, crime, justice, and international development, but the review must have a health-related outcome.
- You can also upload a copy of your protocol to your institutional repository.

Searching: The general stuff

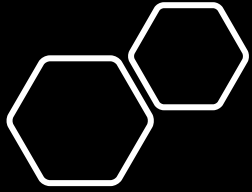


Your search should be:



- Methodologically **rigorous, systematic, transparent** and **reproducible**
- Search strategies must be **highly sensitive** (rather than specific)
- In a variety of **different sources**; One or two are not enough!

It can be **time-consuming!** (work with your librarian)



Information sources and types

Where will you search for studies?

Electronic databases

Handsearching journals or conferences

Forward and backwards searching

Grey literature

Contacting experts

What formats are acceptable?

Scholarly articles

Trade publications

White papers

Government reports

Conference papers

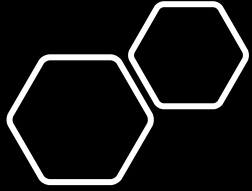


Which databases do I search in?

- One is never enough!
- **First priority:** Discipline-specific databases.
 - For example, in Business they are Business Source Complete and ABI/Inform; In Medicine, they are Medline, Embase, and the Cochrane library, etc.

Your choices are based on your research question and what you have access to. For multidisciplinary questions, search the disciplinary databases for all relevant disciplines.

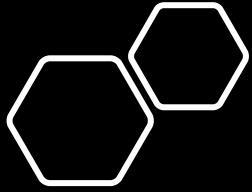
- **Second priority:** Multidisciplinary databases.
 - For example, Web of Science, Scopus, etc. These tend to have broad coverage, but lesser depth. They are searched in addition to, and not instead of the disciplinary databases.



Comprehensive searches

A comprehensive systematic search generally requires:

1. Keywords (searched in **title/abstract**, and **author-keyword** fields)
2. Subject headings (aka subject terms, controlled vocabulary, thesaurus)
3. Operators (truncation, quotations, proximity, wildcards, etc.)
4. Boolean logic (to tie it all together in a logical structure)
5. Building-block or concept-block structure (to organize your search)



Search keywords

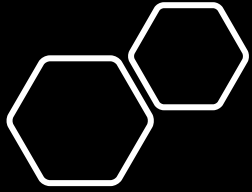
Keywords

- **It's all about the synonyms!**
 - Start with known keywords (from your own knowledge)
 - Mine more from the seed papers you found in your pre-scan
 - Look up the definition in other disciplinary dictionaries/thesaurus
 - Search Google or Google scholar and see how the term is described
 - Look at the scope notes for the related subject headings
 - Think about opposites (mortality versus survival)
 - Consider alternate spellings/terms (Color versus Colour, Soccer versus Football, etc.)
 - Consider acronyms too!

Database operators for searching keywords

-
- **Truncation: (*)** looks for different endings of a word
 - E.g. lead* will find – leaders, leadership, leading..... etc.
 - (You have to be careful not to truncate too much of a word or this can lead to many irrelevant words sneaking in.
 - **Wildcards: (?)** are symbols used to look for alternate letters.
 - E.g. ne?t will find next, nest, neat.
 - **Phrase searching: (" ")** Quotation marks can be used to force phrase searching.
 - **Proximity operators: (N#)** These can be used to find words that are within N words of each other. Great for words that are commonly found close to each other but where there might be many different variations.
 - E.g. (Project* **N3** Manag*) finds Project Management, Management of Projects, managing a project..... etc.

***Note:** Operator symbols are often database-specific. These ones are for EBSCO Business Source Complete*



Database Subject Headings

Subject headings

Subject headings are indexed terms assigned by each database, based on its own thesaurus (i.e. they are always **database-specific**).

Where to find subject headings?

1. From your seed papers (look them up in your database of choice and see how they have been indexed)
2. Search the database thesaurus for the subject headings

New and emerging topics may not have subject headings.

Note: Not all databases have subject headings (e.g. Web of Science, Scopus and Google Scholar* do not have subject headings)

Screenshot of a record: Business Source Complete

◀ Result List Refine Search ◀ 15 of 29 ▶

Flexible Work Schedules and Employee Well-Being.

Authors: Hayman, Jeremy¹

Source: New Zealand Journal of Employment Relations. Jun2010, Vol. 35 Issue 2, p76-87. 12p. 2 Diagrams.

Document Type: Article

Subject Terms:


- *Flextime
- *Job satisfaction
- *Employment practices
- *Industrial hygiene
- *Telecommuting
- *Flexible work arrangements
- Well-being

Author-Supplied Keywords:

- job satisfaction
- well-being
- work schedules
- work/life balance

Abstract: This paper aims to improve understanding of the relationship between the use of **flexible work** schedules and employee **well-being**. Using a sample of 336 employees operating on two **flexible work** schedules (flexitime and telecommuting), clear evidence was found of the positive relationships between **flexible work** practices, job satisfaction and **work/life balance**. The results of the study also indicate that **flexitime schedules** can reduce the impact of role overload and jobinduced stress. However, the findings suggest that telecommuting does not always enhance role overload and **work/life balance**. In addition, employees operating under flexitime **work** schedules displayed significantly higher levels of **work/life balance** than their counterparts utilising telecommuting **arrangements**. The study findings are discussed in relation to theories of employee flexibility and the implications for employees and organisations are addressed. [ABSTRACT FROM AUTHOR]

Subject headings are called "Subject Terms"



Search strategy example

(From: Rousseau, DM., Beck, D., Kim, B., Splenda, R., Young, S. (2019) PROTOCOL: Does executive compensation predict publicly traded firms' financial performance or inaccurate financial reporting? Campbell Systematic Reviews, 15, e1064. <https://doi.org/10.1002/cl2.1064>)

1 ABI/INFORM search strategy

| | |
|----|---|
| 1 | MAINSUBJECT("Chief executive officer**") |
| 2 | AB, TI(ceo OR ceos OR "chief executive officer**" OR "senior leader**" OR "corporate director**" OR executive*) |
| 3 | 1 OR 2 |
| 4 | MAINSUBJECT(Bonus* OR "monetary incentive**" OR "productivity incentive**" OR compensat* OR "compensat*" plans OR "incentive plan**" OR "pay for performance" OR "unreasonable compensation" OR "stock option**" OR "executive compensation") |
| 5 | AB, TI(bonus* OR incentiv* OR "pay for performance" OR compensation OR salary OR salaries OR "stock options" OR "performance award**" OR "performance based pay" OR "performance pay" OR "performance-related pay" OR "executive pay" OR "executive profit sharing") |
| 6 | 4 OR 5 |
| 7 | MAINSUBJECT.EXACT("financial performance" OR "corporate profits" OR earnings OR "retained earnings" OR "undistributed profits" OR "earnings per share" OR "return on investment" OR revenue OR "financial ratios" OR "return on assets" OR "return on equity" OR "corporate mergers" OR "market value") |
| 8 | AB, TI(firm* OR corporate OR corporation* OR company OR companies OR organizational OR financial OR business) NEAR/5 AB, TI(performance OR profit* OR "stock price" OR value OR sales OR revenue OR "market share" OR innovation OR growth OR "financial health" OR liquidity) |
| 9 | AB, TI("return on assets" OR ROA OR "return on income" OR ROI OR ROIC OR "return on invested capital" OR "return on capital" OR ROC OR "return on equity" OR ROE OR EBITDA OR "earnings before interest tax depreciation and amortization" OR "stock market returns" OR "equity pricing" OR "profit margin" OR "financial ratio" OR "merger and acquisition" OR "mergers and acquisitions" OR "market value" OR "market return**" OR "market to book" OR "price to book" OR "total shareholder return") |
| 10 | 7 OR 8 OR 9 |
| 11 | MAINSUBJECT.EXACT("financial restatements" OR "accounting irregularities") |
| 12 | AB, TI(financ* OR account* OR corporate) NEAR/5 AB, TI(misrepresent* OR restatement* OR mislead* OR neglig* OR irregular* OR inaccura* OR inconsisten* OR manipulate* OR deceive* OR dishonest OR deceive* OR misreport* OR fraud* OR lying OR false) |
| 13 | 11 OR 12 |
| 14 | 10 OR 13 |
| 15 | 3 AND 6 AND 14 |
| 16 | Limits: Source Type—Scholarly Journals, Dissertations & Theses, Working Papers, Conference Papers & Proceedings |
| 17 | Limit: 1980-01-01 to present |

Concept block 1
(CEO)

Concept block 2
(Compensation)

Concept block 3
(Financial performance &
inaccurate financial reporting)

Final combination of the 3 concept
blocks using ANDs

Limits and filters used

Consultation
with experts

Reference lists and
“cited by” articles
of:

- included studies
- published SRs and
Meta-analyses

Hand searching
- Journals
- Conferences

Grey literature

Conference proceedings
(Ongoing studies)

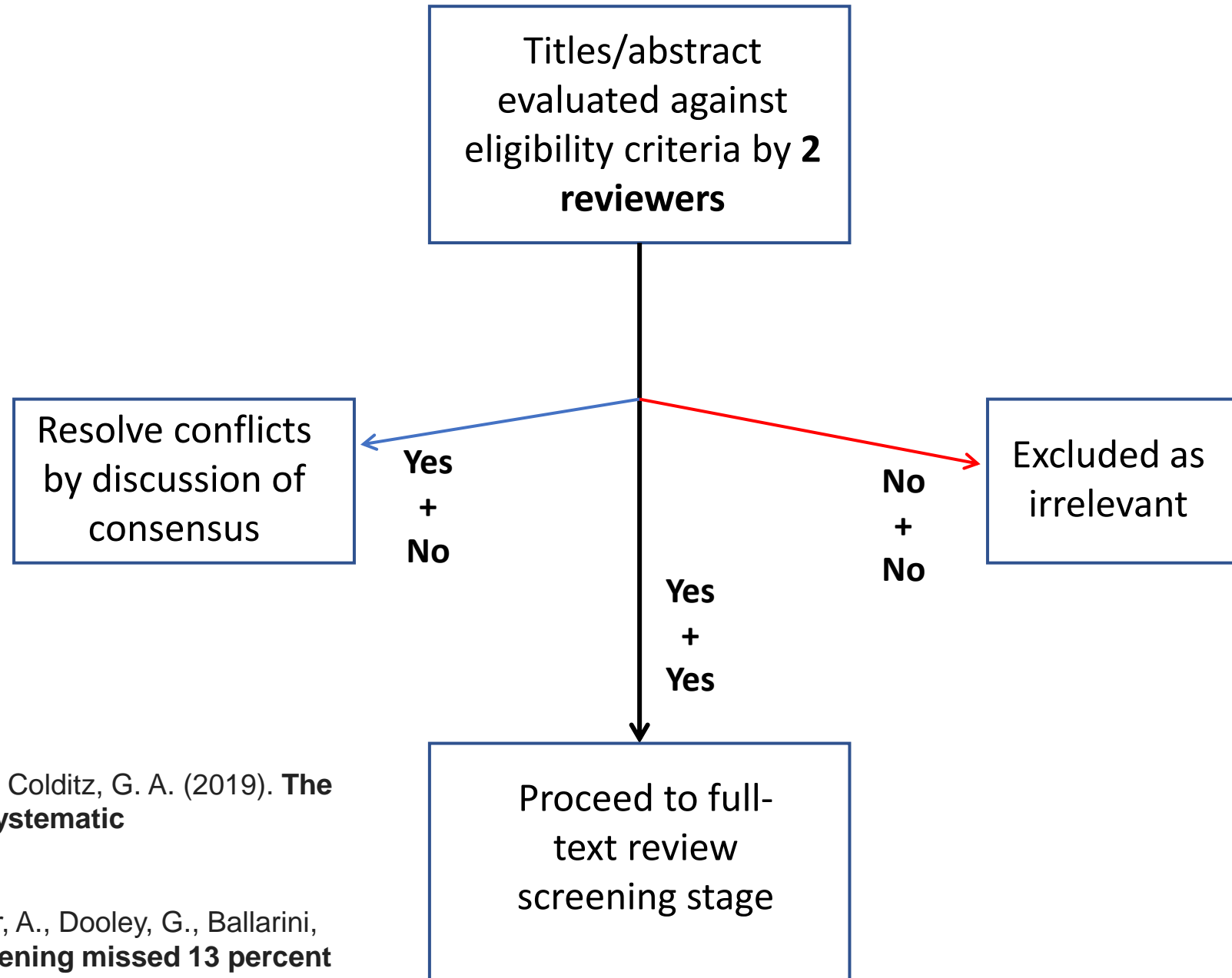
Government documents
and reports

Theses & dissertations
(ProQuest dissertations)

Web site content,
unpublished works, etc.

Beyond
electronic
database
searches

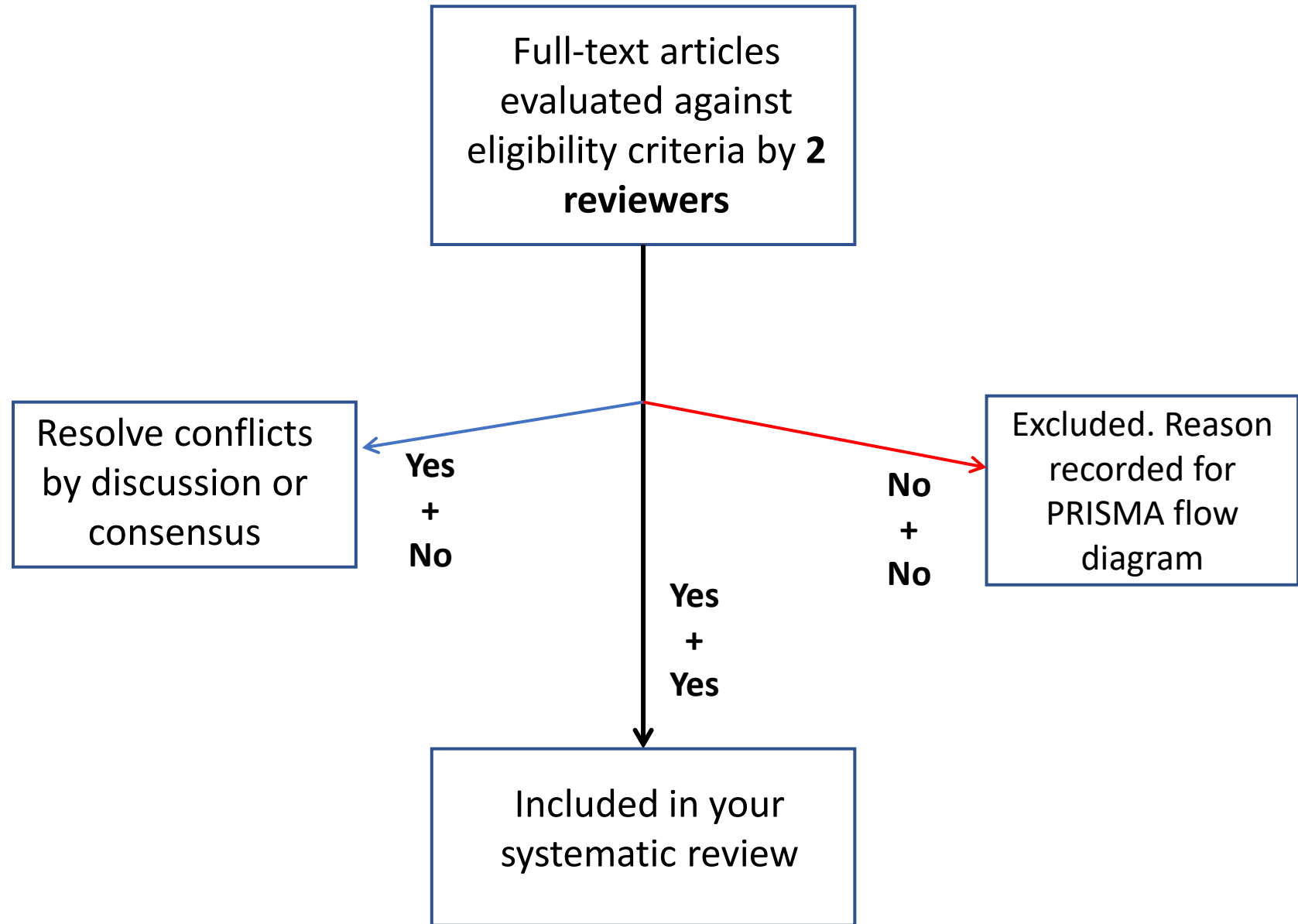
Selecting studies for inclusion



•Stoll, C. R., Izadi, S., Fowler, S., Green, P., Suls, J., & Colditz, G. A. (2019). **The value of a second reviewer for study selection in systematic reviews.** *Research synthesis methods*, 10(4), 539-545. <https://doi.org/10.1002/jrsm.1369>

•Gartlehner, G., Affengruber, L., Titscher, V., Noel-Storr, A., Dooley, G., Ballarini, N., & König, F. (2020). **Single-reviewer abstract screening missed 13 percent of relevant studies: a crowd-based, randomized controlled trial.** *Journal of Clinical Epidemiology*. <https://doi.org/10.1016/j.jclinepi.2020.01.005>

Selecting studies for inclusion



Tools available to facilitate the screening process:
Covidence, Rayyan

Reporting Standards

A well-reported systematic review:

- Is transparent
- Is possible to reproduce
- Enables critical appraisal of its methods

The most used reporting standard for Systematic Reviews is [PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analysis.](#)

- Includes a [checklist](#) for ease of use
- New PRISMA expected in 2020



PRISMA 2009 Checklist

| Section/topic | # | Checklist item | Reported on page # |
|------------------------------------|----|---|--------------------|
| 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, and 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 (e.g., Web address), and, if available, provide registration information including registration number. | |
| Eligibility criteria | 6 | Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. | |
| Information sources | 7 | Describe all information sources (e.g., 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 (i.e., 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 (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. | |
| Data items | 11 | List and define all variables for which data were sought (e.g., 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 (e.g., 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 (e.g., I^2) for each meta-analysis. | |

Page 1 of 2

Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement*. [PLoS Med 6\(7\): e1000097.](#)
[doi:10.1371/journal.pmed1000097](#)

Reporting the search methods

A well-reported search methods section identifies:

- Which databases (including dates of coverage and search dates)
- Inclusion of subject headings
- Inclusion of free-text terms
- refers to line-by-line search strategy (in the appendix)
- Describes all supplementary/grey literature sources and strategies that were employed

Note: Refer to the [PRISMA checklist](#) for further guidance

Search methods for identification of studies

Electronic searches

We searched PROSPERO and the Cochrane Library for related systematic reviews. We developed and carried out systematic searches in the following electronic databases: Cochrane Database of Systematic Reviews (via OVID, 2005 to 10 April 2020); Cochrane Central Register of Controlled Trials (via OVID, 1991 to 10 April 2020); MEDLINE (via OVID, 1946 to 10 April 2020); Embase (via OVID, 1974 to 10 April 2020); Cumulative Index to Nursing and Allied Health Literature (CINAHL) Plus (via EBSCO, 1937 to 10 April 2020); Database of Abstracts of Reviews of Effects (via OVID, 1991 to 10 April 2020); Web of Science core collection (which includes: Science Citation Index Expanded, 1900 to 10 April 2020; Social Sciences Citation Index, 1900 to 10 April 2020; Arts & Humanities Citation Index, 1975 to 10 April 2020; Conference Proceedings Citation Index - Science, 1990 to 10 April 2020; Conference Proceedings Citation Index - Social Sciences & Humanities, 1990 to 10 April 2020; and Emerging Sources Citation Index, 2015 to 10 April 2020); and Clinicaltrials.gov (to 10 April 2020). We used sensitive search strategies as recommended in Chapter 7 of the *Cochrane Handbook for Systematic Reviews of Diagnostic Test Accuracy* (De Vet 2013). Our search strategy included subject headings and free-text terms. We applied no language restrictions in the searches. We present the search strategies for all electronic databases in [Appendix 1](#).

Searching other resources

We handsearched reference lists of included articles and reviews, retrieved via electronic searching, for potentially eligible studies that may have been missed in the electronic database searches. We also carried out forward citation searching of relevant articles in Google Scholar and looked at the "Related articles" on PubMed.

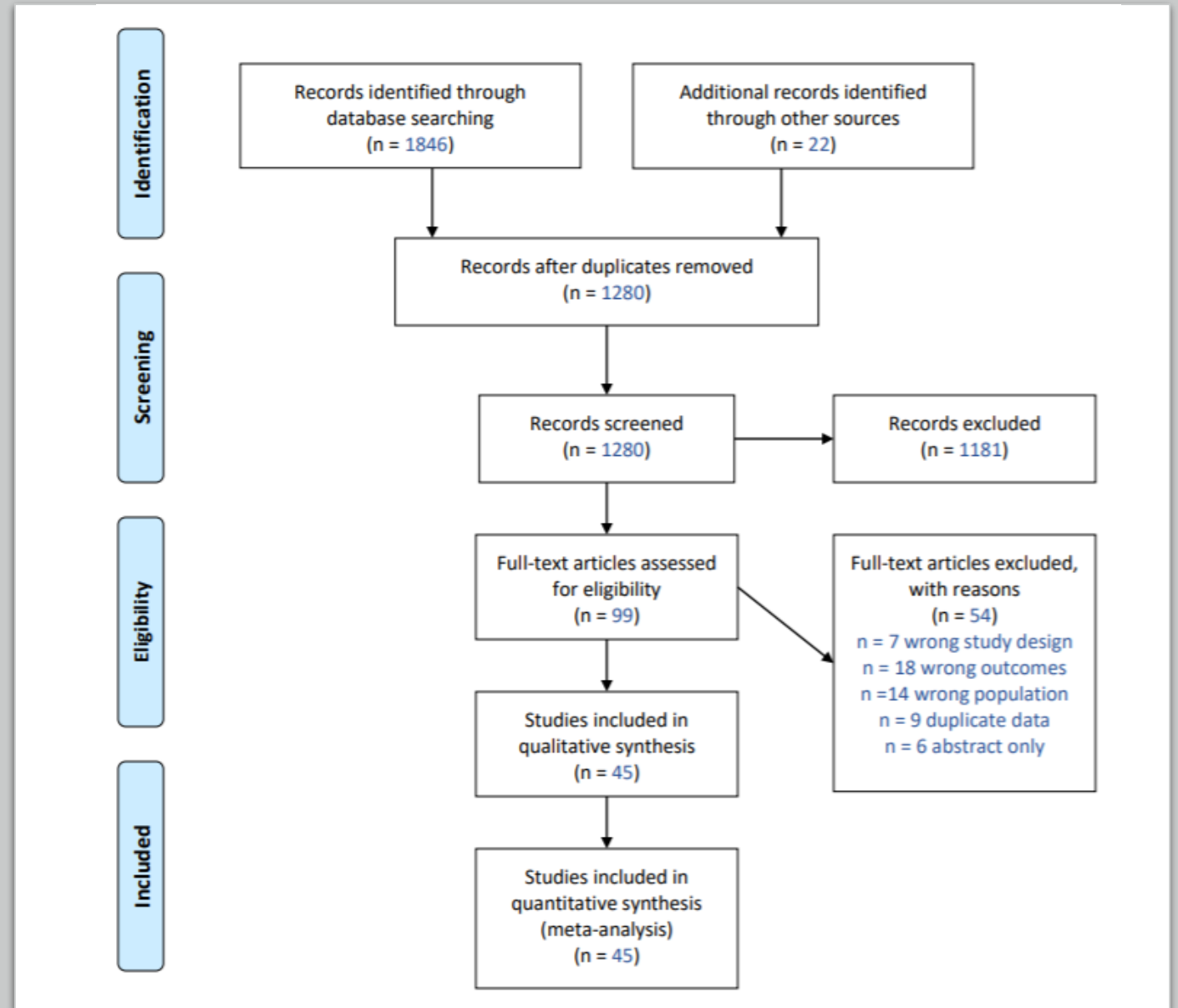
Reporting the study selection

A well-reported study selection section describes:

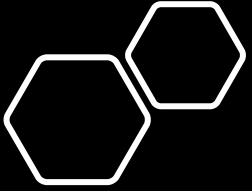
- How many reviewers were involved at each stage
- How discrepancies/conflicts were resolved
- Inter-rater agreement level
- Whether software was used to facilitate the screening process
- Includes a flow diagram

This improves transparency

Note: Refer to the [PRISMA checklist](#) for further guidance



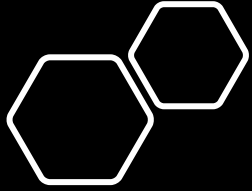
PRISMA flow diagram: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement*. [PLoS Med 6\(7\): e1000097](#). doi:10.1371/journal.pmed1000097



3 key principles for authors of SRs: Comprehensiveness

Improve **rigor/comprehensiveness** by:

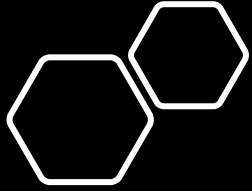
- Increasing the number of databases searched
- Improving the comprehensiveness of the search strategies used
- Using supplementary search techniques (including forwards/backwards searching, hand-searching, grey literature sources)



3 key principles for authors of SRs: Transparent & reproducible

Improve **transparency** by:

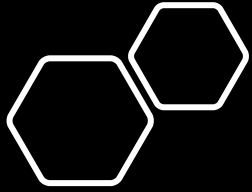
- Creating and publishing a protocol for your review before the review gets underway.
- Reporting all methods in your manuscript such that it can be replicated by following a reporting standard ([PRISMA](#) or [JARS for Meta-analysis](#))
 - Report the exact searches, list of databases, supplementary search protocols, dates of searches
 - Report the study selection process including eligibility criteria, flow diagram showing the process



3 key principles for authors of SRs: Minimizes bias

Improve **overall quality** by minimizing sources of bias:

- Using 2 coders for screening and data extraction
- Using eligibility criteria that are pre-determined, explicit, and can be justified
- Using objective criteria/tool for critical appraisal of the studies
- Including on the review team all of the requisite skills needed to create a high quality systematic review (information sciences, content expertise, methodological expertise, and statistical methods)



Suggestions for journals/editors/ reviewers of SRs

- 1) Endorse a reporting standard¹ and include that in the author guidelines
- 2) Ensure that peer review incorporates an evaluation of:
 - a) Completeness of reporting: by comparing it to a reporting guideline/ checklist such as [PRISMA](#) or [JARS for meta-analysis](#).
 - b) The methods used: by a methodologist and/or a librarian trained in systematic review methods

1- Panic, N., Leoncini, E., De Belvis, G., Ricciardi, W., & Boccia, S. (2013). [Evaluation of the endorsement of the preferred reporting items for systematic reviews and meta-analysis \(PRISMA\) statement on the quality of published systematic review and meta-analyses](#). *PloS one*, 8(12), e83138.

Resources

Buckley, P. J., Devinney, T. M., & Tang, R. W. (2013). [Meta-Analytic Research in International Business and International Management](#)'. *Philosophy of Science and Meta-Knowledge in International Business and Management* (Advances in International Management, Volume 26). Emerald Group Publishing Limited, 263-297.

Denyer, D. & Tranfield, D. (2009). [Producing a systematic review](#). In D. Buchanan & A. Bryman (Eds.), *The SAGE handbook of organizational research methods*: 671-689. London: SAGE Publications Ltd

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