Systematic Review & Meta-analysis: automation tools to help your review
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Systematic Review & Meta-Analysis: Automation tools to help your review

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What is a Systematic Review?

• Systematic review sets is a structured process to identify all data relevant to a specific research question.

• May be followed by meta-analysis, a statistical process that provides a summary estimate of the outcomes from a group of studies.
Replication Crisis?

Why – what are the causes?

- Fraud?
- False positive studies?
- Perverse incentives & publication bias?
- True psychological heterogeneity of observed effects?

"Estimating the reproducibility of psychological science", Open Science Collaboration, Science, 2015; 349(6251)
Reproducibility & Replication

Methods reproducibility
Exactly the same exp. procedures

Results reproducibility
Same methods in a new study

Robustness
Variations in baseline assumptions and experimental procedures

Goodman et al., 2016
Threats to reproducible science

Questionable Research Practices

“Manifesto for Reproducible Science”, Munafo et al., 2017
Why perform a systematic review?

- Provide an overview of available evidence
- Identify knowledge gaps
- Critical appraisal of study quality
- Identify factors influencing effects
- Inform experimental design of new studies
- Reduce waste in future research
Steps of A Systematic Review

1. Research Question
2. Protocol
3. Search Strategy
4. Study Selection
5. Data Extraction
6. Study Quality
7. Meta-Analysis
8. Publication

- Funding
- Screening for Exclusion
- Full Text Retrieval
- Screening for Inclusion
- Meta-data
- Extraction of Outcome Data
Research Question

P – Population
  – Characteristics of population
I – Intervention/Exposure
  – Intervention
C – Comparison
  – Alternative to intervention (e.g. placebo, standard care)
O – Outcome
  – Relevant outcomes (How is it measured?)
T – Type of Scenario
  – Therapy/Prevention, Diagnosis, Etiology, Prognosis
Protocol

- Research Question
- Searches & Search Strategy
- Define Inclusion & Exclusion Criteria
  - Population
  - Intervention
  - Control/Comparison
  - Type of Study
  - Primary Outcome
- Data Extraction Plan
- Quality Assessment
- Data Synthesis & Analysis Strategy
- Number of Reviewers at Each Stage

PROSPERO
International prospective register of systematic reviews
Comprehensive Search Strategy

• Ideally retrieve all relevant documents available
  - balance between sensitivity & precision

- Female AND Parkinson’s
- Woman AND Parkinsonian
Comprehensive Search Strategy

Step A: Search Components
  – Build your search
  – Are there synonyms/standardised terms?

Step B: Search Strategy
  – Where will you search?

Ask your librarian!
Why is searching properly important

Results of the search
The search strategy found 8416 references in CENTRAL, MEDLINE, EMBASE and CBLD, whose titles and abstracts were screened. 8318 references were excluded and the remaining 98 articles were retrieved for detailed evaluation. On detailed examination, we excluded 68 articles.*

* Screened 8416 articles to find 30.
Counts frequency of terms that appear in the title, abstract and keywords of relevant articles to identify search terms
Polyglot Search Translator DEMO

Translates a PubMed or Ovid Medline search to an Embase, CINAHL, PsycINFO, Scopus or Web of Science search.
Translate a PubMed search into a Cochrane Library Search

- Behaviour therapy for children with anxiety
- http://crebp-sra.com/#/polyglot
New search tool developed at the CSIRO in collaboration with CREBP
Harry Schells, Bevan Koopman and Guido Zuccon
Refining the search

664 citations retrieved
10 citations relevant
10 citations relevant retrieved
help?
Search refined

137 citations retrieved
10 citations relevant
10 citations relevant retrieved
help?
Deduplication

- Systematic Review Accelerator (crebp-sra.com)
- Endnote

Rathbone et al. Systematic Reviews 2014, 46
http://www.systematicreviewsjournal.com/content/4/1/6

Better duplicate detection for systematic reviewers: evaluation of Systematic Review Assistant-Deduplication Module

John Rathbone*, Matt Carter, Tammy Hoffmann and Paul Glasziou
Study Selection

• “The criteria used for including and excluding studies form the operational definition of the problem.” Abrami et al., 1988

• Research question
• Study design
• Adequate data to extract meaningful information from
• Ambiguous methods/ methodological quality

• Often conducted in two stages: (e.g. title & abstract, then full text)
  1. Liberally applied to ensure relevant studies are included & no study is excluded without thorough evaluation
  2. More thorough application
Screening Tools

Tools to help speed up this process:

- SyRF (SyRF.org.uk)
- SRA Helper (CREBP-SRA.com)
- Large systematic reviews (> 10,000 studies retrieved) - machine learning algorithms
Screening Tools DEMO

- App.syrf.org.uk

- [http://app.syrf.org.uk/projects/e45eb265-1a84-459d-9eb4-aa630d828659/detail](http://app.syrf.org.uk/projects/e45eb265-1a84-459d-9eb4-aa630d828659/detail)
Full text PDF retrieval

1. Endnote (find full text)
2. SRA Helper search
3. SRA PDF requestor (Bond only at the moment)

- https://www.dropbox.com/sh/w43a46fe6irtfdp/AAB3MmR4iLJFFlyDGtN2Rrd1a/EndNote%20Helper%20demonstration.wmv?dl=0

Ask your librarian!
Data Extraction

- Key study characteristics
  - Participants: Gender, Age, Level of Education
  - Length of follow up, number of times the outcome was assessed
  - How outcome was assessed? (e.g. Big 5, Myers-Briggs, Revised NEO)
- Meta-Analysis?
  - Effect size data
    - Correlation
    - Mean difference
    - Binary/dichotomous data
Data Extraction from Text, Tables & Graphs

- Tables & Text
- Graphs:
  - Universal Desktop ruler
  - Webplotdigitizer
- StatCheck ([http://statcheck.io](http://statcheck.io))
  - Looks for statistical reporting in articles in APA format → Excel spreadsheet of reported values and errors
Where will you store your data?

- SyRF (SyRF.org.uk)
- RevMan
- MS Access
Why assess study quality?

• Low methodological quality can cause bias in the study results
  ➢ Leads to an over- or under-estimation of true treatment effect

• The conclusions from your SR depend on the quality of the included studies!
Assessing External Validity

• What factors are necessary to generalise the study results to other populations/patients/studies:
  – Participant characteristics (gender, age ..)
  – Intervention characteristics (timing, mode of delivery, intensity)
  – Modalities of outcome measure (how assessed, type, duration of follow-up..)
<table>
<thead>
<tr>
<th>Type of Bias</th>
<th>Description</th>
<th>Reduced By..</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection Bias</td>
<td>Systematic difference in baseline characteristics of groups at baseline</td>
<td>Allocation Concealment Randomisation</td>
</tr>
<tr>
<td>Performance Bias</td>
<td>Systematic differences between groups in exposure to factors other than intervention of interest</td>
<td>Blinding Randomisation</td>
</tr>
<tr>
<td>Detection Bias</td>
<td>Systematic differences between groups in how outcomes are determined</td>
<td>Blinding Randomisation</td>
</tr>
<tr>
<td>Attrition Bias</td>
<td>Systematic differences between groups in the way drop-outs are handled</td>
<td>Reporting of Drop-outs</td>
</tr>
</tbody>
</table>
Risk of Bias Checklists

- **EQUATOR Network**
- Cochrane Risk of Bias (for controlled trials)
- Risk Of Bias In Non-Randomized Studies - of Interventions: (Sterne et al., 2016)
- Transparent Reporting of Evaluations with Nonexperimental Designs: (Des Jarlais et al., 2004; CDC)
- Checklist for Reporting Results of Internet E-Surveys: (Eysenbach et al., 2004)
- Self-Report Data: (Stone & Shiffman, 2002)
- Qualitative Research: (Elliott, Fischer & Rennie, 1999)
- Mixed Research: (Leech & Onwuegbuzie, 2010)
Meta-Analysis

1. Check for homogeneity of included studies
2. Assemble relevant study data
3. Choose an effect size measure
4. Calculate the effect size for each study
5. Choose random or fixed effects model
6. Specify subgroups (if applicable)
7. Calculate the summary effect (per subgroup and overall)
8. Interpret results
9. Sensitivity analysis
10. Check for presence of publication bias
Meta-Analysis

• RevMan
  – RevMan Replicant
• PRISMA
• MOOSE (observational studies)
• JARS & MARS (APA)

Preferred Reporting Items for Meta-Analyses: The PRISMA

David Moher\textsuperscript{1,2*}, Alessandro Liberati\textsuperscript{3,4}, Jennifer Te
tlow-Jones\textsuperscript{1,5}, Natalie J. Shek\textsuperscript{6,7}, Gwendolyn L. Sugrue\textsuperscript{8}, Florencia Saunder\textsuperscript{9}, Silvia M. outreach\textsuperscript{10,11}, Universidad de la República, Montevideo, Uruguay, 7 Máximo Kirchner Hospital, Buenos Aires, Argentina, 8 University of Waterloo, Waterloo, Canada, 9 Centre for Health Evidence, St Joseph's Healthcare, Hamilton, Canada, 10 Queen Elizabeth II Health Sciences Centre, Halifax, Canada, 11 Memorial University of Newfoundland, St John's, Canada.
• Study protocol
  – Prospero
  – Publish

• Literature search
  – Librarian
  – Pubmed/Embase/PsychINFO

• Deduplication
  – SRA Deduplicator

• Screening
  – SyRF
  – Endnote Helper

• Retrieve pdfs
  – Endnote

• Extraction
  – SyRF

• Quality Assessment
  – Risk of Bias checklist

• Meta-analysis per study protocol
  – Borenstein et al 2009
  – STATA/R/SAS
  – RevMan

• Drafting of manuscript
  – PRISMA
Interested in using these free tools for your systematic review?

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