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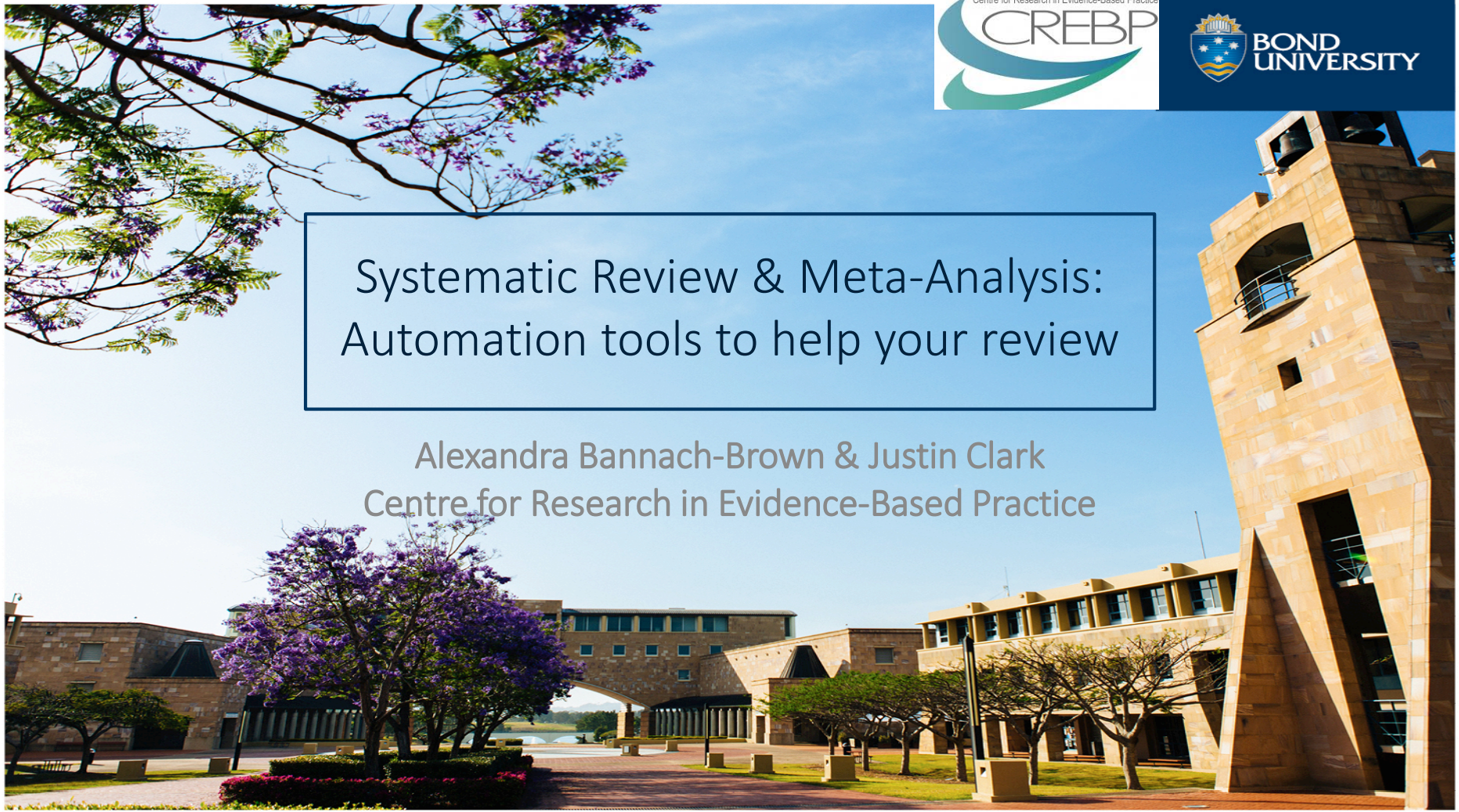


Systematic Review & Meta-Analysis: Automation tools to help your review

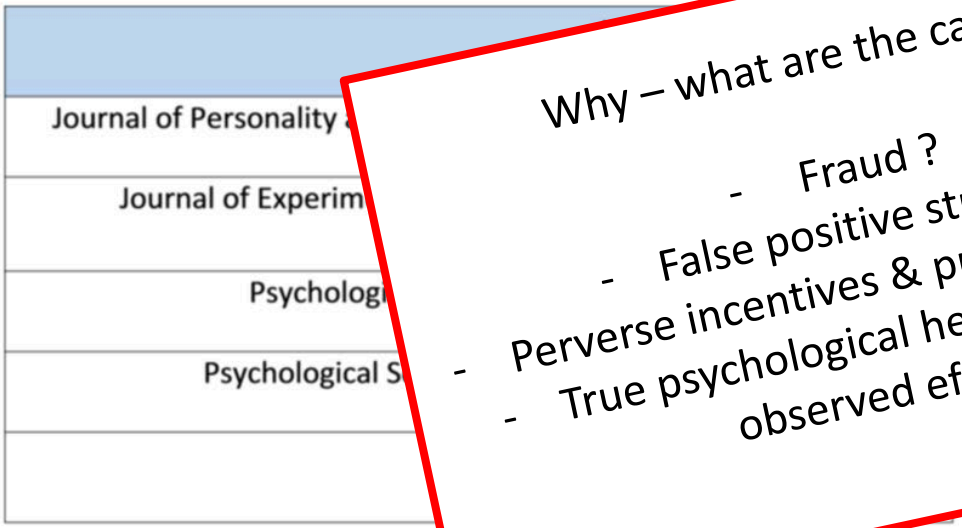
Alexandra Bannach-Brown & Justin Clark
Centre for Research in Evidence-Based Practice

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 ?

verage
roscience
powered
en 8-31%
t al., 2013)

"Reproducibility in Science", Begley & Ioannidis, Circulation Research. 2015;116:116-126
"Estimating the reproducibility of psychological science", Open Science Collaboration, Science, 2015; 349(6251)

Reproducibility & Replication

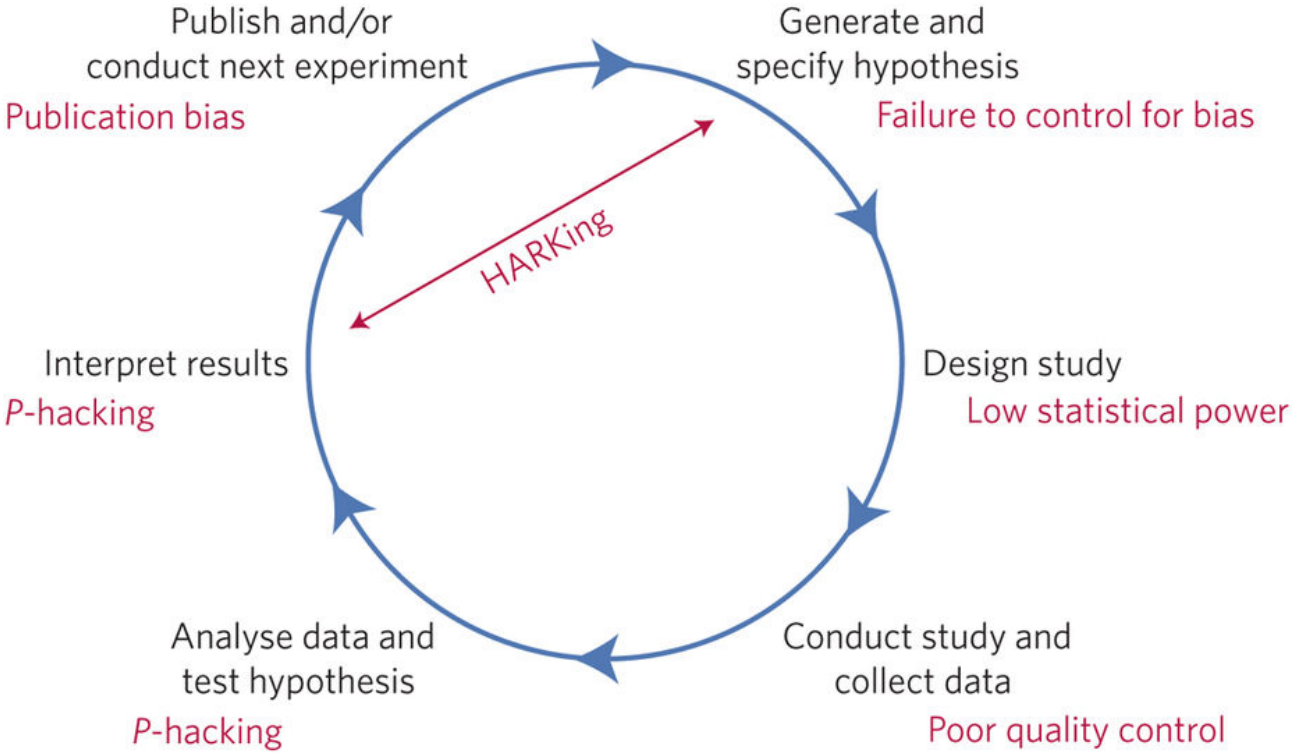
Exactly the same exp. procedures

Same methods in a new study

Variations in baseline assumptions and experimental procedures

Goodman et al., 2016

Threats to reproducible science



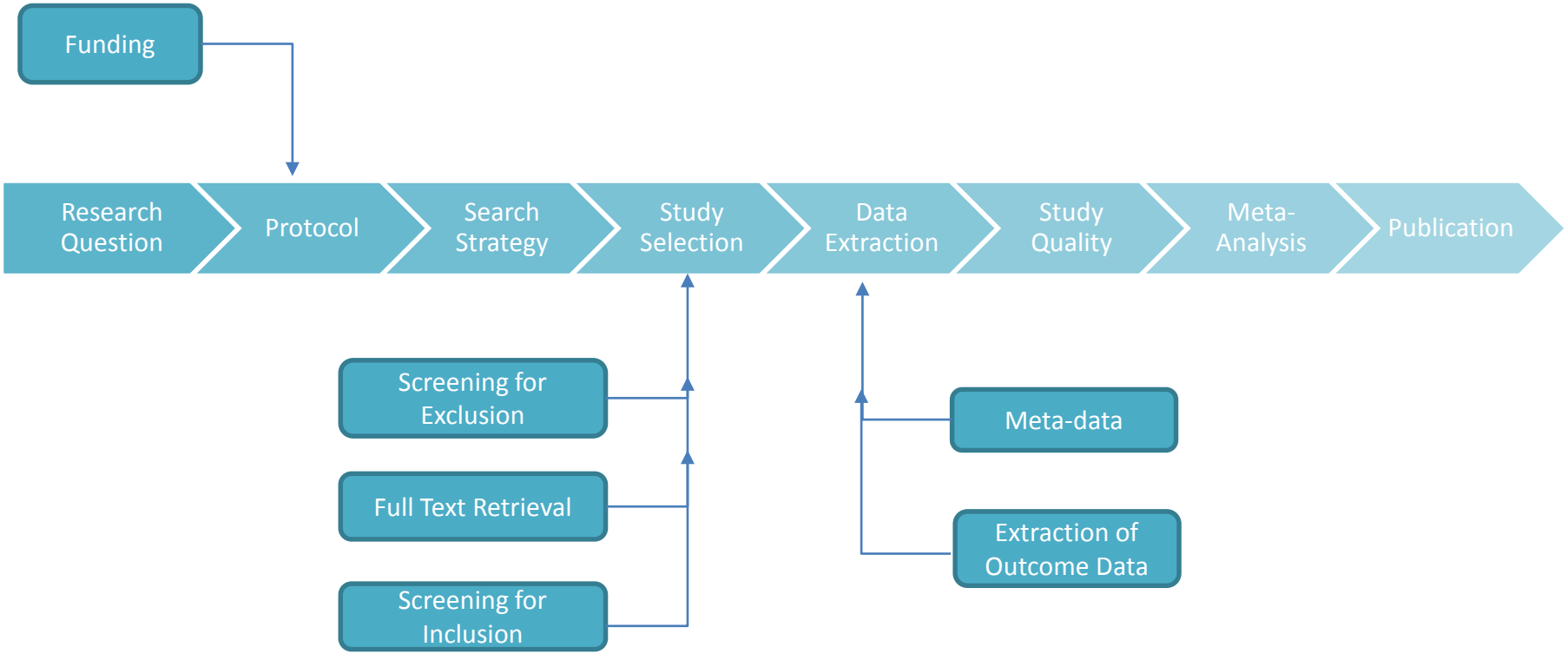
Questionable Research Practices

"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



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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

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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

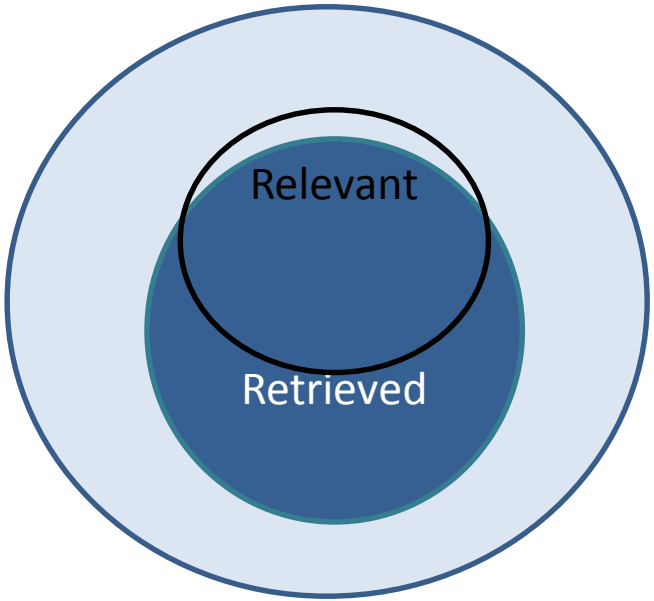
PROSPERO

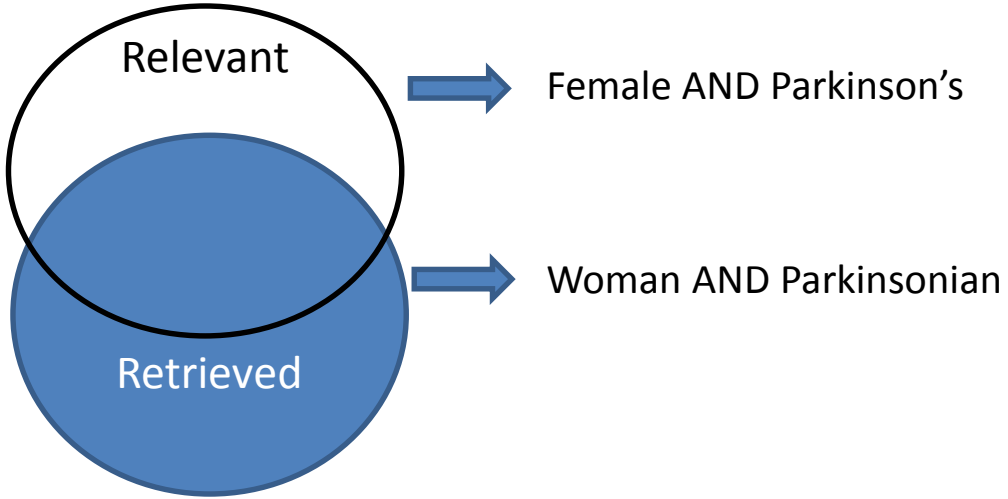
International prospective register of systematic reviews

Research Question
Protocol
Search Strategy
Study Selection
Data Extraction
Study Quality
Meta-Analysis
Publication

Comprehensive Search Strategy

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

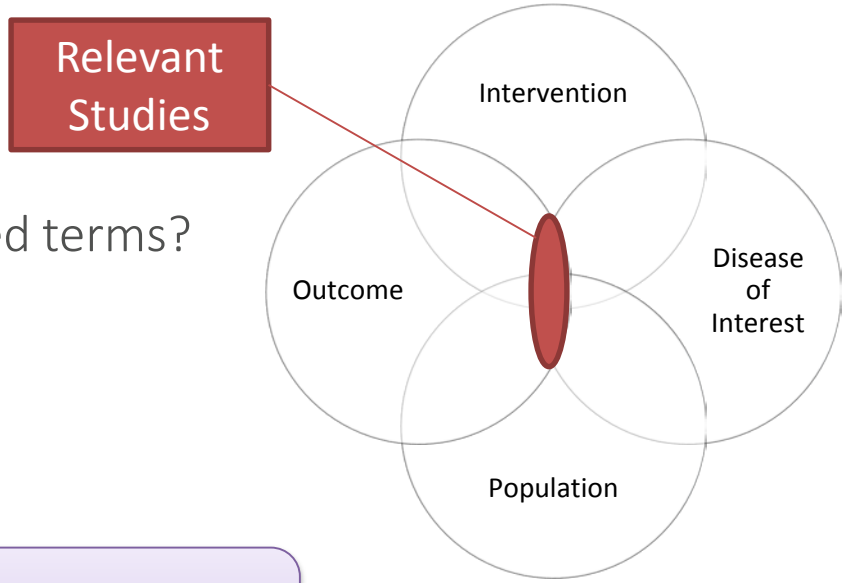




Comprehensive Search Strategy

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

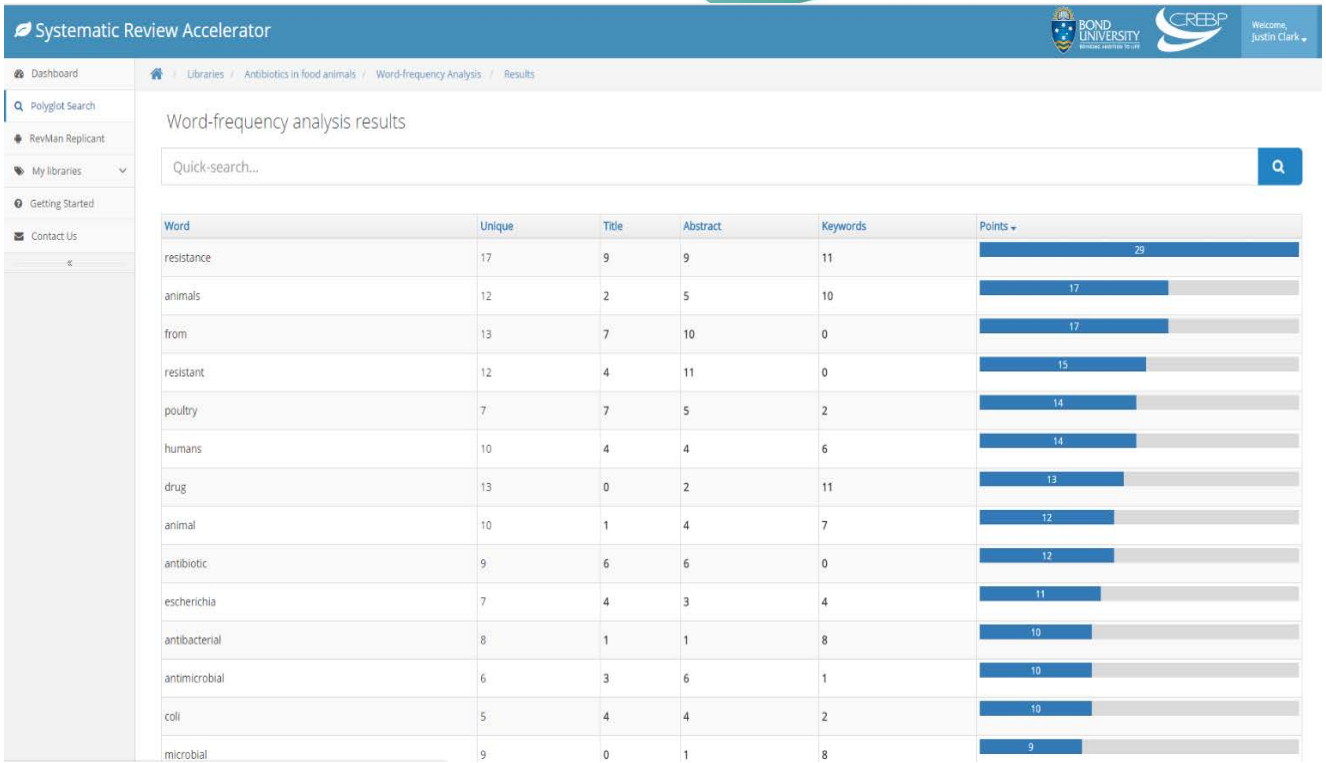
Results of the search

*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**.

Search building

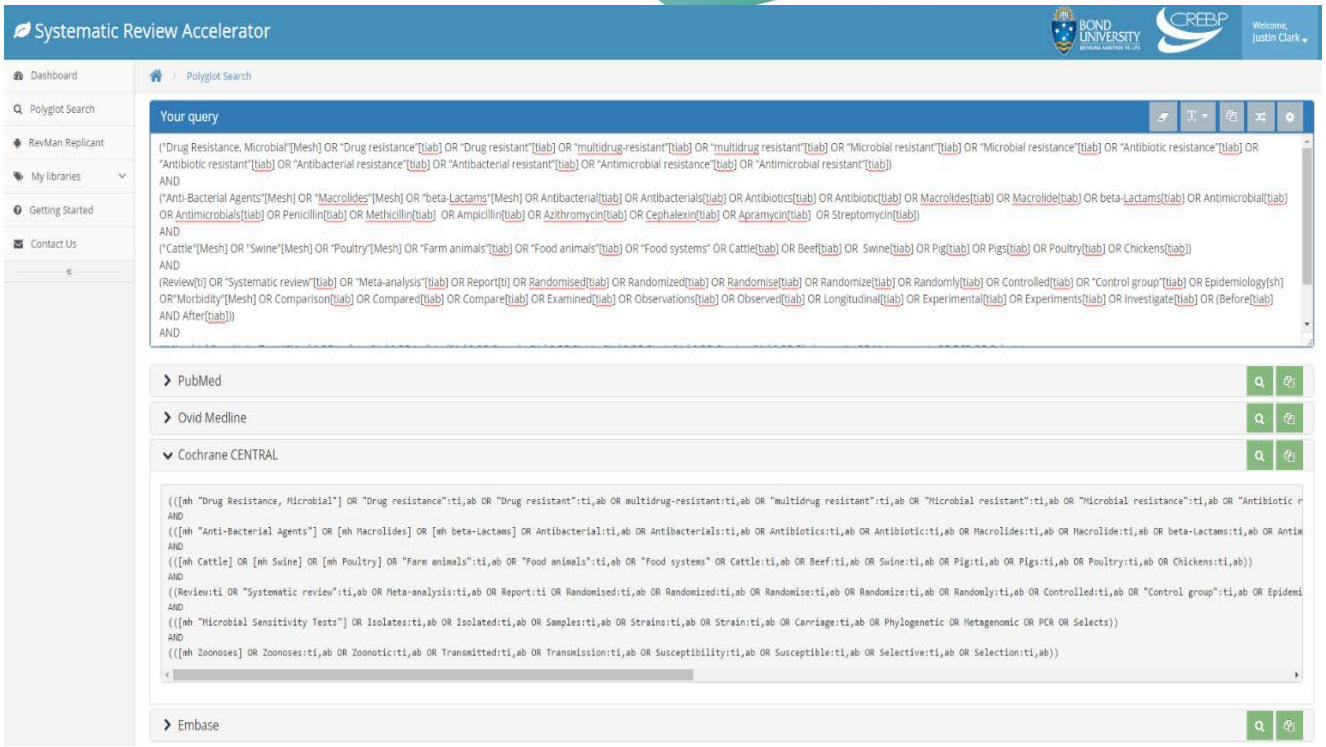
Counts frequency of terms that appear in the title, abstract and keywords of relevant articles to identify search terms



Word	Unique	Title	Abstract	Keywords	Points
resistance	17	9	9	11	29
animals	12	2	5	10	17
from	13	7	10	0	17
resistant	12	4	11	0	15
poultry	7	7	5	2	14
humans	10	4	4	6	14
drug	13	0	2	11	13
animal	10	1	4	7	12
antibiotic	9	6	6	0	12
escherichia	7	4	3	4	11
antibacterial	8	1	1	8	10
antimicrobial	6	3	6	1	10
coli	5	4	4	2	10
microbial	9	0	1	8	9

Polyglot Search Translator DEMO

Translates a PubMed or Ovid Medline search to an Embase, CINAHL, PsycINFO, Scopus or Web of Science search



Search Translator Activity

Translate a PubMed search into a Cochrane Library Search

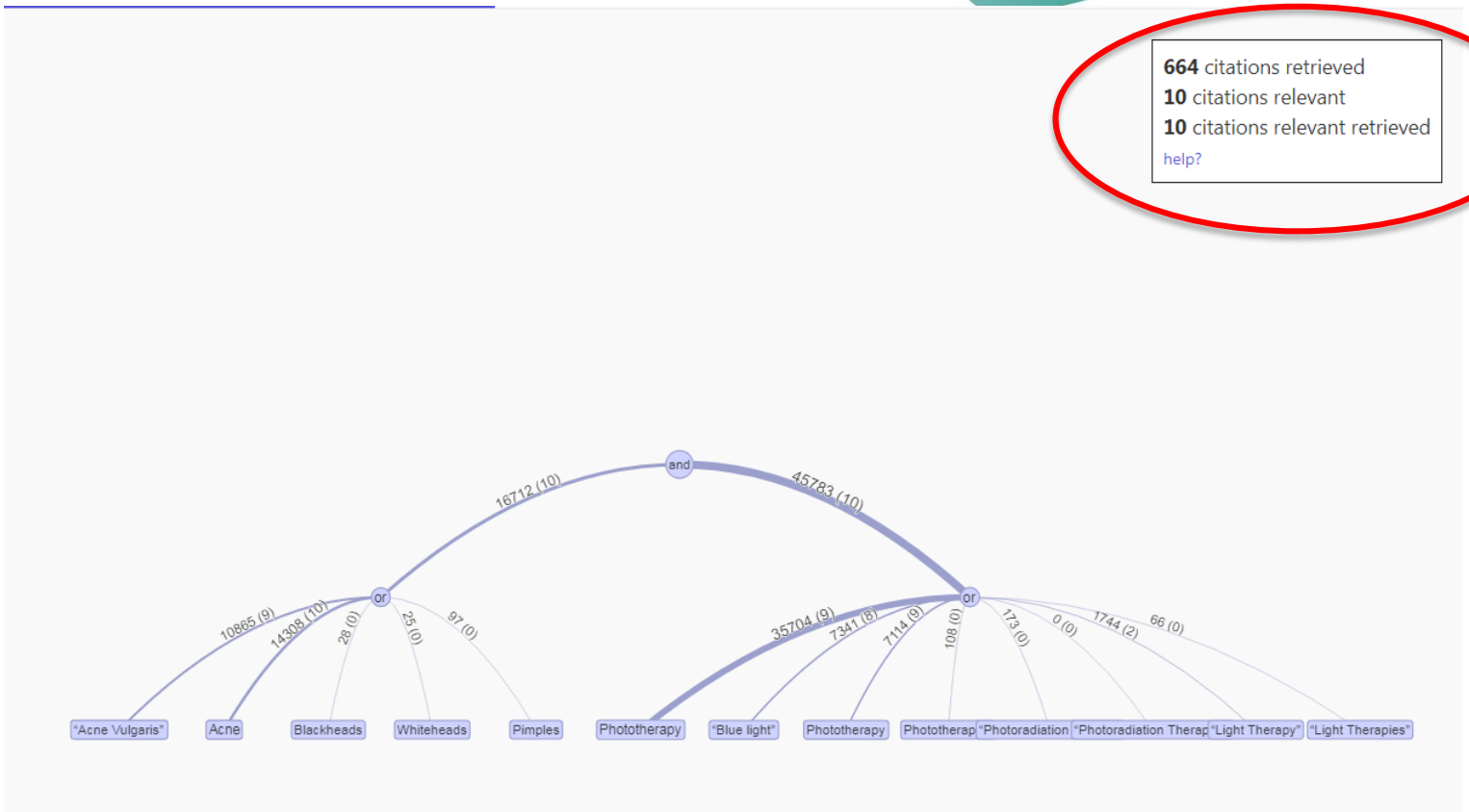
- Behaviour therapy for children with anxiety
- http://crebp-sra.com/#/polyglot

Search refinement tool

New search tool developed at the CSIRO in collaboration with CREBP

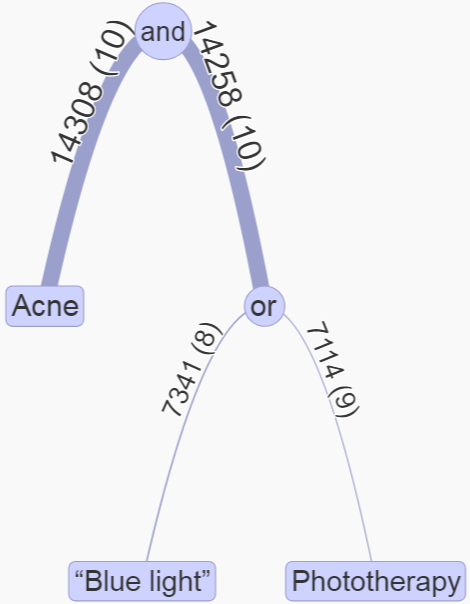
Harry Schells, Bevan Koopman and Guido Zuccon

Refining the search



Search refined

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



Deduplication

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

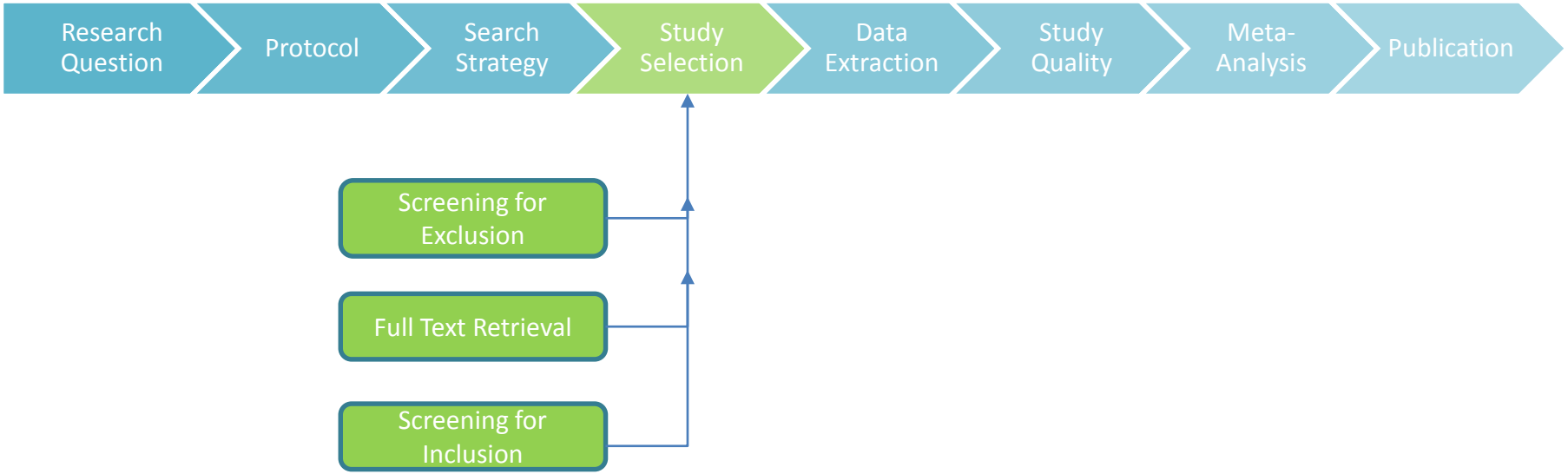
Rathbone *et al. Systematic Reviews* 2014, **4**:6
http://www.systematicreviewsjournal.com/content/4/1/6

SYSTEMATIC REVIEWS

RESEARCH Open Access

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

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


Research Question
Protocol
Search Strategy
Study Selection
Data Extraction
Study Quality
Meta-Analysis
Publication
Screening for Exclusion
Full Text Retrieval
Screening for Inclusion

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

Prespecified

Screening Tools

Tools to help speed up this process:

- SyRF (SyRF.org.uk)
- SRA Helper (CREBP-SRA.com)

SYSTEMATIC Review Facility

Systematic Review Accelerator

- 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

Full text PDF retrieval

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

Ask your librarian!

- https://www.dropbox.com/sh/w43a46fe6irtfdp/AAB3MmR4ilJFFIyDGtN2Rrd1a/EndNote%20Helper%20demonstration.wmv?dl=0

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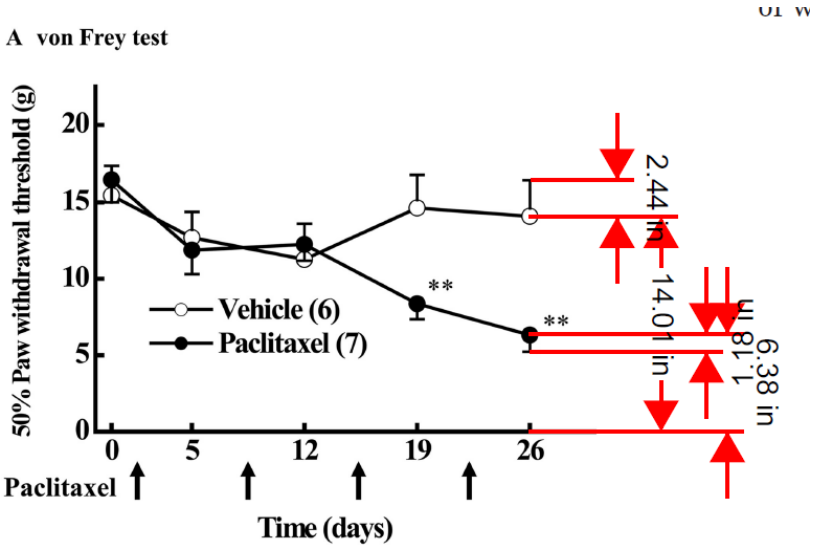
Data Extraction

- 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

Prespecified

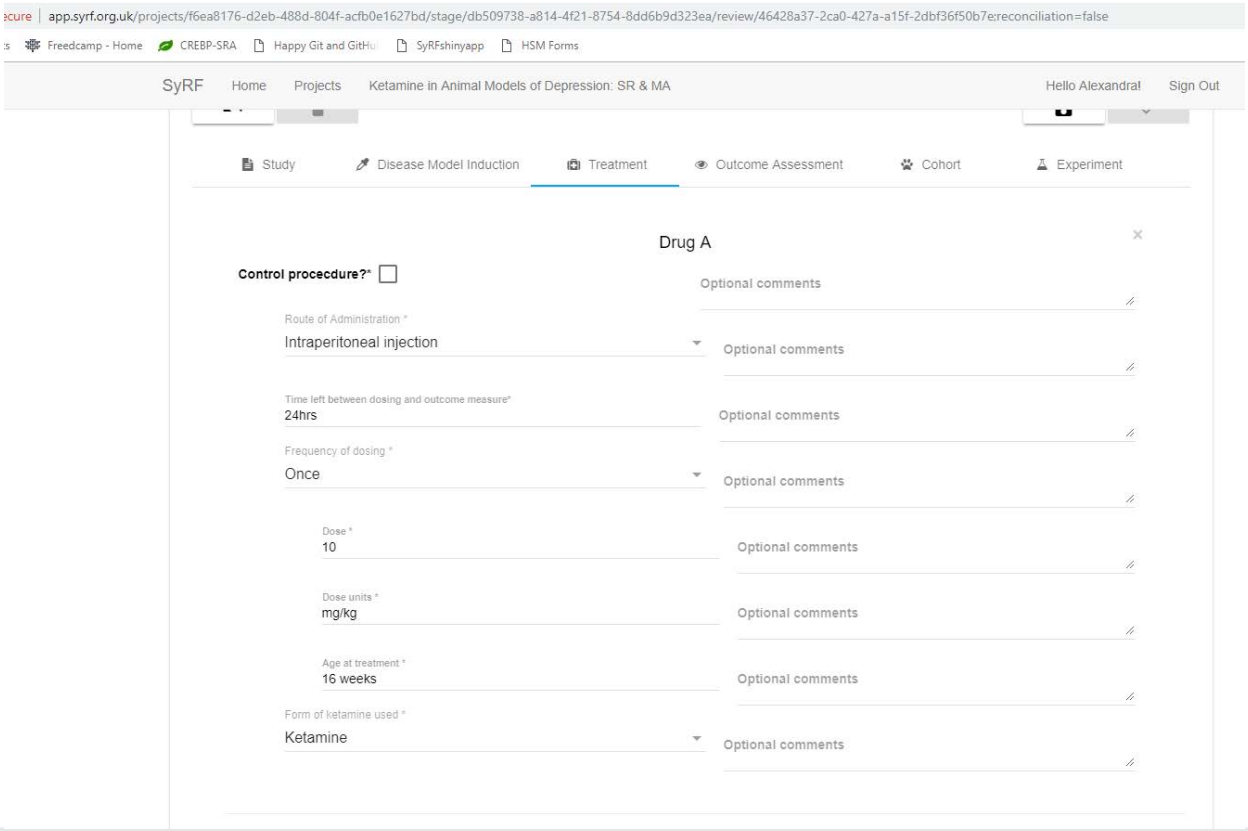
Data Extraction from Text, Tables & Graphs

- Tables & Text
- Graphs:
  - Universal Desktop ruler
  - Webplotdigitizer
- StatCheck (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



Research Question
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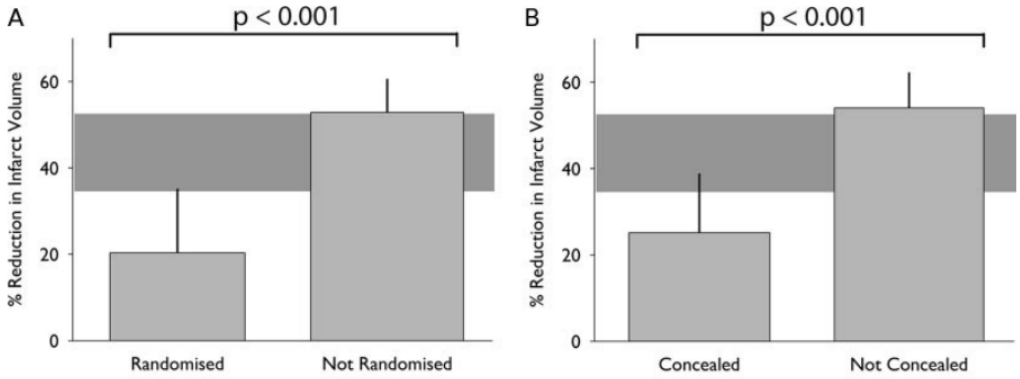
Why assess study quality?

- 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..)

Internal Validity

Type of Bias	Description	Reduced By..
Selection Bias	Systematic difference in baseline characteristics of groups at baseline	Allocation Concealment Randomisation
Performance Bias	Systematic differences between groups in exposure to factors other than intervention of interest	Blinding Randomisation
Detection Bias	Systematic differences between groups in how outcomes are determined	Blinding Randomisation
Attrition Bias	Systematic differences between groups in the way drop-outs are handled	Reporting of Drop-outs

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)

Prespecified

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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

Prespecified

Meta-Analysis

- RevMan
  - RevMan Replicant
  - https://www.dropbox.com/s/my1kudy0ciw210j/Replicant%20tutorial_Aug18.mov?dl=0

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Publication

- PRISMA
- MOOSE (observational studies)
- JARS & MARS (APA)

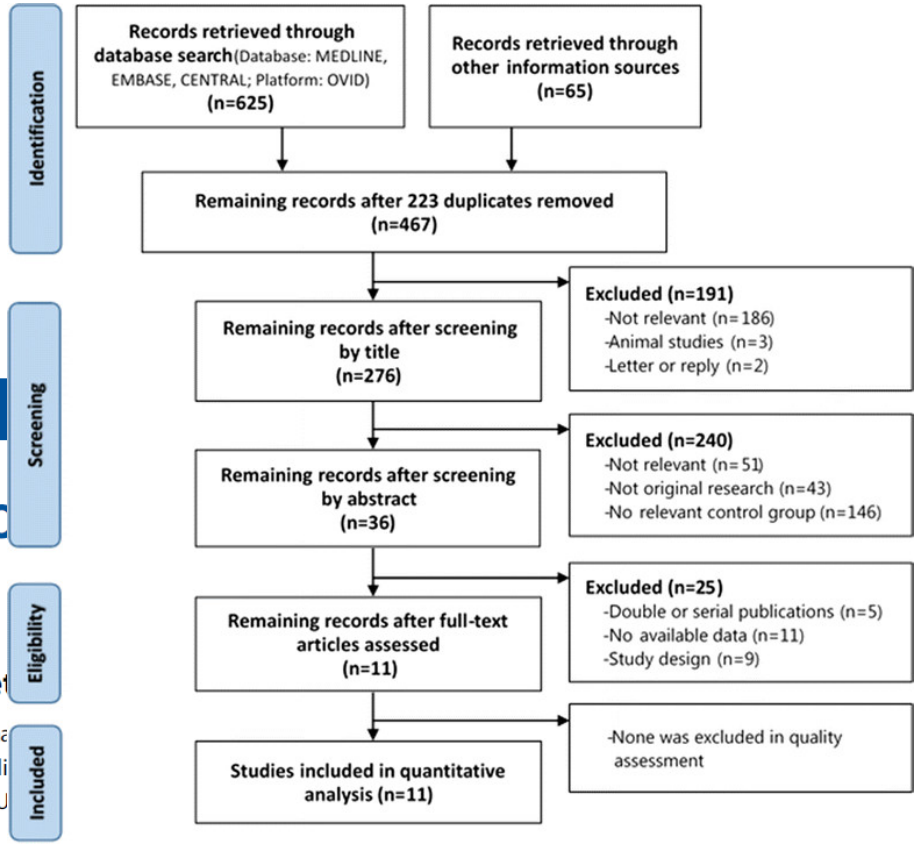
OPEN ACCESS Freely available online

Guidelines and Guidance

Preferred Reporting Items fo
Meta-Analyses: The PRISMA

David Moher[1,2]*, Alessandro Liberati[3,4], Jennifer Tet

1 Ottawa Methods Centre, Ottawa Hospital Research Institute, Ottawa, Ontario, Cana
University of Ottawa, Ottawa, Ontario, Canada, **3** Università di Modena e Reggio Emili
Negri, Milan, Italy, **5** Centre for Statistics in Medicine, University of Oxford, Oxford, U



Resources

- 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?

Contact:

- Alexandra Bannach-Brown – Research Fellow (alexandra_bannachbrown@bond.edu.au)
- Justin Clark - Senior Research Information Specialist (jclark@bond.edu.au)

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