Classical meta-analysis for a binary outcome

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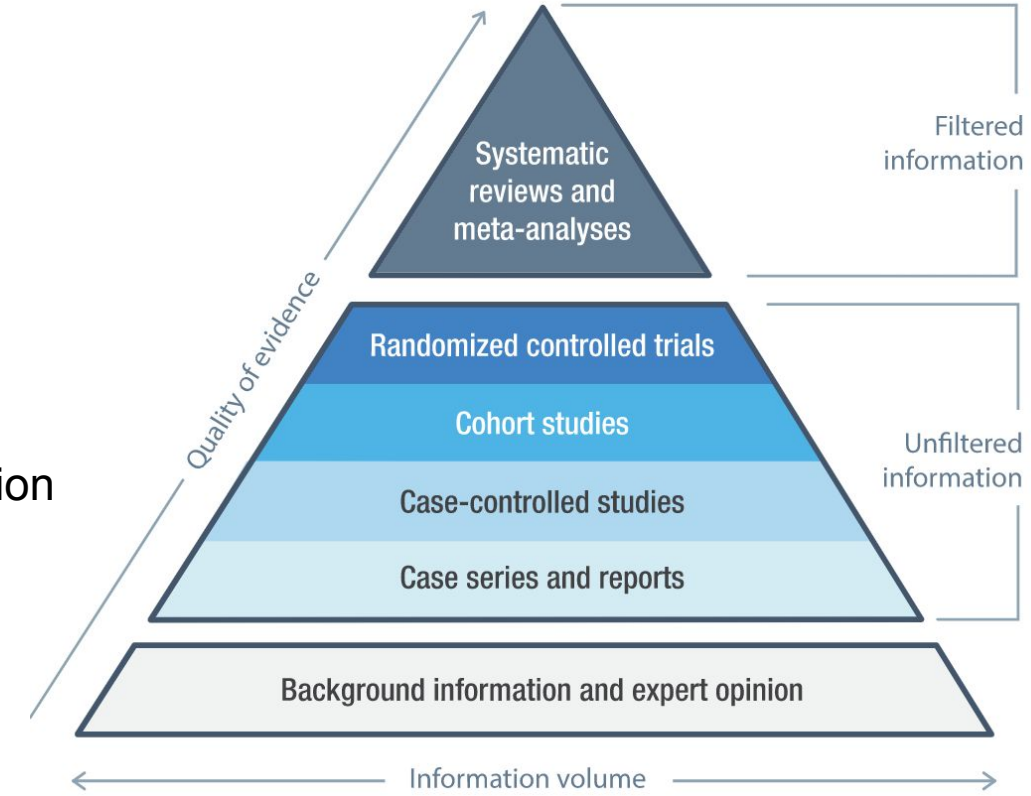
Meta-analysis overview

- Meta-analysis is:
  1. the **statistical combination** of results
  2. from two or more **separate studies** addressing
  3. the **same (specific) research question**.

- Usually part of **systematic reviews**

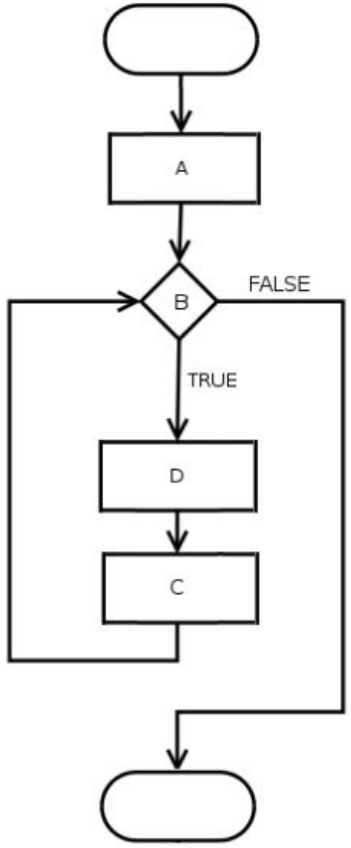
- **Plus**: Highest quality of evidence, settling conflicts, precision

- **Minus**: Systematic bias e.g. through publication bias



Meta-analysis process

1. **Question** formulation
2. **Literature** research
3. **Studies** selection
4. Definition which dependent variables (**effect measures**) to evaluate
5. Meta-analysis model selection
   a. **Fixed effect model**
      – Assumes homogeneity
   b. **Random effects model**
      – For heterogeneous research
6. Investigate between-study **heterogeneity**



Aim: Derive **pooled estimate** of the unknown common truth

Classical meta-analysis methods for binary outcomes - Fixed effects

Assumption: Intervention Effects are the same (heterogeneity ignored)

1. **Inverse Variance method:** weighted average = $\frac{\sum_i Y_i(1/SE_i^2)}{\sum_i(1/SE_i^2)}$ with Y_i = Effect measures (OR/RR…)

2. **Mantel-Haenszel method**
   - Differential weighting, dependent which effect measure used
   - Good for sparse data

3. **Peto odds ratio method**
   - Uses approximation methods to estimate log(OR), only for odds ratio
   - Good if intervention effects are small

Classical meta-analysis methods for binary outcomes - Random effects

Assumption: intervention effect follows (usually) normal distribution (heterogeneity incorporated)

- Commonly used (classical) method: **DerSimonian and Laird method** (Effects related, normal dist.)
- **Fixed vs Random?** Many considerations, pragmatic approach: Do both
- **Measure of heterogeneity:** $I^2 = \frac{Q - df}{Q} \times 100\%$
- Results of Random-effects method and the fixed-effect method are **identical** when there is no heterogeneity

Comparison to Bayesian approaches

Likelihood **combines** data from studies included in the meta-analysis and the meta-analysis model, parameters are estimated via MCMC

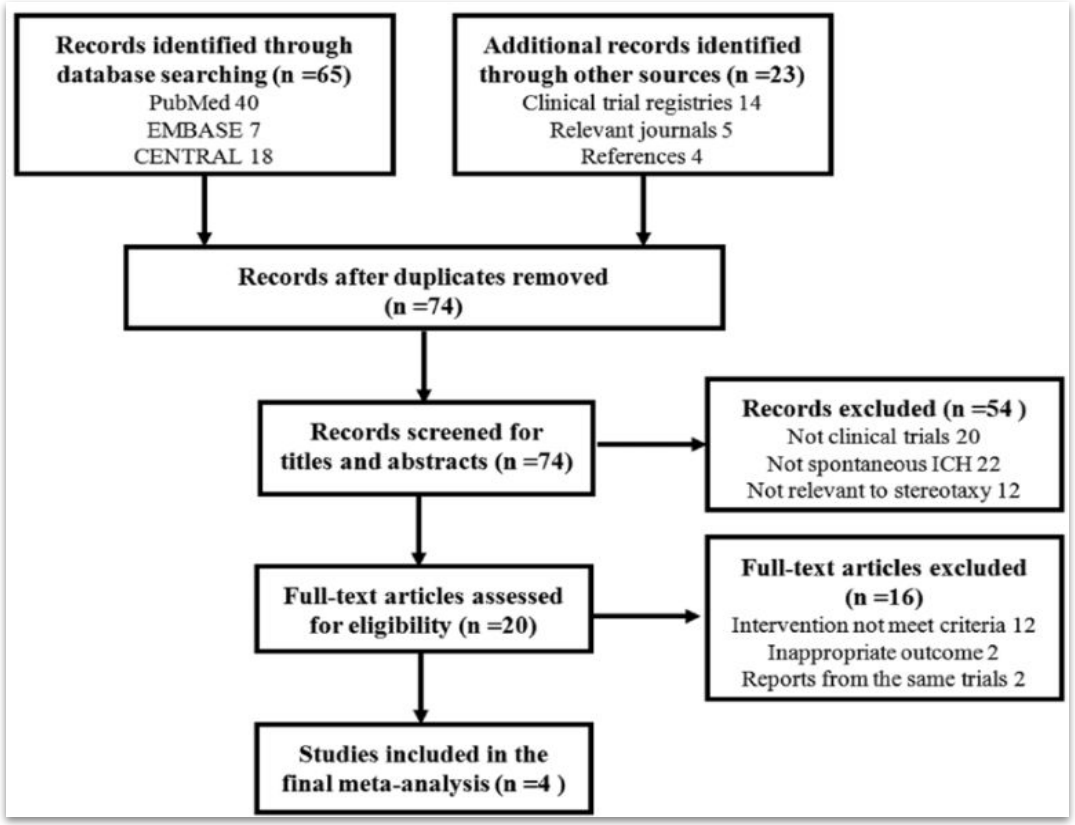
Potential **advantages** for Bayesian approaches:

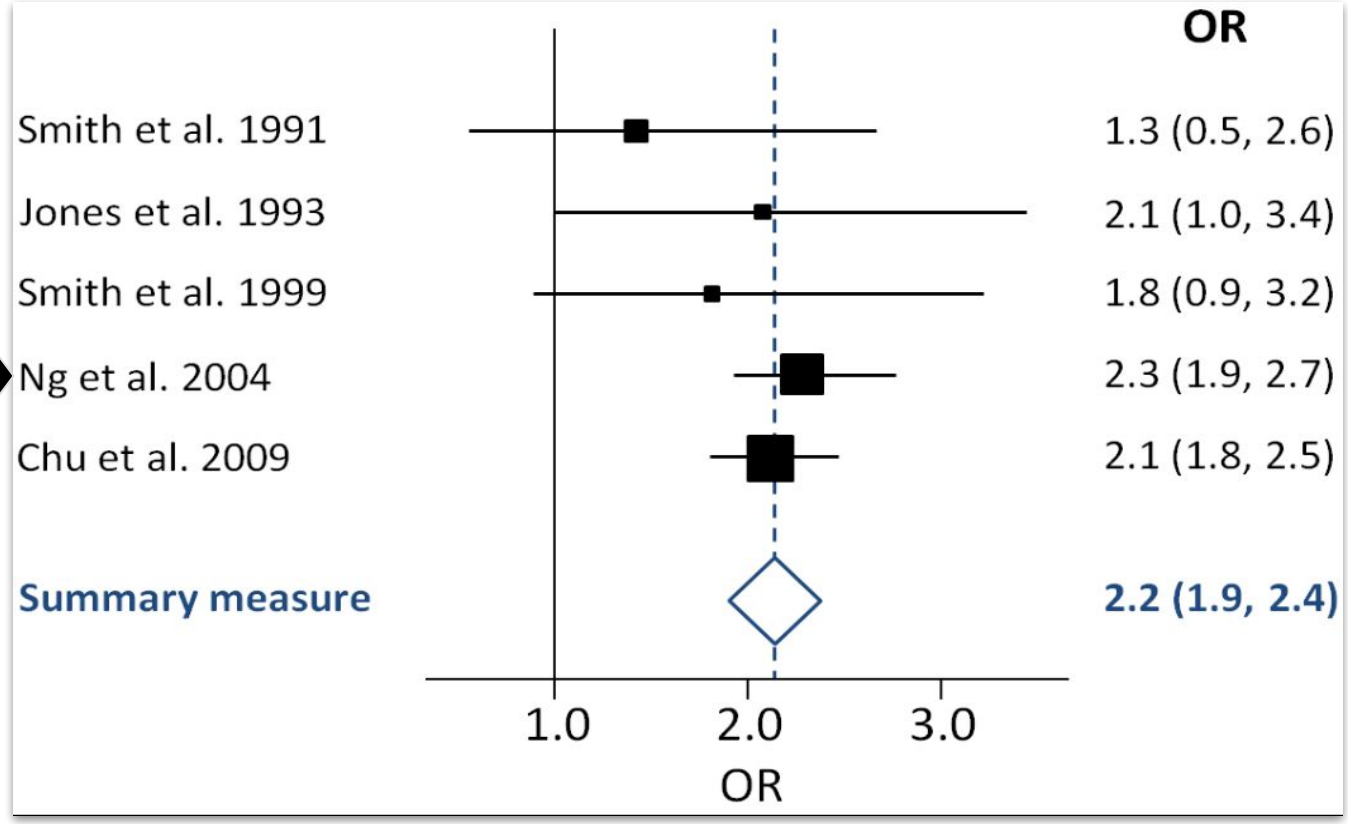
1. Easier **interpretation**
2. Easier **decision making** (possible to calculate the probability of a range for the effect estimate)
3. **Complex** analysis (network meta-analysis)
4. …

However, specific choices of prior distributions influence results

➢ **Use uninformative priors**
➢ **Sensitivity analysis** should be made (repeat meta-analysis only with subset of known, eligible studies)

Appendix: Meta-analysis from input to output





References

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