Common pitfalls of statistics: the myths of systematic review and meta-analysis

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Myth 1: Meta-analysis and systematic review are the same thing.

Reality: A systematic review is a review conducted with an objective and transparent approach for research synthesis in order to minimize bias. Systematic review usually combines the results from individual primary studies by a statistical method called quantitative meta-analysis. However, it is not always true. A systematic review can have no meta-analysis conducted. Moreover, systematic review can synthesize the conclusion using alternative methods such as qualitative synthesis.

Myth 2: Systematic review is the highest level of evidence.

Reality: Only the systematic review of randomized control trials is considered the highest level of evidence in the hierarchy of evidence. The systematic review of observational studies (such as the synthesis of result from case controlled studies) is NOT a good quality evidence because it is also prone to selection bias or confounding bias.

Myth 3: The sole objective of systematic review is number crunching.

Reality:
Not true
The objectives of systematic review should include

1. Locating nearly all studies on the topic. (formulate a reasonable search strategy, search multiple database, hand search, search non-English databases, inclusion of grey literature such as conference abstract and pharmaceutical company reports....)
2. Systematically screen and evaluate each piece of evidence
3. Quantify the quality of included studies
4. Evaluation of heterogeneity
5. Bias detection (e.g. publication bias)

Myth 4: Systematic review is easy.

Reality: If the sole purpose of systematic review is data synthesis, it is true, i.e. just search PubMed to gather some papers and try to extract their odds ratio and combine them). As stated in Myth 2, there is multiple purposes for a systematic review. Data collection for systematic review is laborious to minimize the bias.

Another challenge is to have an appropriate statistical support because the actual statistical analysis of meta-analysis might not be known to all statisticians.

Myth 5: Many primary studies are required to conduct a meta-analysis.

Reality: Meta-analysis can be conducted using only one primary study but the results is meaningless. (No combination) Theoretically, combination of results can be done using only two studies but the added value would be minimal. The average number of primary studies included in Cochrane review is six.

Myth 6: Any values with standard error can be combined by using meta-analysis.

Reality: Some values such as odds ratio, rate, ratio, standardized mean difference, likelihood ratio are extensively studied for meta-analysis. However, some values such as number need to treat do not have the statistical property for being an optimal choice to combine. Risk difference (RD) as a candidate for meta-analysis is still controversial. Please consult a statistician.

Myth 7: For meta-analysis, we should use the traditional cut-off point of alpha equal to 0.05.

Reality: There is a very common misconception that the unit of statistical analysis in meta-analysis is the aggregated subjects in each primary studies. However, the actual unit of analysis is the effect size of each primary studies. Therefore, the sample size for a meta-analysis is usually very small, for example, if a meta-analysis only included 5 studies, the total sample for that particular meta-analysis is only 5! It is generally recommend to relax the critical value of alpha to 0.10 in order to reduce the possibility of type II error.

Answers to Radiological Quiz on page 15

Answer:

1) Enlarged mediastinum

2) Lymphoma

3) CT scan thorax and biopsy under airway protection.
   - Anterior mediastinal syndrome is an uncommon but life-threatening paediatric oncology emergency.
   - High suspicious of superior mediastinal syndrome is needed.
   - Watch out for signs and symptoms of airway obstruction, superior vena cava syndrome in any patient presented of a large neck mass and look for any mediastinal mass.