

Critical Appraisal Course for Emergency Medicine Trainees

Module 1

Concepts and Definitions

Concepts and Definitions

- What is a hypothesis?
- Validity and generalisability
- Chance, bias and confounding
- Accuracy and precision
- Efficacy and effectiveness
- Pragmatic and explanatory research

What is a hypothesis?

- Research involves trying to answer a question
- Quantitative research will usually test a hypothesis
- A hypothesis is a prediction
- Observation or experimentation determines whether the prediction is likely to be true

Validity and Generalisability

- Validity means is this true?
- Generalisability means does this apply elsewhere?
- Assess validity first because there is no point generalising an invalid finding
- Study design may involve a trade-off between validity and generalisability

Threats to Validity

- Chance is random variation leading to imprecision
- Bias is systematic variation leading to inaccuracy
- Confounding is an error of interpretation

The role of chance

- Most systems are subject to variation
- Events may occur due to a wide range of unknown or unmeasured factors
- Some outcomes may simply be due to chance
- Ascribing a finding to a particular cause, when it is actually due to chance, is known as a random error

Random error

- Statistics (p values and confidence intervals) are used to estimate the probability of a random error
- Depends upon: 1) The amount of variation in the measurement, and 2) The number of observations made (the sample size)
- Random error determines precision
- The larger the sample size, the more precise the results will be

Bias

- Systematic error in the way the observations were made or the experiment carried out
- Systematic error determines accuracy
- Bias leads to inaccuracy
- Many type of bias have been described

Types of Bias

- Selection bias
- Measurement bias
- Analysis bias
- Population bias
- Intensity bias
- Provider bias

Types of bias

Understanding how bias works and how it may lead to inaccuracy is more important than putting a name to the type of bias

Confounding

- Confounding is an error of interpretation
- Results may be accurate and precise, but if they are misinterpreted a false conclusion may be drawn
- A confounder is an extraneous factor which affects outcome, whose distribution is not taken into account leading to bias and invalid inferences

Known and unknown confounders

- If confounders are known we can adjust for them in the analysis
- Common confounders are age, gender, smoking and socio-economic status
- But we cannot adjust for unknown confounders

Randomisation

- Known and unknown confounders are distributed randomly between treatment groups
- Avoids bias and confounding
- Effect of chance can be measured using p-values and confidence intervals

Accuracy and precision

- Chance = Random error leading to imprecision
- Bias = Systematic error leading to inaccuracy
- Confidence intervals show the precision of an estimate
- Accuracy can only be determined by appraisal

Pragmatic and explanatory research

- Pragmatic: Does this work?
- Explanatory: How or why does this work?
- This will determine:
 - Selection of participants
 - Delivery of intervention
 - Outcomes measured
- Neither approach is “wrong” or “right”

Summary

- What is a hypothesis?
- Validity and generalisability
- Chance, bias and confounding
- Accuracy and precision
- Efficacy and effectiveness
- Pragmatic and explanatory research

Any questions or comments?