EID424: Reading and Interpreting Medical Research

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Contents

1 Types of papers

- **Invited**: lot of references, provides state of the art, may be ego-stroking
- **Review**: lot lot of references, good for getting up to speed on a topic
- **Original research**: includes development of tool or treatment, methodology is important
  - **Retrospective** (chart review): use existing data, hard to control confounding variables; need lots of data to show any kind of population effect
  - **Prospective**: examine the effect of a treatment vs a control group; treatments decided ahead of time; protocol for all subjects determined
    - Can be difficult; treatments or lack thereof must be ethical
    - Designed to answer a particular question
  - **Randomized** vs. **paired** (matched):
    - Subjects randomly assigned to groups; prevents researchers from choosing groups due to implicit bias

    - For matched: for every person in one group put a like person in the other group; is difficult to match across many categories
  - **Blinding**: investigators examining subjects should not be aware of their treatment status
  - **Double-blind**: both investigators and subject don't know about their treatment status; control for placebo effects

- Gold standard in research is prospective, double-blinded randomized study

- Research should not compromise treatment. It is difficult to challenge the "gold standard"; participants won't receive more attention or treatment.

  - Built-in protections: HIPAA, informed consent, institutional review board
    - HIPAA: any subject data must be de-identified
    - Informed consent: all possible consequences of their participation, any benefits they may accrue, should be written and signed; should be written for layperson
    - IRB: made up of a combination of people: scientists familiar with the topic; other scientists, non-scientific members of the institution, other members of the community
  - Peer review: should be blind to the source of the paper; not always possible for small circles
    - Dependent on ethics of reviewers; reviewers may find it hard to believe controversial but correct findings

- When writing your paper:

  - Know the relevant literature
  - Write for the approprite audience
  - Always define an acronym before you use it
  - Abstract: purpose of study, overview of methodology, overview of results, statement of what study showed
  - Introduction: state purpose and any hypotheses explicitly
  - Materials and methods: allow reader to reproduce your study; subjects involved, apparati used (hardware/software); how analysis performed; statistics

  - Results: don't speculate on what it means; only state what it means
  - Conclusions: summarize results and provide interpretation; how do results relate to the existing literatuure; did you answer your research question; weaknesses of your study; recommendations for further work?

2 Introduction to biostatistics

- Sensitivity: **true positive rate**: probability of detecting disease given that person has it
- Specificity: probability of not detecting disease/system given that person does not have it: **true negative rate**
- Positive/negative predictive value: probability that a person has(n't) disease given a positive/negative test
- False negative is more important for preventing spread
- Hard to get true statistics if there are asymptomatic or if there isn't a test yet
- Cheap, low-cost, fast, low-accuracy tests are okay as long as there is a low false-negative rate
- Women tend to be understudied
- E.g.: CAT scans sensitive but not specific: causes a lot of stress and unnecessary worry
- **Type I error** (false positive): detecting a difference between two groups when none really exists
  - p-value is the chance of a type I error; if it is <0.05 then it is statistically significant
- **Type II error** (false negative): not detecting a difference between two groups that does, in fact, exist
  - Tends to occur with small sample sizes
  - **Statistical power** of 80%; depends on variability of measurements

- Sources of error: bias (human tendencies, instrumentation error), random error (difficulty in reproducing test conditions, noisy measurements (biological systems tend to have large tolerances))
- Comparing sets of data: hoping for independent, Gaussian data
  - Independent t-test if data are independent: interested in the difference in the mean/std of the populations
  - Paired (Student's) t-test if data are not independent: interested in the mean/std of the difference between the pairs
  - t-test for two things: for comparing more than two things
    - ANOVA: analysis of variance, main effects, and interaction
      - Repeated measures (all data being compared are dependent) or mixed models (some comparisons independent)
      - post-hoc ("after this") t-tests to illustrate differences
      - Beware multiple comparisons: the more comparisons used, the more likely you find something significant
      - Correct for multiple comparisons in post-hoc t-tests (Benferroni corrections)
      - Sphericity: variance of effect (SD of difference) is different between different levels of a variable
      - Correction: Greenhouse-Geisser
- Linear correlation:
  - **Correlation coefficient**: Pearson correlation, Person R, R
  - R^2 tells how much one variable explains variance between two variables
  - Multiple regression: model some data as a linear combination of several other variables
    - Used in body fat from skinfold measurements
- Limits of agreement: where can data be expected to live? stdevs
  - Useful way for identifying outliers, comparing groups
- Difficult things to measure: pain, outcome after a treatment/procedure, patient/subject satisfaction

  - Questionnaire: how do you feel? (quantized) visual analog scale (analog)

- Non-normal distributions
  - Few samples
  - Non-continuous data
  - Categorical data
  - Use non-parametric statistics (things are not normally distributed)
- Statistically significance doesn't necessarily mean clinically significant (useful)
- In medical research:
  - Do not compare right vs. left
  - Leg: between knee and ankle
  - Read critically; read abstract last (sales pitch for the paper; write and read last)
- Finding literature:
  - Beware of joke literature: prayer study
  - PubMed
  - Google Scholar