Evidence vs. Ideology

Christopher Spencer Greeley, MD
Associate Professor of Pediatrics
Center for Clinical Research and Evidence-Based Medicine
University of Texas Health Science Center at Houston

Disclaimer
• A full-time employee of the University of Texas at Houston
• No financial or personal conflicts to disclose
• Part of my time is supported by NICHD – K23HD065872

Purpose
• Appreciate the importance of a critical appraisal of the medical literature
  – Peer Review
  – Evidence-Based Medicine
  – Literature appraisal

Take Home Messages
• Medical Literature
  – Read the Material and Methods section
  – Read the references
Peer Review

- Only as good as the reviewers
  - Quality of review is variable
  - May not involve scientific review
  - Often does not involve statistical confirmation
- Many journals have faux review
  - Lacking structure to the review
- Can not been seen as “validating truth”
  - Little more than “someone else read it”

Peer Review Process

- Should be readily identifiable
- Should be a true “peer review” process

Judges

- Viewed as the “peer review” of the courts
- How good are judges at understanding science?

Asking The Gatekeepers

- 400 state court judges
- Asked a series of questions to
  - Assess the understanding of the scientific meaning of the Daubert guidelines
  - How the Daubert guidelines are applied to the admissibility of evidence

Gatowski et al, Law & Human Behavior, 2001
Asking The Gatekeepers

- 91% reported they were the gatekeeper in determining scientific merit of evidence
- 48% reported feeling inadequately prepared to deal with scientific evidence

Gatowski et al., Law & Human Behavior, 2001

Asking The Gatekeepers

- 93% reported General Acceptance as a useful criterion to determine scientific merit
- 82% demonstrated a clear understanding of the concept of General Acceptance

Gatowski et al., Law & Human Behavior, 2001

Asking The Gatekeepers

- 92% reported Peer Review as a useful concept in determining scientific merit
- 71% demonstrated a clear understanding of the concepts behind Peer Review
- 10% demonstrated a clear misunderstanding of Peer Review

Gatowski et al., Law & Human Behavior, 2001

Asking The Gatekeepers

- 91% reported that “error rate” was useful in determining merit of scientific evidence
- 4% demonstrated a clear understanding of the concept of the “error rate”
- 10% demonstrated a clearly incorrect understanding of “error rate”

Gatowski et al., Law & Human Behavior, 2001
Asking The Gatekeepers

- 88% believed “falsifiability” to be a useful guideline
- 4% could demonstrate a true understanding of “falsifiability”
- 35% demonstrated a clearly wrong understanding of the concept of “falsifiability”

Evidence Based Medicine

The extent to which beliefs are based on evidence is very much less than believers suppose.

Bertrand Russell, Skeptical Essays (1928)

Evidence Based Medicine

- David Sackett (McMaster University)
  - Coined the term in the early 1990’s
  - “the conscientious, explicit and judicious use of current best evidence in making decisions about the care of the individual patient. It means integrating individual clinical expertise with the best available external clinical evidence from systematic research.” (BMJ, 1996)
- Clinical interventions, individual patient

Evidence Based Practice

1. Convert our information needs into answerable questions
2. Track down, with maximum efficiency, the best evidence with which to answer these questions
3. Appraise the evidence critically, assess its validity and usefulness (clinical applicability)
4. To implement the results of this appraisal into our clinical practice
5. To evaluate our performance

Sackett, Evidence Based Medicine, 1996
Evidence Based Practice

1. Ask good questions
2. Search for good supporting evidence
3. Analyse the evidence
4. Act upon the new evidence
5. See if it worked

Evidence Based Medicine
(terminology, study/paper types)

- Meta-analysis, systematic review
- Randomized Control Trial
- Cohort study
- Case-Control study
- Cross-Sectional study
- Reviews, opinions, consensus papers

Evidence Based Medicine
("hierarchy of evidence")

1. Systematic reviews and meta-analyses
2. Randomized controlled trials with definitive results (confidence intervals that do not overlap the threshold clinically significant effect)
3. Randomized controlled trials with non-definitive results (a point estimate that suggests a clinically significant effect but with confidence intervals overlapping the threshold for this effect)
4. Cohort studies
5. Case-control studies
6. Cross sectional surveys
7. Case reports
Evidence Based Medicine (terminology)

- **Historic Review**
  - Reviews the change or trends of a condition or subject matter
  - i.e. trends in the management of migraine headaches

- **Topical Review**
  - A specific topic or subject is reviewed
  - Summarizes current literature
  - i.e. current management of migraine headaches

Reviews

- Subject or topical review
- Historical review
- Systematic review
  - Meta-analysis

Evidence Based Medicine (terminology)

- **Systematic Review**
  - An analytic review of the literature on a subject
  - Can be used to answer a specific question
  - Papers are searched for, selected, included and excluded by strict criteria
    - Removal of bias
    - Searches of a specific database
      - Medline, Cochrane...
    - Data are analyzed in parallel
      - Not combined
Quality of Evidence

• Tools available
  – Quorum
  – CAT/CASP
  – Jadad

• USPSTF construct

Quality Assessment

• Research question
  • Eligibility
• Type of study
  • Inclusion/exclusion
• Intervention
  • Outcomes measured
• Comparison
  • Results
• Methods
• Sources of bias
• Participants

Methods & Materials
(Systematic Reviews)

• Quality review protocol
  – Appraisal tool used
  – Number of reviewers
  – Arbitration of discrepancies
• Statistical analysis
  – If meta-analysis, appropriate statistics

Chain Citation

• Repeating the citation without reading the primary source
  – Sweat test in patients with glucose-6-phosphate-1-dehydrogenase deficiency (ADC, Sept 2008)
• Perpetuating (perhaps) untruths
  – Not really reading the references
  • i.e. Scurvy as a cause of retinal hemorrhages
7 Signs of Bogus Science

1. The discoverer pitches the claim directly to the media.
2. The discoverer says that a powerful establishment is trying to suppress his or her work.
3. The scientific effect involved is always at the very limit of detection.

4. Evidence for a discovery is anecdotal.
5. The discoverer says a belief is credible because it has endured for centuries.
6. The discoverer has worked in isolation.
7. The discoverer must propose new laws of nature to explain an observation.

Causation

- There are no specific criteria to “prove” causation
- Most agree with the Bradford Hill Criteria
  - None are “sufficient”
  - Only one is (?) “necessary”
  - Each are considerations when trying to determine the cause of an effect
  - Some are more applicable/understandable

- Strength
  - Strong association between cause and effect
- Consistency
  - Repeated observations, different people, different places, different times
- Specificity
  - Effect has few/one cause

Bradford Hill, Evolution of Epidemiologic Ideas, 1965
Causation
(Bradford Hill Criteria)
• Temporality (? Necessary)
  – The effect comes after the cause
• Biological Gradient
  – Dose-dependent relationship between cause and effect
• Plausibility
  – A proposed biological mechanism

Causation
(Bradford Hill Criteria)
• Coherence
  – Should not violate known biological facts
• Experiment
  – Occasionally experimental evidence can support the relationship
• Analogy
  – Similar causal relationships are identifiable

Fallacies
• Formal Fallacies (argument structure)
  – Faults in logic
• Informal Fallacies (non-structural)
  – Faults in data
  – Faults in interpretation

Fallacies
• Informal Fallacies (non-structural)
  – Post hoc ergo propter hoc
    – “after this therefore because of this”
  – Fallacy of the single cause
    – “What is the cause of child abuse?”
  – Hasty generalization
    – Small samples resulting in incorrect generalizations
  – Argumentum ad novitatem (appeal to novelty)
    – New arguments are better
Fallacies

- Formal Fallacies (argument structure)
  - Denying the antecedent
    - If X then Y
    - Not X
    - Thus not Y
  - Affirming the Consequent
    - If X then Y
    - Y
    - Thus X

- Informal Fallacies (non-structural)
  - Cherry picking
    - Incomplete analysis
  - Begging the question/circular reasoning
    - The conclusion is part of the premise
  - Straw Man
    - An easily refutable position (applied to others)
Fallacies

• Informal Fallacies (non-structural)
  – Cherry picking
    • Incomplete analysis
  – Begging the question/circular reasoning
    • The conclusion is part of the premise
  – Straw Man
    • An easily refutable position (applied to others)
  – Appeal to probability
    • Because something could happen, it will happen

Fallacies

• Informal Fallacies (non-structural)
  – Hasty generalization
    • Small samples resulting in incorrect generalizations
  – Ad Hominem or Ad Feminam
    • Attacks on the arguer and not the argument
  – Negative Proof fallacy
    • Also called “Appeal To Ignorance (Ad Ignorantium)”
    • Because something cannot be proved/shown, it must be false
  – Red Herring
    • Including tangential and irrelevant data

Fallacies in Arguments

• Slippery Slope
  – “The Continuum Fallacy”
  – Extrapolating outcomes not supported by data
• Argumentum verbosium
  – Proof by verbosity
  – The appearance of truth by volume

Christopher.S.Greeley@uth.tmc.edu