The Fundamentals of Study Design in Brain Injury Rehabilitation: How Quality Research can Affect Patient Care

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Introduction

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• Biostatistician at VCU
  – Primary Duty: Assist researchers develop research programs
    • Study planning
    • Data analysis

• Presentation: http://www.biostatistics.vcu.edu/bclresources/
What is (clinical) research?

- Any systematic investigation into the health factors of a group of patients
  - Includes needs assessment, quality improvement, treatment evaluation
  - Systematic
    - Allows for results to be judged on their merits
  - Patients
    - Does not include laboratory studies, case studies, treatment plans, animal models, etc...
Why perform research?

• Advances knowledge that leads to beneficial patient outcomes
  – Individual treatment
  – Programmatic or organizational behavior
• Favors treatments based on evidence-proven results over opinion or tradition
Process of Clinical Research

- Define Research Question
- Assess Resources
- Study Design
- Obtain Data
- Analyze Data
- Disseminate Results
Research Question

• Focus of research study
• Defines:
  – Area of concern
  – Population of interest
• Good Research Questions are:
  – Of interest to the field and the investigator
  – Feasible with available resources
  – Clear and concise
  – Ethical
## Assess Resources

<table>
<thead>
<tr>
<th>Required</th>
<th>Recommended</th>
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<tbody>
<tr>
<td>Time!!!!!!!!!!!!!</td>
<td>External Funding</td>
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<tr>
<td>Content area expertise</td>
<td>Administrative Support</td>
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<tr>
<td>Informatics / Data management</td>
<td>Design and Analysis Support (Biostats)</td>
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<td>Research experience or mentorship</td>
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<td>Access to patients</td>
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<td>Ethical Approval</td>
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Study Design

• Prospective
  – Plan to use patients in the future
  – Pro: Allows control over exactly what is needed for the study; Relatively high level of evidence
  – Con: Can be expensive, time-consuming, and impractical

• Retrospective
  – Use information already collected
    • e.g. administrative data, medical records
  – Pro: Inexpensive; Lots of data already available
  – Con: Potential biases; missing information
Study Design

• Retrospective Study Designs
  – ‘Prevalence’; Cohort; Case-control;

• ‘Prevalence’ studies
  – Summary of a particular group
    • What is the prevalence of depression in females after TBI?
    • What is the average age of males with penetrating TBI?
A sample of TBI patients was assessed to determine the prevalence of anxiety 1 year following injury.

- Clinically Diagnosed Anxiety
  - N=90

- Not at Risk
  - N=10
A sample of TBI patients was assessed to determine the prevalence of anxiety 1 year following injury.

- Clinically Diagnosed Anxiety
  - N=90
- Not at Risk
  - N=10

- Not at Risk
  - N=890
- No anxiety measured (asymptomatic)
Study Design—‘Prevalence’

• Big Caution for ‘Prevalence’ Studies
  – Results are only as good as data
  – ‘Good data’—Generalizable to a population and reflective or real-world occurrences
Study Design - Cohort

- Retrospective Cohort Study
  - Identify exposure groups and assess future outcomes
  - For clinic patients in the past 5 years, do patients who meditate have higher rates of depression 1-year postinjury than those that do not?
  - Mediation: 25%
  - No Meditation: 33%
Study Design - Cohort

- Big Caution for Retrospective Cohort Studies
  - Treatment allocation is often not random
    - Leads to confounding situations
  - Cannot infer causation
Do TBI patients receiving a particular service (ex. OT, vocational services) have better outcomes?

- Service: 20%
- No Service: 40%
Study Design – Case-Control

- Case-control Study
  - Similar to cohort studies, but identify outcomes of interest and then assess the exposure status of each group.

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<table>
<thead>
<tr>
<th>Depression</th>
<th>No Depression</th>
</tr>
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<tbody>
<tr>
<td>Meditation</td>
<td>No Meditation</td>
</tr>
<tr>
<td>Meditation</td>
<td>No Meditation</td>
</tr>
</tbody>
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Study Design – Case-Control

- Case-control characteristics
  - **Cannot** be used to estimate prevalence or incidence
  - Can use matched controls to eliminate the effect of confounding
    - Higher level of scientific evidence
Study Design - Prospective Studies

• Cohort; Clinical Trial

• Generally expensive in terms of:
  – Time comment
  – Required Resources
  – Administrative duties (consent, patient follow-up)
Study Design - Prospective Cohort

- Prospective Cohort
  - Follow a group of people over time
    - Ex: TBI Model Systems; TRACK-TBI
  - Data specific issues
    - Patient Dropout
    - Recall Bias
Study Design-Clinical Trials

• Highest level of evidence; highest level of resources required
  – Can imply causation
  – Defining a sufficient control group is important
    • Ex: Placebo; Standard of Care; Wait-list control

• Very interesting advances in clinical trial design
Obtain Data

• Advice:
  – Work with informaticists to obtain data without manual record review
  – Do NOT use MS Excel for data entry
    • REDCap, SurveyMonkey
  – Set a protocol for procedures
Analyze Data, Disseminate Results

• Analyzed Data
  – Work with biostatisticians

• Disseminate Results
  – Even if nothing interesting discovered, an absence of a difference may be meaningful
    • ‘Negative studies’
    • https://www.penelope.ai/equatorwizard/
Process of Clinical Research

• Define Research Question
• Assess Resources
• Design Study
• Obtain Data
• Analyze Data
• Disseminate Results
Conclusion

Research is fun!!!!!

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