

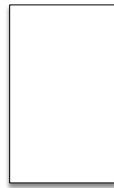
Starting a Research Project

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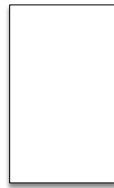
Overall Learning Objectives

- ★ Identify common study designs used in medical imaging research
- ▶ **Form a testable hypothesis from a clinical problem or question**
- ▶ **Perform a literature review**
- ▶ **List the steps required to plan a research project**
- ▶ Locate funding opportunities on the web
- ▶ Identify the safeguards to perform ethical human research
- ▶ List the steps required to submit a grant proposal
- ▶ List the steps required to execute a research study
- ▶ List the steps required to publish medical manuscripts



Outline for today's session

- ▶ Choosing a research question
- ▶ Designing the study
- ▶ Choosing collaborators
- ▶ Choosing a journal or conference
- ▶ Mock consulting session
- ▶ Break
- ▶ Performing a literature review
- ▶ Using Zotero
- ▶ Using medical databases



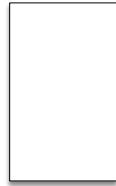
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Choosing a research question

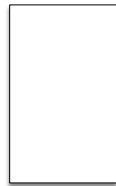


- ▶ What interests you?
- ▶ Is your idea innovative?
- ▶ Is your idea significant?
- ▶ Can the research be completed within the timeframe or budget?
- ▶ ***What question are you really trying to answer?***



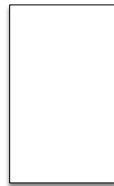
Example: Random forests for predicting metastasis

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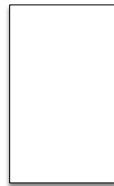
Example: Cumulative false positive rate for digital breast tomosynthesis

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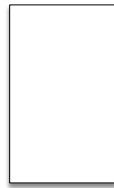
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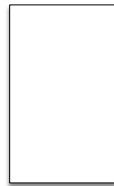
Forming a testable hypothesis

- ▶ Define the patient population of interest
- ▶ Identify measurable outcomes
- ▶ Identify predictors which may influence outcomes
- ▶ Restate question in terms of predictors and outcomes



Example: Random forests for predicting metastasis

- ▶ Define the patient population of interest
 - ▶ Patients with thyroid cancer, post-thyroidectomy
- ▶ Identify measurable outcomes
 - ▶ Cancer diagnosis as determined by biopsy
- ▶ Identify predictors which may influence outcomes
 - ▶ Thyroid nodule size and shape, presence of microcalcification, hilar flow
- ▶ Restate question in terms of predictors and outcomes
 - ▶ Random forest classifiers will demonstrate greater diagnostic accuracy for detection of metastatic disease when compared to classical logistic regression models



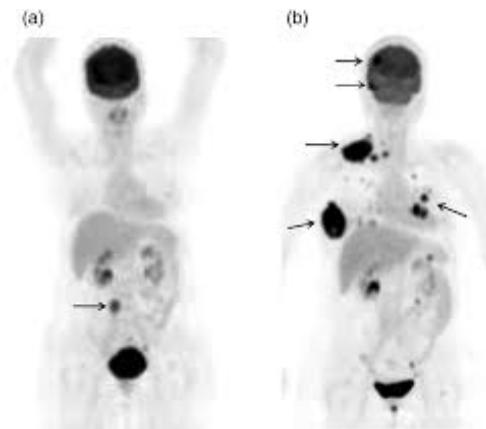
Example: Cumulative false positive rate for digital breast tomosynthesis

- ▶ Define the patient population of interest
 - ▶ Patients presenting for breast cancer screening at UCH
- ▶ Identify measurable outcomes
 - ▶ Number of recalls, number of false positives, number of diagnosed cancers, number of loss to follow-up
- ▶ Identify predictors which may influence outcomes
 - ▶ Familial risk, breast density, personal choice of screening interval
- ▶ Restate question in terms of predictors and outcomes
 - ▶ The cumulative false positive rate will be lower with DBT when compared to film mammography

Example: PET/CT Findings and Melanoma Prognosis



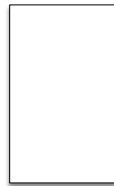
- ▶ Population of interest:
 - ▶ Adults with melanoma, stage T2 or greater
- ▶ Clinical question:
 - ▶ Can I determine patient prognosis based on PET/CT scans?
- ▶ Outcomes:
 - ▶ time to death, time to disease progression
- ▶ Predictors:
 - ▶ Age, gender, tumor stage at diagnosis, treatment



Example: PET/CT Findings and Melanoma Prognosis

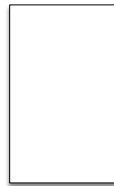
- ▶ Possible hypotheses
 - ▶ BRAF inhibitors reduce the risk of death compared to traditional therapy
 - ▶ PET/CT is more effective than MRI for assessing response to BRAF inhibitors
 - ▶ many other possible hypotheses...





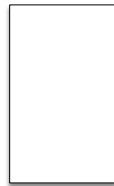
Determine your goals

- ▶ Present findings at a conference?
- ▶ Publish a manuscript?
- ▶ Get funding?
- ▶ Develop new technology and achieve FDA approval?
- ▶ Do the minimum required to get through this residency or fellowship?



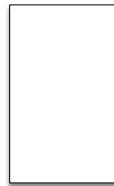
Develop the study design

- ▶ Work with the biostatisticians EARLY
- ▶ Things you'll need to figure out
 - ▶ Budget
 - ▶ Number of participants / power
 - ▶ Timeline
 - ▶ Regulatory requirements
 - ▶ Collaborators
 - ▶ Target journal or conference



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Choose your collaborators

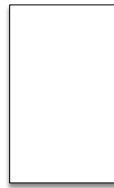
- ▶ Have similar research interests
- ▶ Work well together
- ▶ Be honest scientists
- ▶ Bring outside expertise which you don't have

Managing Co-authorship

- ▶ Discuss with all collaborators **EARLY** in the project
- ▶ Offer co-authorship to individuals who make an **intellectual contribution** to the project
- ▶ Co-author review is required...
 - ▶ Prior to initial submission to a conference or journal
 - ▶ Prior to sending a revision to a conference or journal
- ▶ Co-authors should be notified...
 - ▶ When a abstract or paper is accepted or rejected
 - ▶ When coauthors are added/removed from a project

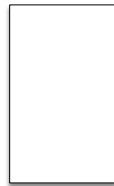
APA ethics guide

- ▶ <http://www.apa.org/ethics/code/principles.pdf>
- ▶ See section 8.12 on Publication Credit



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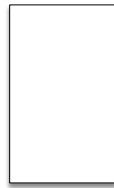


Choose a submission target

- ▶ Consider the impact factor of a journal
- ▶ Examine journal desiderata
- ▶ Look at previous publications in the area
- ▶ Consider your career goals (clinical, academia, etc.)
- ▶ Ask your mentors
- ▶ For conferences, check the submission deadlines and journal embargo

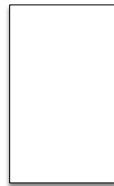
Mock consulting session





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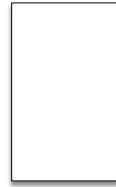
Literature Review

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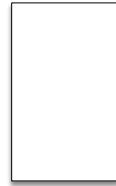
Why perform a literature review?

- ▶ Gain knowledge of the field of interest
- ▶ Determine that the proposed research has not been done before
- ▶ Show the gap in knowledge which will be filled by the proposed research
- ▶ Identify journals which publish studies similar to the proposed research

Performing a literature review

- ▶ Learn to use a reference manager such as Zotero
- ▶ Determine keywords related to your topic
- ▶ Limit as needed by date range, language, etc.
- ▶ Search Pubmed, OVID, Web of Science, or Cochrane databases
- ▶ Select articles based on relevance and quality of evidence
- ▶ Create an annotated bibliography summarizing article purpose and relevance

Cochrane handbook for systematic reviews



► <http://handbook.cochrane.org/>

Example: Annotated Bibliography

Table 1. Summary of study design, analysis, and ROC gold standard used in three papers testing the diagnostic accuracy of ASL

Paper		Ozsunar, 2010	Booya, 2009	Choi, 2013
Design		Retrospective	Cross sectional	Retrospective
ROC (Y/N)		Y	N	Y
Gold Standard for ROC curve		1) Histology 2) ≥ 1 year of imaging and clinical stability	1) Histology 2) Long term clinical follow-up	1) Histology 2) Imaging and clinical follow-up
Statistical Analysis		1) ROC curve of the relative signal intensity of the ROI 2) Chi-Squared comparison of qualitative data	1) Percent concordance of ASL with gold standard	1) ROC curve for qualitative grading of ASL 2) Logistic regression

Citation Management: Zotero

- ▶ Free account at <https://www.zotero.org/>
- ▶ Automatic reference manager
- ▶ Features
 - ▶ Download citations directly from PubMed, Amazon, journal sites, etc.
 - ▶ Create collections of citations and share with collaborators
 - ▶ Plugins for Word to automatically update bibliography
 - ▶ Supports several reference styles (AMA, APA, others)

Zotero installation

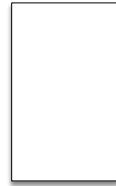


Zotero Installation

- ▶ Download the standalone
- ▶ Download plugin for your browser
- ▶ Download the plugin for Microsoft Word



Zotero demonstration



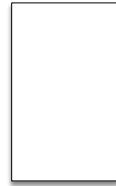
Using medical databases

- ▶ Pubmed
 - ▶ <http://www.ncbi.nlm.nih.gov/pubmed/>
 - ▶ Allows you to search of clinical publications
- ▶ Web of Science / Science Citation Index
 - ▶ Link from <http://hslibrary.ucdenver.edu/>
 - ▶ Allows you to determine who cited a given paper

Anschutz Campus Resources

- ▶ The Health Sciences Library provides access to many print and online journals
 - ▶ <http://hslibrary.ucdenver.edu/>
- ▶ Direct links to major databases such as Pubmed and Cochrane
- ▶ If you can't find an article, Interlibrary Loan is available (possible fee)
- ▶ Chat with a librarian if you need additional help
 - ▶ <http://hslibrary.ucdenver.libanswers.com/index.php>

PubMed Practice



NIH Reporter

- ▶ NIH Reporter
 - ▶ Allows you to search for currently funded research
 - ▶ Answers the question: am I being scooped right now?
 - ▶ <http://projectreporter.nih.gov/reporter.cfm>

NIH Reporter



Questions

