# Health Informatics

Lecture 5

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- Next week: Midterm!

# Uses for medical data

- Finding long-term risk factors for disease
- Drug-drug interactions, side effects (post-market)
- Population health

and more!

# Uniqueness of Medical Data Mining

- Can't just apply methods from data mining/ ML
- Main points
  - Heterogeneity
  - Ethical, legal, social issues
  - Statistical philosophy
  - Special status of medicine

# Heterogeneity of data

- Structured/unstructured, Imaging
  - Many data mining methods can handle only one of these
- How to combine qualitative/quantitative information?

# Heterogeneity of data

- Importance of interpretation

- If we see CHF in record – what did clinician mean?
  - Could be suspected CHF
  - Hypothesis explaining symptoms
  - Past or family history…
- If we don't see indicator for CHF does that mean patient doesn't have it?
  - May not be billed for, may not be treated (if more pressing problems)

# Heterogeneity of data

- Standardization
  - Of data (recall ICD9 for example)
  - Of outcomes
- Example:
  - One group evaluates glucose control system by calculating how often glucose is within 70-150, another group uses 80-140. How to compare?

# Heterogeneity of data

- Difficulty applying precise labels
- Uncertainty
  - Does a particular billing code mean patient definitely has illness?
  - When did the illness start?
- **Test vs diagnosis**
  - We see imperfect indicators for a disease, not the disease itself
  - For prediction, target event may be diagnosis NOT onset of disease

# Ethics, legal and social factors

- Access to data (researchers, patients)
- Concern about liability
  - Affects what data can be collected, which tests can be done
- Privacy
  - Can we use all the data we want?
  - Can we analyze in Amazon cloud? Give text to mechanical turkers? Scrape data from password protected websites?

# HIPAA

Recapping your CITI training…

Health Insurance Portability and Accountability Act

Includes definitions for protected health information (PHI), and what can be shared and with whom

- Who's covered by HIPAA?
  - Ex: healthcare provider, researchers working with PHI from hospital
- What's required?
  - Usually need consent, unless waiver from IRB or meet certain other criteria
- Key component: data de-identified and you don't have reason to believe that they can be re-identified. If this satisfied, no longer covered by HIPAA

# 18 HIPAA identifiers

1. Names
2. Certain geographic information*
3. Dates other than year; all ages over 89 and all elements of dates (including year) indicative of such age, except when aggregated into a category of age 90 or older;
4. Phone numbers;
5. Fax numbers;
6. Electronic mail addresses;
7. Social Security numbers;
8. Medical record numbers;
9. Health plan beneficiary numbers;
10. Account numbers;
11. Certificate/license numbers;
12. Vehicle identifiers and serial numbers, including license plate numbers;
13. Device identifiers and serial numbers;
14. URLs
15. IP addresses
16. Biometric identifiers, including finger and voice prints;
17. Full face photographic images and any comparable images
18. Any other unique identifying number, characteristic, or code

- No longer covered
  - Remove 18 HIPAA identifiers, and no knowledge that people can be re-identified
  - Or guarantee “small” chance of re-identification
- Limited dataset
  - 16 of 18 removed (can keep dates)
  - No consent needed
  - Re-identification prohibited

# De-identifying data

- Basic: replace all IDs with research ID, change dates, remove HIPAA identifiers
- Different shift/function for each patient

- Structured data
  - Add noise
- Text
- Genome
  - Generalize sequence
- Images
  - Facial blur

# Statistical methods

- Do the assumptions of computational methods hold? Do we need new domain-specific ones?
  - E.g. Clinical NLP as distinct subset of NLP
- Importance of domain knowledge
- Error

# Statistical methods

The data are not static:

- EHR systems change
- Terminology changes
- New tests developed

# Nonstationarity

## Risk Calculator for Cholesterol Appears Flawed

By GINA KOLATA
Published: November 17, 2013 | 794 Comments

Last week, the nation's leading heart organizations released a sweeping new set of guidelines for lowering cholesterol, along with an online calculator meant to help doctors assess risks and treatment options. But, in a major embarrassment to the health groups, the calculator appears to greatly overestimate risk, so much so that it could mistakenly suggest that millions more people are candidates for statin drugs.

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TWITTER
GOOGLE+
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EMAIL
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REPRINTS


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Mark Graham for The New York Times

Dr. Nancy Cook and Dr. Paul M. Ridker of Harvard Medical School found that a new online calculator used to assess heart treatment options

The apparent problem prompted one leading cardiologist, a past president of the American College of Cardiology, to call on Sunday for a halt to the implementation of the new guidelines.

"It's stunning," said the cardiologist, Dr. Steven Nissen, chief of cardiovascular medicine at the Cleveland Clinic. "We need a pause to further evaluate this approach before it is implemented on a widespread basis."

# Other ways data may be nonstationary

- Changes in record keeping
- Changes in patient population over time
- Changes in terminology (gallop vs third heart sound; crackles vs rales)
- More accurate tests
- New diagnoses/risk factors

- Note diff between physiology and our observation of it!

# Statistical methods

Missing data

Very common and the reason for it changes interpretation

-Chronic vs acute conditions

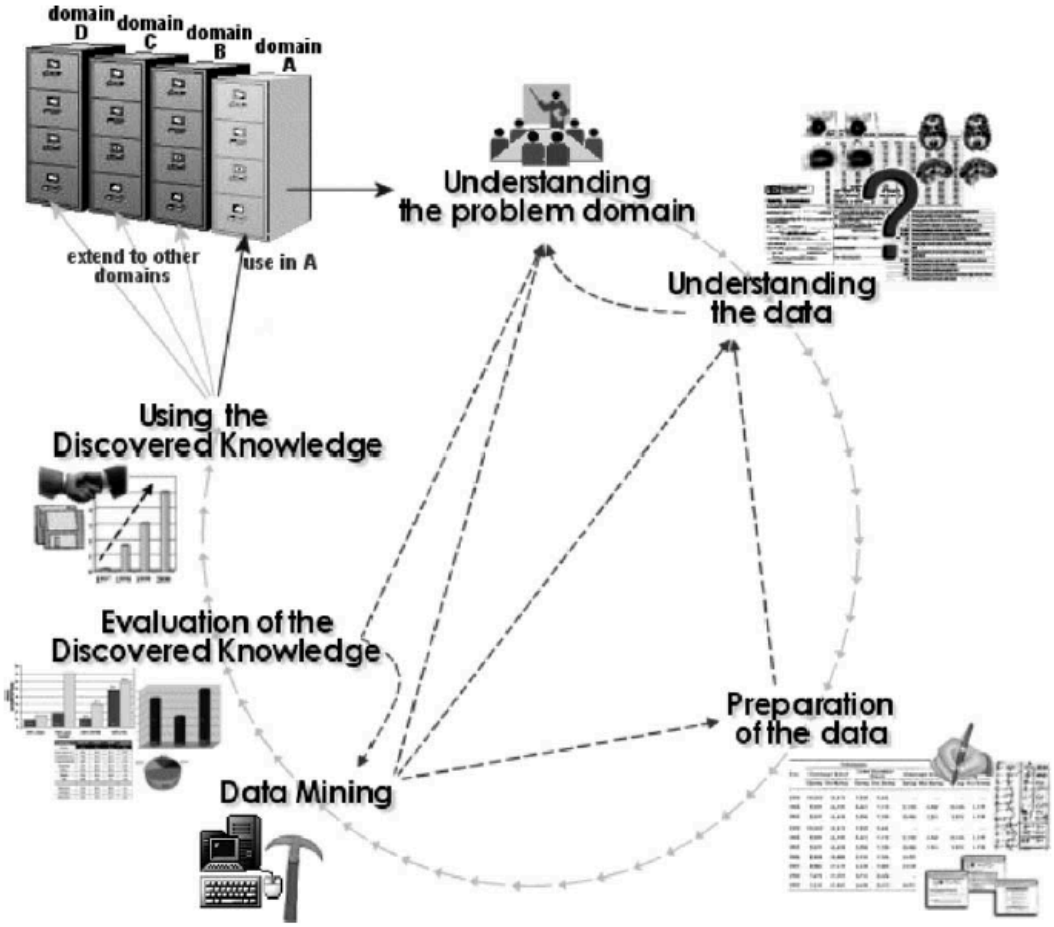
-expensive test (e.g. could be missing due to insurance coverage)

# Statistical methods

Redundancy, inconsistent data

-conflicting lab results

-note says patient is Male, later says Female




Cios, K.J. & William Moore, G., 2002, Uniqueness of medical data mining, *Artificial intelligence in medicine*, 26(1-2), pp. 1-24.

# Special status of medicine

- Impact/risk of false findings: good enough for a paper vs good enough to treat a patient
- Cannot do any conceivable test

# Today’s paper

# More on challenges

- Observational Data in general
  - Nonstationarity
  - Selection bias
  - Choosing variables
  - Seeing vs doing
- Biomedical Data
  - Biased approximation of truth
  - Sample size
  - Censoring (left, right)
  - Institutional differences
  - Fragmentation of data