Health Care Data

Health Care Information Systems: A Practical Approach for Health Care Management
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Course URL: http://pinformatics.org/phpm631

Learning Objectives

- Health Care Data and Information Defined
  - What are health data and health information?
- Health Care Data and Information Sources
  - Where does health data originate and why?
  - When does health care data become health care information?
- Health Care Data Uses
  - How do health care organizations use data?
  - What is the impact of the trend toward analytics and big data on health care data?
- Health Care Data Quality
  - How does the quality of health data impact its use?
Johns Hopkins University Reimagines the M.B.A.

... threading health-care courses throughout its program, refocusing on quant skills

- WSJ 1/22/2020

Part of the research process Mr. Ferrari launched involved asking intensive questions of companies about what specific skills they were looking for when they hire newly minted M.B.A.s. A key finding from the research:

- Employers said they needed M.B.A.s with data-science and data-analytics skills.

- While students don’t need to be data scientists, they need to be able to supervise a team of them, Mr. Triantis said. That means they have to understand what certain software and tools are capable of, what analyses can be done with them and then make solid decisions based on sifting through data.

- More broadly, employers want to see an emphasis on science, technology and math skills in combination with softer skills like leadership that have been so in vogue in recent years.

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Definitions

- Health Care Data v. Health Care Information
  - Data need to be processed to be information
  - On a continuum, not clear cut
    - One person’s data maybe be another person’s information depending on the purpose
  - Protected Health Information (PHI)
    - collected by covered entity
    - For covered functions?

- Electronic Medical Records (EMR) v. Electronic Health Records (EHR)

- Scope of Care
  - Episode of Care: a specific condition for a specific time period
  - Continuum of Care: a system that guides and tracks patients over time through a comprehensive array of health services spanning all levels and intensity of care
  - Population Health: varies. Managing population health is to improve health outcomes within defined communities
Data to Decision

Data Science
Knowledge Discovery & Data mining (KDD)

Big Data: operational data  KDD: Clean, Merge, Reprocess

Human consumable, valid, novel, potentially useful, and ultimately understandable information
KDD Process

- Data cleaning & integration
- Feature Selection (what vars?)
- Analysis / Datamining
- Validation / Evaluation
- Action

Purposes: Patient Records

- Patient care
- Communication
- Legal documentation
- Billing and reimbursement
- Research and quality management
- Population health
- Public health
## Components: Patient Records

- Identification screen
- Problem list
- Medication record
- History and physical
- Progress notes (SOAP)
  - Subjective findings, Objective Findings, Assessments, Plan
- Consultation: outside provider
- Physician’s orders
- Imaging and x-ray reports
- Laboratory reports
- Consent & authorization forms
- Operative reports
- Pathology reports
- Discharge summary

## Components: Claims

- Accounting/Billing
  - Verify insurance coverage
  - Bill third party payers
    - UB-04/CMS-1450 (837I): institutional (hospitals, SNFs, home health, FQHC, community mental health centers etc)
    - CMS-1500 (837P): non-institutional provider claims (private physician services)
      - AMA
  - Process payments upon receipt
EHR Information Screen

Source: Medical University of South Carolina; Epic.

EHR Problem List

Source: Medical University of South Carolina; Epic.
EHR Progress Notes

Subjective:
Patient ID: Roth, Sheryl K (age) = 43 yrs, female

Sore Throat:
This is a new problem: The current episode started in the past 7 days. The problem has been ongoing for 3-4 days. The peak was present on the day of the first visit. The patient first noted a sore throat on the day of the first visit. The patient had been treated for this problem.

Associated symptoms include coughing, ear pain, headache, a hoarse voice, shortness of breath, and swollen glands.

Review of Systems:
Constitutional: Positive for fever and chills.
Hematology: Positive for anemia, increased red blood cell count, and increased white blood cell count.
Respiratory: Positive for shortness of breath.
Neurological: Positive for headaches.

The following portions of the patient's history were reviewed and updated as appropriate: allergies, current medications, past family history, past medical history, past social history, past surgical history, and problem list.

Objective:
Physical Exam:
Nose: Rhinorrhea and sinus tenderness present.

Assessment:

EHR Lab Report

Results

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Abnormality</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBC and differential</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEMOGLOBIN</td>
<td>13.0 (A)</td>
<td>12.8 (A)</td>
</tr>
<tr>
<td>HEMATOCRIT</td>
<td>41-53 %</td>
<td>44</td>
</tr>
<tr>
<td>RED BLOOD CELL COUNT</td>
<td>4.80-5.90 x10^6</td>
<td>4.60</td>
</tr>
<tr>
<td>MEAN CORPUSCULAR VOLUME</td>
<td>69.0</td>
<td>91.2</td>
</tr>
<tr>
<td>WHITE BLOOD CELL COUNT</td>
<td>8.4</td>
<td>7.4</td>
</tr>
<tr>
<td>LYMPHOCYTES</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>EOSINOPHILS MATURE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PLATELET COUNT</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td>MEAN PLATELET VOLUME</td>
<td>7.5-11.5</td>
<td>9.8</td>
</tr>
</tbody>
</table>

Source: Medical University of South Carolina; Epic.
Codes: Diagnostic and Procedural

- ICD-10 (International Classification of Diseases)
  - ICD-10-CM (clinical modification) vs ICD-10-PCS (procedure coding system)
- CPT (Current Procedural Terminology)
  - Copyrighted with all rights to publication and distribution held by the AMA
  - Provides a uniform language for describing medical and surgical services
  - HCPCS level 1: standard for physician’s office, outpatient, ambulatory care
- Coding plays a major role in reimbursement for care
  - Both up coding and down coding is a problem

Example ICD10?

- Our daughter is a coder in Indianapolis and with the news about the iguanas falling out of trees in Florida with the cold spell there, I asked her
- Question: Is there was an ICD10 code for someone showing up in an ER after having been hit by a falling iguana.
  - Answer Y/N?
- Question: If so, what is it?
  - Answer?
- There is: Struck by other non-venomous reptiles code W5982XA.
Data Warehousing considerations

- What data to include?
- How to reconcile inconsistencies?
- How often to update?
  - Data cleaning & integration
  - Feature Selection (what vars?)
  - Analysis / Datamining
  - Validation / Evaluation
  - Action

Accountable Care Act

- Shifting focus from episodic care to population health
- Successful population health require extensive coordination of care across providers and community organizations
  - Comprehensive shared care plan (CSCP)
  - Care managers are needed to interact with patients on a regular basis during and in between clinical encounters
- Reliance on HIT
Healthcare Data Quality

Depends on the use of the data

- Traditionally (file cabinet):
  - Patient Clinical/Claim Records
    - Episodic
    - Generally from a single organization

- Today (conveyor belt - big data):
  - EHR/Electronic Claims Record
    - Continuous instead of episodic
  - Criteria for quality has shifted

Small v. Big Data

- Small Data
  - Comparable to a filing cabinet
  - Static

- Big Data
  - Comparable to a conveyor belt
  - Volume
  - Variety
  - Velocity
  - Veracity
Properties of BIG DATA : 4V

- Volume: constantly generating
- Velocity: constantly changing
- Variety: expressed in many ways
- Veracity: lots of errors
- (Value)

EXAMPLE: the INTERNET!
What do you do to find information/knowledge on the Internet?

Small v. Big Data Examples

- Small Data
  - Disease and Procedure Indexes
  - Health Care Statistics
    - Utilization Statistics
    - Performance Statistics

- Big Data
  - Collected from a variety of sources
  - Wide range of uses across multiple industries and efforts
The Big Data Problem - Nutshelled
Michael Franklin (UC Berkley)

Something’s gotta give:

- Time
- Money
- Quality (precision)
- Massive Diverse and Growing Data

AMPLab: Integrating Three Key Resources

- **Algorithms**
  - Machine Learning, Statistical Methods
  - Prediction, Business Intelligence

- **Machines**
  - Clusters and Clouds
  - Warehouse Scale Computing

- **People**
  - Crowdsourcing, Human Computation
  - Data Scientists, Analysts
AHIMA Data Quality Characteristics

- Accuracy
- Accessibility
- Comprehensive
  - all relevant without inundating
- Consistency
- Currency
  - Data go obsolete

Q: Accuracy vs Precision?

Five dimensions of EHR data quality
Weiskopf and Weng

- Fundamental
  - Completeness
  - Correctness: free of error
  - Currency
- Proxies to assess fundamental dimensions
  - Concordance: consistency, reliability
  - Plausibility: believeability, validity
Strategies for minimizing data quality issues ‘Garbage in Garbage out’

- Up front vs after the fact
- Standardizing data entry fields
- Designing data elements to avoid errors
  - Checking digits, algorithms, well-designed user interfaces
- Developing and adhering to guidelines for documenting the care that was provided
- Building human capacity, including training, awareness building

Read Assignment 2 & Lab 2
Video: Reported in a usable manner

- TX Mental Health Landscape (2:46)
  - [https://www.youtube.com/watch?v=8dPqQt0yXJA](https://www.youtube.com/watch?v=8dPqQt0yXJA)
- Wealth Inequality (1:30)
  - [https://www.youtube.com/watch?v=QPKKQnijnsM](https://www.youtube.com/watch?v=QPKKQnijnsM)

Data Analysis: Assignment 1

Four basic elements of data analysis

- Source of data
  - EHR, claims data, laboratory data, etc.
- Stored in a retrievable manner
  - Database or data warehouse
- Analytical tool applied
  - Mathematical statistics, probability models, predictive models, etc.
- Reported in a usable manner
DSS (Reports)

- **PricePoint**
  - for consumers
- [http://www.txpricepoint.org/](http://www.txpricepoint.org/)

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**What is Data Mining?**

- Using a combination of **artificial intelligence, machine learning, and statistical analysis** to analyze data
- and discover useful **patterns** that are “hidden” there
Data to Decision

KDD Process

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Sample Applications

- Direct Marketing
  - Identify which prospects should be included in a mailing list
  - Clinical trial recruitment: cohort identification
- Market segmentation
  - Identify common characteristics of customers who buy same products
  - Profile common characteristics in homogeneous patient group
- Customer churn
  - Predict which customers are likely to leave your company for a competitor
  - Potentially Preventable Readmissions to ED
- Market Basket Analysis
  - Identify what products are likely to be bought together
  - Care coordination: common services for a condition (bundled services)
- Insurance Claims Analysis
  - Discover patterns of fraudulent transactions (medical fraud)
  - Compare current transactions against those patterns

Business uses of data mining: Essentially five tasks

- Classification: Group data into predetermined categories
  - Classify credit applicants as low, medium, high risk
  - Classify insurance claims as normal, suspicious
- Estimation: Estimate probability of an event through models built from previous data
  - Estimate the probability of a direct mailing response
  - Estimate the potential cohort size for a clinical trial
- Prediction: Predict an outcome based on input based on models built from previous data
  - Predict which customers will leave within six months
  - Predict which patient will return to the ED
- Affinity Grouping: Group people based on similar characteristics
  - Find out what books to recommend to Amazon.com users
  - Find treatment regime that was successful for similar patient
- Description
  - Help understand large volumes of data by uncovering interesting, useful, and actionable patterns
Applications in Health

- A March 2014 poll from MeriTalk and EMC found that 63 percent of healthcare executives in the federal government believe that big data will improve population health management

- Examples
  - Manage population health
    - Accountable Care Organizations (ACO)
  - Clinical decision support
  - Cohort identification for clinical trials
  - Medical fraud detection

Job market of data scientists

- Statisticians will be the next sexy job
  - Google Chief Economist Hal Varian
- Shortage of 190,000 data scientists by the year 2019
  - McKinsey Global Institute
Case Study

- Specialized Program for High Utilizers in One Hospital Network
  - innovative and effective High Alert emergency department overutilization program
  - "SETON’s High Alert Program is a specialized, focused case management program. In this program, we develop individualized care plans based on the particular circumstances of individuals. These care plans can be electronically pushed into future clinical encounters to ensure the individualized plan is followed, resulting in consistent care directed at the specific patient."
  - Dr. Christopher Ziebell (Emergency Department Medical Director at the University Medical Center Brackenridge)
  - Dr. Ziebell serves on the Board of Trustees of SETON Healthcare and the Board of Managers of Emergency Service Partners; is Executive Director of Hospital Physicians in Clinical Research; and, chairs the EMS Steering Committee of the Travis County Medical Society.

Take Away I
What is Data Science? KDD Process

- Operational Data
  - Data cleaning & integration
- EDW
  - Feature Selection (what vars?)
- Task Specific Data
  - Analysis / Datamining
- Results
  - Validation / Evaluation
- Information Presentation
  - Action
Take Away II
What is Big Data?

- 4 Vs of Big Data
  - Volume: lots of data
  - Velocity: constantly generating & changing
  - Variety: expressed in many ways
  - Veracity: lots of errors
  - (Value)

- Big Data Problems
  - Time
  - Money
  - Quality (Precision)

- Three Resources: AMP
  - Algorithm
  - Machine
  - People

Take Away III
Business uses of data mining: Essentially five tasks

- Classification
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  - Help understand large volumes of data by uncovering interesting, useful, and actionable patterns
How do you get good with data?

- Sorry, no short cuts. Build experience.
- In this course, start you out.
  - Tableau / Excel
    - Assignment 1
    - lab 1-3, ?++
  - SQL
    - Assignment
    - Labs

Bias and Variance
http://scott.fortmann-roe.com/docs/BiasVariance.html

- precise but not valid?
- What is real data like?
- Adjust for bias
- Take into account variance
Numerical Data: distribution

- Mean
- Standard Deviation
  - How dispersed
- Range: Max/Min
- Median (percentile)
- Scatter Plot: 2 vars

Categorical Data

- Tabulation
- Cross tabulation
  - 2 variables
- GIS: maps