The U.S. health care system is in need of fundamental change. Americans ought to be able to count on receiving care that is safe and uses the best scientific knowledge. But there is strong evidence that this is not the case. Health care today harms too frequently, and fails to deliver its potential benefits routinely. As medical science and technology have advanced at a rapid pace, the health care delivery system has foundered. Between the care we have and the care we could have lies not just a gap, but a wide chasm.

Crossing the Quality Chasm: A New Health System for the 21st Century
Institute Of Medicine, National Academy of Sciences, 2001

Six Aims for Improvement

- Health care needs to be:
  - Safe
  - Effective
  - Patient-centered
  - Timely
  - Efficient
  - Equitable
Are we really that far off?

- Aren’t our patients safe?
- Don’t we deliver effective care?
- Don’t we do so equitably?

Health Care Should Be Safe, …

- 44,000 – 98,000 people die each year from preventable medical errors (defined as the failure of a planned action to be completed as intended, or the use of the wrong plan to achieve an aim)
- Costs of errors approximated at $17 billion to $29 billion per year in hospitals nationwide

Effective, …

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Compliance</th>
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<tr>
<td>ACE-inhibitors for CHF</td>
<td>50%</td>
</tr>
<tr>
<td>AIM 1997;157:1103-1108</td>
<td></td>
</tr>
<tr>
<td>Aspirin post-MI</td>
<td>85%</td>
</tr>
<tr>
<td>NEJM 1999;340:286-292</td>
<td></td>
</tr>
<tr>
<td>Beta blockers post-MI</td>
<td>60%</td>
</tr>
<tr>
<td>NEJM 1999;340:286-292</td>
<td></td>
</tr>
<tr>
<td>Early reperfusion in elderly</td>
<td>&lt;50%</td>
</tr>
<tr>
<td>JAMA 1999;282:341-348</td>
<td></td>
</tr>
</tbody>
</table>

*How long does it take, on average, for new knowledge generated by a randomized controlled trial to be incorporated into practice?*
And Equitable

- Mortality
  - The rate of suicide in American Indian males is twice as high as young white males
- Morbidity
  - Incidence rates for specific types of cancer (e.g., prostate) are as much as 60% in African-American males as white males
- Health behaviors
  - Smoking in adolescents vary widely by geography – 19% in rural counties vs. 11% in non-rural counties
- Preventive medicine
  - Women below the poverty line are 75% less likely to undergo screening mammography than their counterparts above the poverty line
- Access to care
  - 28% of children from families at 1-1.5x the poverty level are uninsured vs. 5% in families at 2x or above.

So...

- What factors affect health disparity?
- Why is compliance with proven therapies suboptimal?
- Why do have so many errors?

- What can be done about it?

We cannot improve what we cannot measure

One Approach:
A Population-Based Perspective

- Can be helpful for addressing health disparities
- Can be useful for evaluating the quality of health care, including the:
  - processes of care (e.g., efficiency, evidence-based care)
  - and outcomes (e.g., morbidity, mortality, complications)
- Complements traditional individual-oriented care
- Can be incorporated into clinical practice
Today’s Agenda

- What is Population-Based Medicine (PBM)?
- The role of PBM
- Medical Informatics and PBM
- The Clinical Data Repository (CDR)
  - Introduction
  - Demo
- The CDR as a PBM resource for the POM course

The Continuum of Clinical Care

“...medicine that addresses the health care of whole populations rather than that of individual patients. It represents a community-based strategy for disease management and health promotion and places each individual patient within the context of the larger community made up of both sick and healthy people.”

Robert Wood Johnson Foundation

“...The health of my patient will be my first consideration.”
World Medical Association
Declaration of Geneva, 1948

“It is the duty of the physician to promote and safeguard the health of the people.”
World Medical Association
Declaration of Helsinki, 1964
PBM In Practice

- Identifying health disparity in your own practice / population of patients
- Improving chronic disease management for specific conditions (e.g. asthma, diabetes, heart failure)
- Identifying at-risk populations in your own practice
- Using Healthy People 2010
- Implementing practice guidelines (e.g. treatment of acute myocardial infarction)
- Integrating preventive service recommendations (e.g. screening, counseling, immunization)

Sample PBM Resources

- Healthy People 2010 (http://www.healthypeople.gov/)
- CDC National Center for Health Statistics (http://www.cdc.gov/nchs/)
- Agency for Healthcare Research and Quality (http://www.ahrq.gov/)
- National Guidelines Clearinghouse (http://www.guidelines.gov)

A Population-Based Approach

- Identify and characterize a population of patients
  - E.g. all the patients of a specific provider, clinic, or healthcare institution
- Identify the health care problems of highest priority
  - By prevalence, outcome, utilization, etc.
- Adapt office procedures to maximize delivery of appropriate services
  - What is the problem, and how best can it be addressed?
- Assess impact and provide feedback
PBM-Related Information Needs

- What kind of information do you need to implement these efforts?
- Where does the data come from?
- Is the data valid?
- How is the data recorded and stored?
- How is the information provided in a timely fashion?

Medical Informatics

- “...the scientific field that deals with the storage, retrieval, sharing, and optimal use of biomedical information, data, and knowledge for problem solving and decision making.”

ShefHife, 2001

Medicine is Data-Intensive...

- Clinical medicine
  - History, physical exam
  - Laboratory tests
  - Imaging modalities
  - Monitoring data (OR, ICU)
- Population health
- Health services research
  - Clinical trials
  - Outcomes research
- Size of the biomedical literature databases
  - MEDLINE contains approx. 11 million citations, with 400,000 new references added each year
…But the Practice of Medicine Can Be Information-Poor

- When did this patient last have a colonoscopy?
- What is the prognosis for my patient with end stage renal failure?
- Did the female I sent for a rheumatology referral manage to get an appointment? Did she go? What happened?
- What did this man’s prostate biopsy show?
- Where is the *$#@! chart?!

What is Medical Informatics?

- Electronic Medical Records (EMR)
- Physician Order Entry (POE)
- Information Retrieval (IR)
- Computerized Decision Support Systems (DSS)
- Medical Terminology
- Medicine and the Internet
- Handheld Computers in Clinical Practice
- Multimedia Medical Education
- Privacy and Security

A National Perspective on Informatics

"Information technology, including the Internet, holds enormous potential for transforming the health care delivery system, which today remains relatively untouched by the revolution that has swept nearly every other aspect of society. … the committee calls for a nationwide commitment of all stakeholders to building an information infrastructure to support health care delivery, consumer health, quality measurement and improvement, public accountability, clinical and health services research, and clinical education. This commitment should lead to the elimination of most handwritten clinical data by the end of the decade." (emphasis added)

Crossing the Quality Chasm: A New Health System for the 21st Century
Institute Of Medicine, National Academy of Sciences, 2001
Informatics and PBM

- Where do we find all the data we need to incorporate a population-based medicine approach?
- The holy grail of medical informatics is the development and widespread adoption of comprehensive electronic medical records that collect detailed, longitudinal data about patient encounters
  - CC, HPI, PMH, FH, SH, Allergies, Meds, Immunizations
  - Diagnoses (admitting, working, discharge)
  - Procedures (therapeutic and diagnostic)
  - Labs, Radiology
  - Images / text / waveform / numeric
  - Providers

Electronic Medical Record: The Holy Grail

- Computer-Readable Coded Data
- The potential!
  - Assist ordering
  - Error prevention
  - Research
  - Facilitate access to knowledge
- PBM
- Discharge Summary
- Admission Note

Reality

- Chief complaint
- History and Physical
- Vitals
- Nursing Notes
- Operative Notes
- Dietary Notes
- Laboratory Results
- Daily Progress
- Orders
- Discharge Summaries
So, In the Meantime…

- Clinicians must find ways to use existing electronic data (demographics, financial, limited coded diagnoses and procedures, labs)
  - E.g. Dr. Joel Shectman, Internal Medicine – compiling laboratory and visit data to evaluate the care of diabetic patients at Uva and provide feedback to residents

  OR

- Implement processes to capture additional data
  - E.g. Dr. Scott Strayer, Family Medicine – capture of tobacco use data on handheld computers
  - Creation of specialized office information systems*

*A Primer on Population-Based Medicine, AMA, 2002

Information Retrieval:
Accessing Population Data

- State / regional / national data available for some conditions (CDC, AHRQ)

- In most academic and community health care institutions, aggregate patient data is unavailable to health care providers and researchers – hospital information systems that support clinical work only allow access to information on one patient at a time…

What is the CDR?

- The UVa Clinical Data Repository (CDR) is a unique local resource that integrates clinical data from Uva patients into a single WWW-based database that allows you to perform population-based queries on the UVa patient population
  - Laboratory data
  - Billing data (diagnoses and procedures, medications)
  - Hospital registration data (demographics, insurance)
  - Virginia Department of Health (VDH) (death certificate)
Purpose of the CDR

- Originally developed as a tool for clinical researchers
- Enable flexible and rapid retrospective queries of patient data
  - “Show me all patients admitted with pneumonia in 1999”
- Supply data sets for research and medical management applications
- Provide insights into opportunities for improving outcomes and containing costs
  - What therapies tend be associated with better patient outcomes?

Data Contents

- Coded diagnoses and procedures for each inpatient or outpatient visit
- Laboratory results
- Medications (inpatient visits only)
- Demographics
- Utilization and financial data
- Mortality data

- What’s missing?
  - Symptoms
  - Exam findings
  - Outpatient pharmacy

Security and Confidentiality

- Disguised Patient and MD Identifiers
- Authorization Required for Access
- All Uses are Tracked and Audited
- 2nd Level Authorization Required to obtain real identifiers
The Process

1. Begin a new project
2. Define a population by setting conditions
3. Submit your query to the database
4. Display standard reports or download data
5. Combine populations in multiple ways

Define a Population

- By diagnosis
  - Patient visits for which ACUTE MI was diagnosed
- By procedure
  - Patient visits in which SCREENING MAMMOGRAPHY was performed
  - Patients who received a BLOOD TRANSFUSION
- By age, race, gender
- By date
- By unit

Define a Population

- By medication
  - Patients who received ASPIRIN
- By lab test
  - Patients who had a serum glucose of < 40
- By physician, clinic, age, sex, date range, insurance type, ...
Standard Reports – Summary

- How many patients / visits were there that met your criteria?
- Demographics
- Comorbidities (the presence of other diseases in this patient population)
- Diagnoses / procedures that were coded during these visits
- Lab results
- Mortality
- …

Diagnoses and Procedures in the CDR

- For every hospitalization, clinic visit, ER visit, etc., the diagnoses assigned and procedures performed must be recorded for the clinic/provider/hospital to be reimbursed!
- In clinic – done by providers (you’ll get to know this all too well…)
- In the hospital, trained coders carefully review the chart and make a list of diagnoses assigned.
- Every visit has one PRINCIPAL diagnosis, but potentially many more SECONDARY diagnoses.
  - A patient might be admitted for an asthma exacerbation, but then develop pneumonia, develop a drug allergy, etc.
  - Her principal diagnosis would be asthma, and secondary diagnoses would include pneumonia, allergic reaction, etc.
- Diagnoses are represented using a system of codes called ICD9.
- Procedures are represented using CPT (outpatient) and ICD9 (inpatient).

ICD9

- ICD (International Classification of Disease)-originated in 1893 as the International List of Causes of Death, with the goal of compiling mortality statistics
- ICD9-CM (clinical modifications) is the version currently in use in the U.S., and is run by the CDC
- Roughly 15,000 codes exist
- Classifies diseases in a hierarchical structure with a 5 digit numerical code
- Includes some procedure codes as well, used during inpatient visits (like Coronary Artery Bypass Graft!!)
ICD9-CM Classifications

1. Infectious and Parasitic Diseases
2. Neoplasms
3. Endocrine, Nutritional, and Metabolic Diseases and Immunity Disorders
4. Diseases of the Blood and Blood-Forming Organs
5. Mental Disorders
6. Diseases of the Nervous System and Sense Organs
7. Diseases of the Circulatory System
8. Diseases of the Respiratory System
9. Diseases of the Digestive System
10. Diseases of the Genitourinary System
11. Complications of Pregnancy, Childbirth, and the Puerperium
12. Diseases of the Skin and Subcutaneous Tissue
13. Diseases of the Musculoskeletal System and Connective Tissue
14. Congenital Anomalies
15. Certain Conditions Originating in the Perinatal Period
16. Symptoms, Signs, and Ill-Defined Conditions
17. Injury and Poisoning

A Closer Look

7. DISEASES OF THE CIRCULATORY SYSTEM

Acute rheumatic fever (390-392)
Chronic rheumatic heart disease (393-398)
Hypertensive disease (401-405)
Ischemic heart disease (410-414)
Diseases of pulmonary circulation (415-417)
Other forms of heart disease (420-429)
Cerebrovascular disease (430-438)
Diseases of arteries, arterioles, and capillaries (440-448)
Diseases of veins and lymphatics, and other diseases of circulatory system (451-459)

ICD9-CM and Acute MI

410. Acute myocardial infarction
   410.0 Of anterolateral wall
   410.1 Of other anterior wall
   410.2 Of inferolateral wall
   410.3 Of inferoposterior wall
   410.4 Of other inferior wall
   410.5 Of other lateral wall
   410.7 Subendocardial infarction
   410.8 Of other specified sites
   410.9 Unspecified site

   The following fifth-digit subclassification is for use with category 410:
   • 0 episode of care unspecified
   • 1 initial episode of care
   • 2 subsequent episode of care

   Example: 410.71 = Subendocardial Infarction, Initial episode of care
Diagnoses and Procedures

- To specify the diagnosis and/or procedures you want to use as conditions, you must identify the ICD-9/CPT codes that match the concepts you're interested in.
- The CDR allows you to search for specific codes or browse through a hierarchical classification (CCHPR).
- See CDR FAQ (in the Documentation link of the menu)
- More on this later…..

CDR Demonstration

- Goals/objectives of Healthy Virginians 2002 include:
  - Eliminating health disparities
  - Reducing the hospitalization rate for pediatric asthma (among other conditions)
  - Reducing emergency department visits for asthma
- Before we can make progress, we need to know where we stand!
- Let's take a closer look at pediatric asthma at UVa….
  - What disparities exist?
  - How often are kids hospitalized with asthma?
  - How often do they go to the ED for this condition?

Asthma Prevalence by Race, Gender

<table>
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<tr>
<th>Count of Ptid</th>
<th>Sex</th>
<th>A</th>
<th>B</th>
<th>H</th>
<th>I</th>
<th>O</th>
<th>Grand Total</th>
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<tr>
<td></td>
<td>N</td>
<td>96.92%</td>
<td>86.76%</td>
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<td>3.08%</td>
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<td>6.63%</td>
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<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
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</table>

<table>
<thead>
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<th>Grand Total</th>
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<td>93.75%</td>
<td>90.48%</td>
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<td>6.25%</td>
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</table>
Insurance, Utilization, and Asthma

<table>
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<tr>
<th></th>
<th>Percentage with a history of asthma</th>
<th>Average Number of ER visits (over a five-year period)</th>
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<tbody>
<tr>
<td>Self-Pay</td>
<td>0.16</td>
<td>1.61</td>
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<tr>
<td>Medicaid</td>
<td>0.35</td>
<td>1.35</td>
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<tr>
<td>Other</td>
<td>6.66</td>
<td>0.67</td>
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ED Visits for Asthma

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<tr>
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<th>None</th>
<th>1-3</th>
<th>4-6</th>
<th>7 or more</th>
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<tbody>
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<td>Self-Pay</td>
<td>69.75</td>
<td>24.71</td>
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<td>Medicaid</td>
<td>75.40</td>
<td>22.94</td>
<td>1.00</td>
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<tr>
<td>Other</td>
<td>83.11</td>
<td>14.07</td>
<td>1.77</td>
<td>0.54</td>
</tr>
</tbody>
</table>

Our Goals for PBM / CDR in POM

- Introduce you to the principles and promise of population-based medicine
- Provide you with access to aggregate data to explore these principles first hand
- Teach you how to use the CDR
PBM CDR Lab Sessions

- Each of you will attend a one-hour lab session this week or next, held in the Carter Classroom. You should each have had your login id’s and passwords e-mailed to you at your xyz@virginia.edu account – bring this (you can also access e-mail from the room)
- In the sessions, you will work through some basic CDR queries and we’ll talk about how you might use the CDR to look at data regarding disease prevention in our patients.
- Also - keep the CDR in mind as you formulate learning objectives throughout the year…..

How else might you use the CDR?

- A helpful tool for comparing information in textbooks with real patient data (disease prevalence and practice patterns can vary widely) – e.g. how do physicians here treat meningitis
- Coming into a new rotation:
  - what kinds of patients will I see?
  - What kinds of conditions?
- Learning about patients with complex chronic illnesses
  - What diseases / complications is my patient with chronic renal failure at risk for?
- Potential source of data for a research project

Need Help?

- On-line code tables and documentation
- Available CDR project team-members
  - Jason Lyman, MD, MS, CDR Director
    (lyman@virginia.edu, 924-8240)
  - Ken Scully, MS, Developer and Database Administrator
    (kscully@virginia.edu, 982-4035)

Please don’t hesitate to contact us at anytime!

QUESTIONS OR COMMENTS?