Topics for Today’s Talk

Some definitions

- What is biomedical informatics?
- What are the underlying scientific issues?
- What are the workforce and educational requirements?

- What are the relationships between psychology and biomedical informatics?
- What is AMIA?
- The current policy and funding juggernaut
Historical Perspective

• Computers in medicine emerged as a young discipline in the 1960s
• No consistency in naming field for many years
  – “Computer applications in medicine”
  – “Medical information sciences”
  – “Medical computer science”
• Emergence in the 1980s of a single, consistent name, derived from the European (French) term for computer science: *informatique*
  – Medical Informatics → Biomedical Informatics
Biomedical informatics is 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.

Biomedical informatics touches on all basic and applied fields in biomedical science and is closely tied to modern information technologies, notably in the areas of computing and communication.
“Fundamental Theorem” of BMI

Biomedical Informatics in Perspective

Basic Research

Biomedical Informatics Methods, Techniques, and Theories

Biomedical Informatics ≠ Bioinformatics

Applied Research

Bioinformatics

Imaging Informatics

Clinical Informatics

Public Health Informatics

(Also often called Structural Informatics)

(Also often called Informatics in Health Informatics, Clinical Medicine Informatics)
Biomedical Informatics in Perspective

Basic Research

Biomedical Informatics Methods, Techniques, and Theories

Biomedical Informatics ≠ Health Informatics

Applied Research

Health Informatics

Bioinformatics

Imaging Informatics

Clinical Informatics

Public Health Informatics

Molecular and Cellular Processes

Tissues and Organs

Individuals (Patients)

Populations And Society
Decision Support Lies at the Heart of All Informatics Applications

• Essentially all clinical applications of computing are intended to provide decision support.

• Biomedical informatics is inherently aimed at enhancing the quality of decisions made by health professionals and patients.

• Many of the legal and ethical issues that arise in the context of biomedical informatics are linked to the influence that informatics systems can have on decisions made regarding patients and their care.
Envisioned Cycle That Has Motivated Our Work

Providers Caring for Patients

Electronic Health Records

Regional and National Registries

Biomedical Research

“Meaningful Use”? Standards for Prevention and Treatment

Creation of Protocols, Guidelines, and Educational Materials

Information, Decision-Support, and Order-Entry Systems

Standards for Prevention and Treatment
The Last 20 Years

• Biomedical informatics training programs at several universities supported by the National Library of Medicine (now ~20)

• Creation of professional societies, degree programs, quality scientific meetings, journals, and other indicators of a maturing scientific discipline

• Broadening of applications base, but with a tension between the field’s service role and its fundamental research goals
A Key Limitation As We Seek To Bring Informatics into Clinical Care

There are too few people trained at the interface between computer, information, and communication sciences with the biomedical and health sciences.

Responses:

• Degree programs in biomedical informatics
• Informatics training in health professional schools
• Certificate and continuing education programs in informatics for health professionals
• MD/PhD and MD/MS programs
• Fellowships and board certification in biomedical informatics (initially for physicians)
Biomedical Informatics Disciplines

- Computer Science (hardware)
- Computer Science (software)
- Cognitive Science & Decision Making
- Management Sciences
- Clinical Medicine & Public Health
- Basic Medical Sciences
- Bioengineering
- Epidemiology & Statistics
Biomedical Informatics in Perspective

Contribute to...

Biomedical Informatics Methods, Techniques, and Theories

Draw upon....

Other Component Sciences

Contributes to....

Biomedical Application Domain

Draws upon....

Applied Informatics

Contribute to...

Decision Science

Cognitive Science

Information Sciences

Management Sciences

Other Component Sciences

Draw upon....

Computer Science
Chapter 4: Cognitive Science and Biomedical Informatics
by Vimla L. Patel and David R. Kaufman

1036 Pages
Springer - 2006
Trends

• Creation of several new biomedical informatics departments or independent academic units
• Strong job market for graduates of informatics degree programs
• Government investment in training and research is reasonably strong, especially for applications and demonstrations
• Remarkable political attention in Washington, with a recognized role for BMI in health reform
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What are the relationships between psychology and biomedical informatics?

- What is AMIA?
  - Some background and history
  - Current status and programs

- The current policy and funding juggernaut
### Relationships Between Cognitive Psychology and Biomedical Informatics

- Human-computer interaction
- Usability testing
- Decision support
- Topic of study in BMI programs
- Informatics tools to support professional psychologists

- Informatics education in psychology training programs
- Patient safety research
- Consumer health and patient education

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Methods of Analysis

- Task and activity analysis
- Meaningful relations between ideas and concepts (semantic), higher level understanding (conceptual), and context-sensitive (pragmatic) representations
- Dialogue analysis for team communication
- Protocol analysis
- Usability analyses
<table>
<thead>
<tr>
<th>Cognitive Science Theory</th>
<th>Medical Cognition Conceptual Frameworks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td>Medical Problem Solving</td>
</tr>
<tr>
<td>Knowledge Organization</td>
<td>Organization of Clinical and Basic-Science Knowledge</td>
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<tr>
<td>Problem Solving</td>
<td>Diagnostic Reasoning Strategies</td>
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<tr>
<td>Heuristics/Strategies</td>
<td>Medical Decision Making</td>
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<td>Computational Theory of Mind</td>
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<td>Medical Cognition</td>
<td>Biomedical Informatics</td>
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<tr>
<td>Medical Problem Solving</td>
<td>Knowledge and Data Representation</td>
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<tr>
<td>Organization of Knowledge</td>
<td>Management of Medical Information</td>
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<tr>
<td>Diagnostic Reasoning Strategies</td>
<td>Human-Technology Interaction</td>
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<tr>
<td>Medical Decision Making</td>
<td>Cognitive Models for Enhancing Decision Support</td>
</tr>
<tr>
<td>Text Comprehension and Problem Representation</td>
<td>Cognitive Assessment of Usability and Interfaces</td>
</tr>
<tr>
<td>Development of Medical Expertise</td>
<td>Targeted Training</td>
</tr>
<tr>
<td>Medical Discourse</td>
<td></td>
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</tbody>
</table>
Effect of an EHR System on Human Cognition

• Transition from paper records to EHR and back to paper record

• Impact on knowledge organization, reasoning

• Information and other technologies are not merely tools to expedite, facilitate and enable the execution of task

# Information in EHR and Hand-Written Records

<table>
<thead>
<tr>
<th>Category of Information</th>
<th>Hand-Written Patient Record</th>
<th>Computer-Based Patient Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Chief Complaint</td>
<td>10</td>
<td>28</td>
</tr>
<tr>
<td>2. Past Medical History</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>3. Life Style</td>
<td>33</td>
<td>19</td>
</tr>
<tr>
<td>4. Psychological Profile</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>5. Family History</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>6. History of Present Illness</td>
<td>55</td>
<td>27</td>
</tr>
<tr>
<td>7. Review of Systems</td>
<td>52</td>
<td>8</td>
</tr>
<tr>
<td>8. Physical Examination</td>
<td>60</td>
<td>55</td>
</tr>
<tr>
<td>9. Diagnosis</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>10. Investigation</td>
<td>29</td>
<td>17</td>
</tr>
<tr>
<td>11. Treatment</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td><strong>TOTAL ENTRIES</strong></td>
<td><strong>304</strong></td>
<td><strong>225</strong></td>
</tr>
</tbody>
</table>
74 year old woman, whose diagnosis was made in February, as she complained of polyuria/nocturia and fatigue for a few years. She was told her sugar was very high and she was sent to Dr. K., who started her on Diabeta 5 mg/d and sent her to Dr. S. in ophthalmology who reported normal retina. She lost weight, her polyuria improved, her bladder urgency got better, and her glucose values improved dramatically. She does no monitoring at home. She had to be hospitalized for an ankle fracture after falling on ice, for 3 months. At follow-up, Dr. K. seemed pleased with the results.
CHIEF COMPLAINT: Type II diabetes mellitus

PERSONAL HISTORY

SURGICAL: cholecystectomy: Age 60 years old
MEDICAL: hypothyroidism: asymptomatic since 25 years

LIFE STYLE

MEDICATION

DIABETA (Tab 2.5 MG)
Sig: 1 tab(s) Oral before breakfast
SYNTHROID (Tab 0.125 MG)
Sig: 1 tab(s) Oral before breakfast

HABITS: smoking: 0 alcohol: 0
<table>
<thead>
<tr>
<th>Glucose levels:</th>
<th>&lt;130</th>
<th>130-180</th>
<th>&gt;180</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lunch</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Supper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedtime</td>
<td></td>
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</tr>
</tbody>
</table>

Last HbA$_{1c}$ since April 96: 7.4/7.2/6.7/6.6/8.9 - higher values in log book

Retinopathy: NIL March 97

Nephropathy: NIL Oct. 96
Diagnostic Reasoning

Paper Record

Multiple Hypotheses

Return to Paper Record

Same as EMR!
Collaborative Cognition

1. Team members
2. Representation
3. Data sources

DATA

Multiple
Intellectual Partnership

- Distributed cognition
  - Human-computer interaction analysis paradigm

- Knowledge resides partly in the environment
Intellectual Partnership

- Coordinating *internal* (user’s mind) and *external* (interface, environment) resources
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BMI and HIT
American Medical Informatics Association (AMIA)

- A professional home for biomedical and health informaticians
  - Most of the pioneers of the field plus most emerging authorities
  - 4000 members from 53 nations
- An national authority in biomedical and health informatics, e.g., the sound application of HIT and related issues
- Leadership in informatics education, research, and policy, plus close ties to HIT industry and, increasingly, to the biotech world
AMIA Members

- ~4000 members
- Of those indicating an area of interest
  - 73% clinical health care informatics & clinical research informatics
  - 17% public health/population
  - 10% translational bioinformatics
- ~1/3 are physicians
- Other health professionals well represented as well
The official journal of AMIA

Consistently ranked as the #1 journal in health care informatics among 19 others

Peer-reviewed papers about the science of informatics; 29% acceptance rate

State of the art reviews, discussion forums, policy position papers, & invited editorials
Present

- Introduction to Biomedical & Health Informatics (3 in US, one international)
- Research Informatics (1)
- Translational Bioinformatics (1)
- Public Health Informatics (1, begins this year)

Coming soon

- Nursing Informatics (new)
- Consumer/Personal Health Informatics
- Others international topics and sites
- Exploring new topics and programs -- proposals and suggestions are welcome
Goal: Common Interprofessional Informatics Curriculum (CIIC)

- Enthusiasm from key organizations across the health professions
- Model curricula under development for medical students
- Longstanding leadership in informatics curricula for nursing students
- Further progress awaits funding as we seek grant support for the major effort involved
AMIA’s Advocacy Work

• Seeks to help shape national public policy with respect to informatics and health IT

• Positive reputation on the Hill as a source of impartial, balanced information at a time when HIT is much on people’s minds

• Annual “Hill Day” brings AMIA members and perspectives to key Senate and House committee members
• AMIA 2009 Annual Symposium
  • November 14-18, 2009
  • San Francisco Hilton and Towers
• Joint AMIA Summits on Translational Science
  • March 10-13, 2010
    Parc 55 Hotel
    San Francisco, CA
• Translational Bioinformatics (March 10-12) and Clinical Research Informatics (March 12-13)
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Major Health Information Technology Components in Obama Stimulus Package

Stimulus package contains $19 billion for health care technology spending and adoption of electronic health records

Chanley Howell
February 19, 2009

On February 17, 2009, President Barack H. Obama signed into law the American Recovery and Reinvestment Act of 2009 (ARRA). This article summarizes the provisions of the ARRA's stimulus expenditures and other stimulus measures relating to health information technology (HIT), including incentives for adoption of electronic health record (EHR) systems.

Executive Summary

Medicare/Medicaid Incentives
The ARRA provides substantial stimulus expenditures in the health care industry — over $20 billion — for the development and adoption of HIT. The largest allocation of funding — approximately $17 billion
Politics and Law

February 10, 2009 8:45 PM PST

U.S. stimulus bill pushes e-health records for all

by Declan McCullagh

The U.S. Senate on Tuesday approved an $838 billion “stimulus” bill by a 61-37 vote, capping more than a week of political sparring between critics of the measure and President Obama, who claimed during a press conference that an “economic emergency” made it necessary.

What didn’t come up during the president’s first press conference was how one section of the convoluted legislation—it’s approximately 800 pages total—is intended to radically reshape the nation’s medical system by having the government establish computerized medical records that would follow each American from birth to death.

Billions will be handed to companies creating these databases. Billions will be handed to universities to incorporate patient databases “into the initial and ongoing training of health professionals.” There’s a mention of future “smart card functionality.”

Yet nowhere in this 140-page portion of the legislation does the government anticipate that some Americans may not want their medical histories electronically stored, shared, and searchable. Although a single paragraph promises that data-sharing will “be voluntary,” there’s no obvious way to opt out.

“Without those protections, Americans’ electronic health records could be shared—without their consent—with over 500,000 covered entries through the forthcoming nationally linked electronic health records network,” said Sue Blevins, president of the Institute for Health Freedom, a nonprofit group that advocates health care privacy.
February 23, 2009

Dear AMIA Members:

As you know, on February 17, 2009, President Obama signed into law HR 1, The American Recovery and Reinvestment Act, a $787 billion stimulus package intended to revitalize the U.S. economy. I am pleased to provide you with a summary of recent AMIA activities regarding the passage of this bill as well plans for future activities.

Contained in HR 1 is some $19.2 billion intended to support widespread deployment and utilization of health information technologies (HIT) and the availability of an electronic health record (EHR) for all citizens by 2014. Within Title XIII of HR 1 entitled “Health Information Technology” (or the “Health Information Technology for Economic and Clinical Health Act” or the “HITECH Act”) there are many provisions that members of AMIA will be pleased with; there are also some provisions (especially relating to “improved” privacy and security requirements) likely to cause concern.
Key Responsible Government Agency

Health Information Technology

HHS.gov

Health Information Technology

Health Information technology (Health IT) allows comprehensive management of medical information and its secure exchange between health care consumers and providers. Broad use of health IT will:

- Improve health care quality;
- Prevent medical errors;
- Reduce health care costs;
- Increase administrative efficiencies;
- Decrease paperwork; and
- Expand access to affordable care.

Interoperable health IT will improve individual patient care, but it will also bring many public health benefits including:

- Early detection of infectious disease outbreaks around the country;
- Improved tracking of chronic disease management; and
- Evaluation of health care based on value enabled by the collection of de-identified price and quality information that can be compared.

ONC Strategic Plan
Available Here

Medical Identity Theft Final Report
Available Here

Privacy and Security Framework
Announced

Upcoming Events
The World Health Care Congress
2nd Annual Leadership Summit on Consumer Connectivity
Carlsbad, CA
February 24-27, 2009
More>>

5th Academic Medical Center Conference
Chapel Hill, NC
March 1-4, 2009
More>>

All Upcoming Events items
A New National Coordinator for the New Era

- Dr. David Blumenthal
- Health policy expert from Harvard (Kennedy School of Government)
- General internist from Massachusetts General Hospital
- Former health staff member for Edward Kennedy
- Health policy advisor for Obama during the Presidential campaign
An Optimistic Perspective

A spokeswoman from the Department of Health and Human Services has cited a Congressional Budget Office estimate that 90 percent of doctors would be using health IT by 2019, thanks to the stimulus bill.

- Will there be “meaningful use”?
- Will there be corresponding health reform so that HIT supports a more efficient, effective, and accessible health system?
Thank You!

shortliffe@amia.org
Biomedical Informatics and Cognitive Psychology