Artificial Intelligence in Clinical Medicine: From Theory to Your New Reality

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Objectives

- Recognize that Artificial Intelligence in healthcare is the application of automation of computer technology to clinical processes
- Describe the two major variant applications in artificial intelligence in clinical medicine
- Understand the importance of major US Government HIT incentive Programs on the use of tools in implementing artificial intelligence in clinical medicine.
Overview

- Objectives
- Pre-Test
- A Short History of AI in Clinical Medicine
- The Role of AI in Patient Safety
- Types of Applications of AI in Clinical Medicine
- Meaningful Use- The New Reality of AI in Clinical Medicine
- Post-Test
- Summary
Pre-Test

1. Which of the following represent the application of artificial intelligence through computer automation in clinical processes:

A. Clinical Decision Support
B. Expert Systems
C. Lab interfaces
D. A and C
E. A and B
2. The two major variants of the application of artificial intelligence in clinical medicine are

A. artificial and natural systems
B. Strong systems and assistive systems
C. Health IT and computers in medicine systems
D. Meaningfully used and artificial expert systems
Pre-Test

3. The CMS Meaningful Use Incentive program mandates

A. That clinicians use EHRs in a specified, meaningful way

B. Utilize artificial intelligence through the use of clinical decision support to improve patient care delivery

C. Achieve key policy goals through the effective use of Health IT tools

D. All of the Above
Short history of AI in medicine - the beginning?

1. 1936 - Dr. Alan Turing's simple machine

The 1960’s- The AI in Clinical Medicine Awakening

- 1960s
  - 1965- MUMPS database
  - 1968- COSTAR
  - 1969- HELP system*
The 1970’s- Robust Advancement

• 1970- Internist-1
• 1971- Intel debuts the Intel 4004- the world's first single chip microprocessor
• 1970- Mycin
• 1974- SNOMED
• 1979- E-MYCIN (Essential MYCIN)
The 1980’s-The Watershed Years

1981- IBM PC (model 5150) introduced
1982- PUFF introduced- based on E-MYCIN
1985- CADUCEUS- modification of INTERNIST
1985- DICOM founded
1987- HL7 founded
1990-Present- Warp speed ahead

- 1990's to present
  - 1994- LOINC Created
  - 1996- HIPAA enacted
  - 1999-2001- IOM reports on medical errors and AI/HIT systems as a needed solution
  - 2004- President GW Bush- creates Office of National Coordinator with $100 million budget
  - 2009- ARRA- provides HITECH provision with $19 Billion for HIT.
  - 2010-2011- ONC specifies meaningful use and includes clinical decision support in its stages approach.
Types of AI applications Relevant to clinical medicine

- Strong systems
  - Large, complex, monolithic systems intended to
  - Intensive data analysis. Can look for associations within data sets that do not fit to traditional theoretical models
  - Practical disadvantage: does not fit into clinicians everyday workflow
- Systems are usually sub specialized:
  - MYCIN for infectious disease
  - PUFF for pulmonary medicine- lung functions
Types of AI applications Relevant to clinical medicine (cont)

- Assistive systems
  - Compliments clinicians rather than replaces them
  - Collects and presents data in a manner that is patient centric
  - Data sets often have to evolve with the actual patient database
- Clinical decision support
  - Generating alerts and reminders
  - Diagnostic assistance
  - Information recognition and retrieval
  - Image recognition and retrieval
PUFF- Pulmonary Expert System\textsuperscript{2}

- PUFF was created at the Stanford University and Pacific Medical Center in San Francisco, CA in 1982.
- Consisted of Essential Mycin (which provided a production rule database consisting of an interpreter, explanation and knowledge acquisition modules) and domain specific knowledge in pulmonary medicine.
- Fed in patient data and get an interpretation.
Patient safety and the Drive for AI applications in healthcare: HIT driving patient safety

- 1999-2001 IOM reports
  - Defining the problem: To Err is Human
  - Recommending solutions: Crossing the Quality Chasm
- Explosion of medical knowledge
- Economic constraints: Will Medicare survive?
- Much of AI in medicine must be driven by process intelligence of human drivers
  - We need more automation
  - We don't need as much intelligence
- Infrastructure redesign with subsystems focus

Patient safety and the Drive for AI applications In healthcare: HIT driving

Patient safety (cont)

- Ambulatory
  - Electronic Health Records
    - Basic guidelines for implementation
    - Tracking test results becomes a challenge
  - Electronic prescribing
    - Structure clinical data
    - Structured lab data
    - Interaction checker- drug-drug, drug-allergy
  - Clinical Decision support tools are evolving


Patient safety and the Drive for AI applications in healthcare: HIT driving

Patient safety (cont)

- Inpatient
  - Computerized Physician Order Entry
    - Process driven
    - Stakeholder buy-in and use
Patient safety and the Drive for AI applications in healthcare: HIT driving

Patient safety (cont)

- Implementation is everything
  - Can reduce errors
  - Errors of omission/commission can occur

- Decision support tools
  - Order sets
  - Analytics
  - Guideline adherence

- Transitions of Care


Explosion of Medical Knowledge

- Medical knowledge is said to double every 4-7 years—many sources differ—hard to quantify
- Human knowledge is now no longer linear—now logarithmic in nature
Medicare and 2017

- Probably the biggest driver for healthcare reform
- In 2009, Medicare was predicted to become insolvent in 2017 due to the high number of enrolling beneficiaries
- Cost of healthcare is now almost 17% of the Gross Domestic Product (the total value of goods and services produced within a given period). GDP per capita is an indicator on the quality of life of the citizens of a given country.
- Disaster if cost doesn’t go down, quality does not go up and more people are seen in shorter periods of time
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**Medicare**

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*Source: Office of the Chief Actuary, Social Security Administration*
The era for meaningful use: AI
En masse: Your New Reality

- The new era of HITECH
  - Health Information Technology for Economic and Clinical Health
  - Outlined in 2009 American Recovery and Reinvestment Act
  - $19 Billion to establish a Health IT infrastructure
- Policy Underpinnings
  - Patient and Family Engagement
  - Coordinated Care
  - Quality Safety and Efficiency
  - Privacy and Security
The era for meaningful use: AI En masse: Your New Reality (cont)

- Improved Public and Population Health
- Meaningful Use:
  Main objectives
  - For
    - Hospitals
    - Eligible providers
  - Stage 1
    - Electronic capture of health in a coded format
    - Use coded information to track key clinical conditions
    - Communicating that information for care coordination purposes
The era for meaningful use: AI En masse: Your New Reality (cont)

- initiating the reporting of clinical quality measures and public health information

- Stage 2
  - disease management
  - clinical decision support
  - medication management
  - support for patient access to their health information
  - quality measurement and research
  - bi-directional communication with public health agencies
The era for meaningful use: AI En masse: Your New Reality (cont)

- Stage 3
  - improvement in quality, safety and efficiency
  - decision support for national high priority conditions
  - access to self management tools
  - access to comprehensive patient data and improving population health outcomes
- Infrastructural redesign
  - EHR Certification
  - EHR Deployment and support
  - Health Information Exchanges
  - HIT Training programs
Summary and Post Test
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Post-Test

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Answers to Post-Test Questions

1. D
2. B
3. E