Overview of Health Informatics

ITI

BMI-Dept
Week 6
Fellowship
Overview of Health Informatics
ITI, BMI-Dept
Day 11
Agenda

- Definition of Standard
- Importance of Standards
- Standard Development
- Health Level Seven International (HL7)
- Digital Imaging and Communications in Medicine (DICOM)
- Clinical Document Architecture (CDA)
- International Classification of Diseases (ICD)
- RxNorm
- National Drug Codes (NDC)
- Logical Observation Identifiers Names and Codes (LOINC)
- Nursing Terminology
- Systematized Nomenclature of Medicine-Clinical Terms (SNOMED CT)
- Unified Medical Language System (UMLS)
- Interoperability in Healthcare
- Integrating the Healthcare Enterprise (IHE)
  - A Roadmap for Interoperability of eHealth Systems (RIDE Project)
- Disease Registries
- Public Health Informatics
- Secondary Use of Clinical Data
- Information Retrieval (IR)
- Medical Resources
- Evidence Based Medicine (EBM)
- BMHI in relation to Organizational Behavior
- BMHI in relation to Project Management
Standards, Definitions
(Shortliffe, 2006)

• Standard is “comprises a set of rules and definitions that specify how to carry out a process or produce a product” (Hammond, Cimino, 2006)

• “standard is useful because it provides a way to solve a problem that other people can use without having to start from scratch” (Hammond, Cimino, 2006)
Importance of Standards

• “any meaningful exchange of utterances depends upon the prior existence of an agreed upon set of semantic and syntactic rules” (ISO, 1987)

• There are problems evolved from:
  – Synonymy and Polysemy
  – Multiple care Providers
  – Many patient encounters
  – Diversity/Huge Medical knowledge
  – Others?!
Importance of Standards cont. (Hovenga, 2010)

- “Standards are needed to facilitate interoperability between clinical information systems within and between healthcare organizations”
- “Enables the exchange and aggregation of clinical (point of care) information documented by several health care providers’ within any number of clinical information systems for each patient treated”
Importance of Standards cont. (Hovenga, 2010)

• Many different data/information entered by many/different healthcare providers, may be aggregated, then used for:
  – Direct patient care
  – Practice evaluation
  – Outcome evaluation
  – Clinical Trials
  – Planning
  – Bio-surveillance
  – Others?!
Standard Development (Hammond, Cimino, 2006)

- Standards Could be a evolved through:

1. **Ad hoc method**, ACR-NEMA produce DICOM
2. **De facto method**, Microsoft products
3. **Government-mandate method**, USA-NIST produced CMS’s UB92
4. **Consensus method**, as HL7
Categories of Standards

- In Health Informatics, we deal mainly with two categories of standards:
  
  - Messaging Standards, e.g. HL7, DICOM, CDA
  - Standard Terminology, e.g. LOINC, ICD-10, CPT-4, RxNorm
Health Level Seven International (HL7)

- Not-for-Profit, Standard Developing Organization (SDO)
- Founded 1987, USA
- Accredited by ANSI in 1994
- Members: 2,300+
- Includes about 500 corporate members, representing more than 90% of the Healthcare IT vendors.
HL7 cont.

• Developed the will know HL7 Messaging Standard

• “HL7 V2.x has been proven to be very cost effective for the health industry” (Hovenga, 2010)

• HL7 V2.x enables syntactic interoperability

  • MSH|^~\&|GHH LAB|ELAB-3|GHH OE|BLDG4|200202150930||ORU^R01|CNTRL-3456|P|2.4<cr> PID|||555-44-4444||EVERYWOMAN^EVE^E^^^^L|JONES|19620320|F|||153 FERNWOOD DR.^ ^STATESVILLE^OH^35292||(206)3345232|(206)752-121| |||AC555444444| |67-A4335^OH^20030520<cr> OBR|1|845439^GHH OE|1045813^GHH LAB|15545^GLUCOSE|||200202150730||| | | 555-55-5555^PRIMARY^PATRICIA P^^^^MD^^|||F| | | |444-44-4444^HIPPOCRATES^HOWARD H^^^^MD<cr> OBX|1|SN|1554-5^GLUCOSE^POST 12H CFST:MCNC:PT:SER/PLAS:QN|^182|mg/dl|70_105|H|||F<cr>
• HL7 v2.x suffers from many limitations that lead to “even systems that are compliant with these HL7 standards are likely to have various difficulties in communicating with each other” (Hovenga, 2010)

• This lead to the necessity to develop another version to avoid these limitations, such as HL7 Version 3
Digital Imaging and Communications in Medicine (DICOM)

- [http://medical.nema.org/](http://medical.nema.org/)
- 1983, by American College of Radiology (ACR), and the National Electrical Manufacturers Association (NEMA)
- Some view DICOM as a “Set of Standards”
- Developed to fulfill all functions of medical imaging such as: data transfer, storage, and representation
DICOM cont.

Source: http://www.sobox.it/images/si-viewer-001.jpg
Clinical Document Architecture (CDA)

- http://www.hl7.org/implement/standards/cda.cfm
- Released by HL7
- Considered a part of HL& standard
- “CDA makes documents both:
  - Machine-readable, so they are easily parsed and processed electronically
  - Human-readable, so they can be easily retrieved and used by the people who need them”
- Use XML and HL7 RIM
Terminology Standards (Shortliffe, 2006)

Terminology Standards includes standards for:

- Diseases and Diagnosis: ICD10
- Drugs: RxNorm, NDC
- Laboratory: LOINC
- Procedure: CPT-4
- Nursing: NANDA codes, NIC, HHCC
International Classification of Diseases (ICD)

- [http://www.who.int/classifications/icd/en/](http://www.who.int/classifications/icd/en/)

- 1893, the International Statistical Institute adopted the first edition, which was known as the International List of Causes of Death, was adopted by in 1893

- 1948, WHO got the responsibility of ICD

- “The ICD is the international standard diagnostic classification for all general epidemiological, many health management purposes and clinical use”
ICD cont.

• “It is used to classify diseases and other health problems recorded on many types of health and vital records including death certificates and health records” (WHO, 2010)
• There were many limitations with ICD-9
• This lead to development of ICD-10
• Please check:
  http://apps.who.int/classifications/apps/icd/icd10online/
RxNorm

- Provided by the National Library of Medicine (NLM) as part of Unified Medical Language System (UMLS)
- “provides normalized names for clinical drugs and links its names to many of the drug vocabularies commonly used in pharmacy management and drug interaction software” (NLM, 2010)
National Drug Codes (NDC)

- [http://www.fda.gov/Drugs/InformationOnDrugs/ucm142438.htm](http://www.fda.gov/Drugs/InformationOnDrugs/ucm142438.htm)
- Developed by the Food and Drug Administration (FDA) USA
- “Widely used in the United States, but it is not as comprehensive as the WHO codes” (Hammond, Cimino, 2006)
Logical Observation Identifiers Names and Codes (LOINC)

- [http://loinc.org/](http://loinc.org/)
- Developed by Regenstrief Institute, Indiana University
- “Originally called Laboratory Observations, Identifiers, Names and Codes, then the system has been extended to include non-laboratory observations (vital signs, electrocardiograms, and so on)” (Hammon, Cimino, 2006)
- “The purpose of the LOINC database is to facilitate the exchange and pooling of results for clinical care, outcomes management, and research” (LOINC, 2010)

- CPT is a registered trademark of the American Medical Association (AMA)
- CPT is a “medical nomenclature used to report medical procedures and services under public and private health insurance programs” (AMA, 2010)
- “provide a pre-coordinated coding scheme for diagnostic and therapeutic procedures
- for billing and reimbursement” (Hammond, Cimino, 2006)
Nursing Terminology
(Hammond, Cimino, 2006)
• Motivated by the failure of other standards “to represent concept needed in Nursing Care”
• This lead to evolution of:
  – North American Nursing Diagnosis Association (NANDA) codes
  – Nursing Interventions Classification (NIC)
  – Nursing Outcomes Classification (NOC)
  – Georgetown Home Health Care Classification (HHCC)
  – Omaha System (which covers problems, interventions, and outcomes)
International Health Terminology Standards Development Organization (IHTSDO)

- [http://www.ihtsdo.org/](http://www.ihtsdo.org/)
- Based in Denmark, international Not-for-Profit organization
- Goal is “to develop, maintain, promote and enable the uptake and correct use of its terminology products in health systems, services and products around the world…” (IHTSDO, 2010)
- “IHTSDO acquires, owns and administers the rights to SNOMED CT”
Systematized Nomenclature of Medicine-Clinical Terms (SNOMED CT)

- 1975, first SNOMED by Roger Côté and David Rothwell
- “Considered to be the most comprehensive, multilingual clinical healthcare terminology in the world” (IHTSDO, 2010)
- “SNOMED links to LOINC and ICD-9.
- In 2003, the National Library of Medicine paid for free downloads of SNOMED through 2008” (Hoyet, 2008)
Unified Medical Language System (UMLS)

- Developed by the National Library of Medicine (NLM), USA
- “The UMLS integrates and distributes key terminology, classification and coding standards, and associated resources to promote creation of more effective and interoperable biomedical information systems and services, including electronic health records” (NLM, 2010)
Interoperability in Healthcare

- “the ability of two or more systems or components to exchange information and to use the information that has been exchanged” (IEEE, 1990)
- Interoperability within/between healthcare facilities is considered for the Hottest topics in Health Informatics
- If interoperability is hindered, Health Informatics abilities would be hindered
Interoperability in Healthcare cont.

• Adopting standards is a step to achieve interoperability, but not everything.

• “Standards are tools used in the interoperability Process”

• Many initiatives and projects are developing to achieve interoperability in healthcare, e.g.:  
  – Integrating the Healthcare Enterprise (IHE)  
  – A Roadmap for Interoperability of eHealth Systems (RIDE)
Integrating the Healthcare Enterprise (IHE)

- [http://www.ihe.net/](http://www.ihe.net/)

- “IHE is an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information” (IHE, 2010)

- It is not a Standard Development Organization (SDO)

- It use already existing standards in a Coordinated Way

- So better communication and easier implementation of Health Information Systems
A Roadmap for Interoperability of eHealth Systems (RIDE Project)

- “RIDE is a roadmap project for interoperability of e-Health systems leading to recommendations for actions and to preparatory actions at the European level” (RIDE, 2010)
- Focus on semantic interoperability
Disease Registries
(Hoyet, 2008)

• Electronic disease registry is “A software application for capturing, managing and providing access to condition specific information for a list of patients to support organized clinical care” (CHCF)

• Usually used for chronic diseases as Diabetes and Hypertension

• Useful for both healthcare provider and patients
Disease Registries cont. (Hoyet, 2008)

- Entering data could be through either manual, automated or automated-integrated process

- Examples:
  - Chronic Disease Electronic Management Systems (CDEMS)
    http://www.cdeems.com/
  - DocSite Patient Planner
    http://www.docsite.com/
Public Health Informatics

- Definition: “the systematic application of information and computer science and technology to public health practice, research, and learning” (Friede et al., 1995; Yasnoff et al., 2000)
- Focus on population’s health rather than individual’s health
- Centers for Disease Control were the normal procedure till September 11th, 2001
- After September 11th, 2001, the status changed
In 1988, IOM described Public health in terms of:

• Assessment: monitoring and tracking of health population’s health, then analysis to conclude reasons behind health problems

• Policy development, depending on results of assessment

• Assurance, that the required healthcare services are actually provided
Public Health Informatics Application (Hoyet, 2008)

• Public Health Informatics Network (PHIN) is the natural evolution for CDC

• “PHIN goal is to link together the players involved with US Public Health, using well established data standards”

• “vision is to improve disease surveillance, health status indicators, data analysis, monitoring, intervention, prevention, decision support, knowledge management, alerting and the official public health response”
Secondary Use of Clinical Data

- Is the use of health information for purpose other than the direct healthcare service, which is the primary use e.g. Bio-surveillance, clinical trials

- “non-direct care use of personal health information (PHI) including but not limited to analysis, research, quality/safety measurement, public health, payment, provider certification or accreditation, and marketing and other business including strictly commercial activities” (Safran et. al., 2007)
Secondary Use of Clinical Data cont.

- AMIA recommendations for secondary use of health data are:
  1. Increase transparency of data use and promote public awareness
  2. Focus ongoing discussions on data access, use, and control, not on ownership
  3. Discuss privacy policies and security for secondary use of health data
  4. Increase public awareness of benefits and challenges associated with secondary use of health data
Secondary Use of Clinical Data cont.

• AMIA recommendations for secondary use of health data are:

5. Create a taxonomy for secondary uses of health data

6. Address comprehensively the difficult, evolving questions related to secondary use of health data

7. Focus national and state attention on the secondary use of health data
Information Retrieval (IR)

• Definition: “is the field concerned with the acquisition, organization, and searching of knowledge-based information” (Hersh, 2003)

• While BMI is being developed new formats for data appeared other than text, such videos, chemical structures, cartographic materials,...etc. (Hersh et al., 2006)

• So new methods and digital libraries should also be developed

• IR would make use of Standards and interoperability protocols
Medical Resources
(Hoyet, 2008)

• “Ideal medical resources are those that are:
  – Evidence based with references and level of evidence
    Updated frequently
  – Simple to access with a single sign-on
  – Available at the point of care
  – Capable of being embedded into an electronic health record
  – Likely to produce an answer with only a few clicks
  – Useful for primary care physicians and specialists
  – Written and organized with the end user in mind”
Medical Resources (Hoyet, 2008)

- Examples for Online Medical Resources:
Evidence Based Medicine (EBM)

- Definition: “the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients” (CEBM, 2010)
- “clinicians should seek and apply the highest level of evidence available” (Hoyet, 2008)
- “Patients should receive care based on the best available scientific knowledge. Care should not vary illogically from clinician to clinician or from place to place” (IOM, 2001)
Evidence Based Medicine cont.

• Studying EBM is important, because (Hoyet, 2008):
  1. “Our current methods of keeping medically or educationally up to date do not work
  2. Translation of research into practice is often not successful
  3. Lack of time and the volume of published material result in information overload
  4. The pharmaceutical industry bombards clinicians and patients everyday; often with misleading or biased information
  5. Much of what we consider as the “standard of care” in every day practice has yet to be challenged and is probably wrong”
EBM Pyramid (Hoyet, 2008)

- Meta-analyses
- Systematic reviews
- Random controlled trials
- Cohort studies
- Case control studies
- Case report/case series
- Animal research
BMHI in relation to Organizational Behavior

• Organizational Behavior: “Actions and attitudes of individuals and groups toward one another and towards the organization as a whole, and its effect on the organization's functioning and performance” (businessdictionary, 2010)

• E.g.: Leadership, Motivation, Team working, Communication, Conflict and Negotiation, Power and Politics,...etc.
BMHI in relation to Project Management

- “application of computers, communications and information technology and systems to all fields of medicine - medical care, medical education and medical research” (Collen, 1980)
- “the scientific field that deals with biomedical information, data, and knowledge—their storage, retrieval, and optimal use for problem solving and decision making” (Shortliffe, 2006)
- Due to the practical and implementable nature of BMHI discipline, so Project Management Science plays a big role
Announcement

• Final Exam will be “Sunday July 18, 2010; 10:00 AM”
• Final Report has to be submitted before “Saturday July 24, 2010; 9:00 AM”

Best Wishes
Thanks
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