A Unifying Socio-technical Model of Health Information Technology Implementation, Use, and Evaluation

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My goals today...

• Describe why we need models like this...
• Describe where this model came from...
• Describe our new model...
Why do we need this model?

- Design, development, implementation, use, and evaluation of HIT is complex and prone to failure
- Need a method of understanding the relationships...
- **Technical subsystem:**
  - devices, tools and techniques needed to transform inputs into outputs
- **Social subsystem:**
  - employees and the knowledge, skills, attitudes, values and needs they bring to the work environment
  - reward system and authority structures that exist in the organization
- **Environmental subsystem:**
  - customers, suppliers, and the rules and regulations, formal and informal, which govern the relations of the organization to society at large
Roger’s Diffusion of Innovations Theory
Norman’s 7-stages of Action Model
The original socio-technical perspective...

Systems Engineering Initiative for Patient Safety
Brender’s Factors for Success and Failure of Health Informatics Applications

• Identified and rated over 100 factors affecting success and/or failure of HIT...

• Main Categories:
  – Functional
  – Organizational
  – Technical
  – Managerial
  – Cultural
  – Legal
The 8-Rights Socio-Technical Model of HIT

Communication & Workflow

Users

Human – Computer Interface

Clinical Content

System & Application Software

IN  FR  AS  TR  UC  TU  RE
1. Hardware & Software

• Must be capable of supporting ALL required clinical activities.
• CPOE should be able to:
  – Calculate a medication dose
  – transmit the order to the appropriate department
  – notify the nurse of a placed order
• Local software oversight committees are a way to help ensure proper and safe functioning.
• Cloud computing, reliable computing services that are accessible from remote locations via the Internet
Issue Under Study

- Monitoring
- Hardware and Software
- Content
- Workflow and Communication
- State and Federal Rules
- User Interface
- Organizational Characteristics
- Personnel

JAMA. 2009;302(10):1111-1113
2. Clinical Content

- Standard medical vocabularies to encode clinical findings
- Clinical knowledge to create specialty-specific features and functions
- Must be evidence-based, carefully constructed, monitored, complete, and error free
2. For patient-specific CDS, you need DATA!

<table>
<thead>
<tr>
<th>Input Data Element</th>
<th>Rule Types</th>
<th>Rules</th>
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<tbody>
<tr>
<td>Laboratory result/observation</td>
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<td>2,087</td>
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<tr>
<td>Drug list</td>
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<td>4,752</td>
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<td>Hospital visit</td>
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<td>Diagnosis/problem</td>
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<tr>
<td>Race</td>
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</tbody>
</table>

3. User Interface...

- Allows clinicians to quickly grasp a complex system safely and efficiently.
- All the relevant patient data so clinicians can rapidly perceive problems, formulate responses, and document their actions.
- Includes physical aspects of the interface (e.g., keyboard, mouse, or touch screen) may also contribute to error in the input or selection of information.
- The federal government and HIT vendors should develop common user interface standards for health care applications.
Issue Under Study

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- Personnel
4. Personnel...

- Trained and knowledgeable personnel are essential
  - System developers should have software engineering skills
    - be able to design effective user interfaces,
    - use existing standardized clinical vocabularies, and
    - have a sound understanding of clinical medicine.
  - Trainers, implementers, and maintenance staff need
    - clinical experience,
    - understanding of system capabilities and limitations, and
    - excellent project management skills.
  - Users should understand how
    - to integrate the system into their workflows or lifestyle and
    - how to function when it is unavailable
  - Close interaction among informatics experts, clinical application coordinators, and end users is essential
A multidisciplinary team responsible for creating and maintaining clinical content

• Staff of dedicated knowledge engineers
• Subject matter experts
• Clinical content committees
Issue Under Study

 Workflow and Communication

 State and Federal Rules

 Organizational Characteristics

 Personnel

 User Interface

 Content

 Hardware and Software

 Monitoring
5. Workflow and Communication

• Disruptions in workflow or information transfer are fertile grounds for inefficiency and error.

• Careful workflow analysis that accounts for EHR use could lead to identification of potential breakdown points.

• Errors may result from interventions that are not delivered at the best point in the workflow.
Simplified workflow...

INPATIENT

A. Pre-Admission
B. Admission / Nursing Assess.
C. MD's H&P and plan
D. Documentation
E. Orders
F. Order handling (RN, Pharm)
H. Results arrive
I. Consult requests

Pre-visit q'naires Pt reminders

Structured docu.

order sets, parameter checking

Follow-up care prompts

AMBULATORY

A. Pre-Visit
B. Start of Visit / Intake
C. Clinician's H&P and plan
D. Documentation
E. Orders / Rx
F. Therapies / Procedures
G. End of Visit / Check-out
H. Rx Dispense
J. Results Arrive

Time-based checks

K. Post-Visit / Home Care
Why is this so hard?
Hardware and Software
Content
User Interface
Organizational Characteristics
Personnel
State and Federal Rules
Workflow and Communication
Monitoring

Issue Under Study

JAMA. 2009;302(10):1111-1113
6. Organizational Characteristics

• Culture of innovation, exploration, and continual improvement are key organizational factors for safe HIT use.

• Organizations should:
  – Actively facilitate reporting of errors or barriers to care resulting from HIT use,
  – carefully review their existing policies and procedures before implementation.
7. State and Federal Rules & Regulations

• Regulations may act as barriers or facilitators for safe HIT
• ARRA stipulates that clinicians and health care organizations can receive incentive payments for “meaningful use” of EHRs.
  – Legislation could result in suboptimal systems
• Regulations to safeguard patient privacy may have the greatest unintended consequence on EHR implementation.
• Policies must address safety and effectiveness of health information exchange across organizational boundaries
  – reopen the debate about national patient identifiers.
• State and federal governments should create an environment compatible with widespread use and interoperability
  – Schedule II narcotics
  – Mexico – must have a paper medical record
8. Monitoring

• Reports have described serious errors related to the use or misuse of HIT...result of:
  – Faulty system design,
  – User configuration, or
  – Implementation processes.

• Organizations must continually evaluate the usability and performance of their systems after implementation,
  – reliably measure benefits, and
  – assess potential e-iatrogenic effects.

• Use of a vendor-independent hazard reporting database

• National implementation accreditation test to help ensure that the systems are functioning as designed and are safe to use.

• The LeapFrog clinical decision support functionality test is an example of how such a test could be constructed.
Summary...

• Health Information technology design, development, implementation, use, & evaluation is about more than...

• Informaticists must take all of the elements of this model into consideration to solve real-world HIT problems.
Eight Rights of Safe Electronic Health Record Use
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Thank you,
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