Using IT to Improve Patient Safety

Dean F. Sittig, Ph.D.

@DeanSittig
Overview of EHR’s role in patient safety
Unintended consequences of EMR use
Red-flags to help identify EMR-related safety concerns
SAFER Guides: safe & effective EMR implementation and use
Q & A
HIT can improve safety and effectiveness of healthcare

Randomized clinical trial of pressure-controlled inverse ratio ventilation and extracorporeal CO2 removal for adult respiratory distress syndrome.

A H Morris, C J Wallace, R L Menlove, T P Clemmer, J F Orme, Jr, L K Weaver, N C Dean, F Thomas, T D East, N L Pace, M R Suchyta, E Beck, M Bombino, D F Sittig, S Böhm, B Hoffmann, H Becks, S Butler, J Pearl, and B Rasmusson
At about 8 a.m. Monday, the electronic health record system at seven East Bay hospitals, medical offices and clinics went dark. The meltdown continued through late afternoon or early evening, according to early reports from the California Nurses Association.

The incident left doctors and nurses without access to patient information — including medications and patient histories — at Alta Bates Summit Medical Center facilities in Berkeley and Oakland, Eden Medical Center in Castro Valley, Mills Peninsula Health Services in Burlingame and San Mateo, Sutter Delta in Antioch, Sutter Tracy, Sutter
Smokers prescribed Viagra to quit

Smokers trying to quit the habit were mistakenly prescribed anti-impotence drug Viagra by doctors.

NHS Greater Glasgow and Clyde said the error was due to a computer glitch at two city GP practices.

When GPs selected anti-smoking pill Zyban, computers selected sildenafil, the generic name for Viagra.

A health board spokeswoman said: "At no time was patient care affected by this as all prescriptions are subject to stringent double checking."

The e-Formulary computer system used by GPs automatically selects a list of the most popular drugs when doctors fill out prescriptions.

Some patients went to the pharmacy with a prescription for the anti-impotence drug instead of the anti-smoking pill to help them stop smoking.
## Defining Major types of HIT-related Safety Concerns

<table>
<thead>
<tr>
<th>Type of HIT-related safety concern</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Instances in which <strong>HIT fails during use or is otherwise not working</strong> as designed.</td>
<td>Broken hardware or software “bugs”</td>
</tr>
<tr>
<td>2. Instances in which HIT is working as designed, but the design <strong>does not meet the user’s needs or expectations.</strong></td>
<td>Usability issues</td>
</tr>
<tr>
<td>3. Instances in which HIT is well-designed and working correctly, but was <strong>not configured, implemented, or used in a way anticipated or planned</strong> for by system designers and developers</td>
<td>Duplicate order alerts that fire on alternative PRN pain medications</td>
</tr>
</tbody>
</table>

### Major types of HIT-related Safety Concerns

<table>
<thead>
<tr>
<th>Type of HIT-related safety concern</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Instances in which HIT is working as designed, and was configured and used correctly, but interacts with external systems (e.g., via interfaces) so that data is lost or incorrectly transmitted or displayed.</td>
<td>Order for extended release morphine changed to immediate release morphine by error in interface translation table</td>
</tr>
<tr>
<td>5. Instances in which specific safety features or functions were not implemented or not available (i.e., HIT could have prevented an issue).</td>
<td>Patient receives 5 grams of acetaminophen in 24 hours because max daily dose alert not available</td>
</tr>
</tbody>
</table>
Evolution of safety (and risks) - Phases

Safe IT:

◦ Events unique/specific to HIT; more likely early in implementation

Using HIT safely:

◦ Unsafe or inappropriate use of technology
◦ Unsafe changes in the workflows that emerge from technology use

Using HIT to improve/monitor safety

◦ Monitor health care processes and patient outcomes to identify potential safety concerns before harm

We use a comprehensive, socio-technical model to...

- Help us discover & understand
- Where and how EHR-related unintended consequences occur,
- So we can prevent or manage them

8-dimension Socio-Technical Model of Safe & Effective EHR Use

Hardware & Software
We found failures of hardware to function as designed...

Hardware failures include:
- power losses
- server failure
- network outages
- voice-data outages

Users require more hardware to meet the their never ending demands

Pardon us ...

We’re improving our computer system so we can provide you with better service and care. While we get up to speed, we apologize for any inconvenience.
Failures in data input, storage, and retrieval can lead to patient harm

Software failures (or “bugs”)

- may affect the data in a single CIS or the transmission of data among CISs.

Poorly designed software leads to work-arounds

Both types can result in more or less complete information corruption or loss.
High-quality, efficient clinical care becomes over dependent on the computing infrastructure.

- System failures wreak havoc unless good downtime procedures exist.
- Reliance on clinical decision support may reduce learning.
- “If it's in the computer it must be right!”

Red flags: Indications that something may be wrong

- For example, a 60-year old healthy patient complains of fever and a cough for a week; given a diagnosis of upper respiratory infection; prescription for cough syrup

- If the same patient indicated he is coughing up blood and he just returned from Liberia, that would warrant special attention

- Ebola test, Chest x-ray, travel to Liberia and blood in sputum at that age are “red flag” that could suggest something much more serious, like Ebola or lung cancer

Red flags: Extended EHR unavailability

- NO documented EHR downtime and reactivation procedures
- Critical hardware components not duplicated
Example Red Flags: Hardware & software...

Mean response  > 3 seconds or any request >10 secs

Access to computers is poor:
  > 2 clinicians waiting during peak usage
  clinicians must walk > 50 feet to find computer
  < 1 computer/staffed bed on an acute care unit
  < 2 computers per staffed bed in an ICU

Wireless network has “dead spots” on clinical units

No encrypted, offsite, daily backup, periodically tested

No computer-based method of notifying RNs of new orders or clinical results

8-dimension Socio-Technical Model of Safe & Effective EHR Use
Red flags: Incorrect patient ID

Key patient identifying information missing from EHR screens or printouts

Real-time clinical decision support can be a major factor in many of these hazards...

- CDS is not consistently useful.
- CDS can be impractical to maintain.
- CDS is not 100% reliable especially in complex situations, i.e., when it is really needed!
Red flags: failure to heed a computer-generated warning or alert

Widespread non-adherence to alerts

Clinicians report too many irrelevant alerts during order entry or as asynchronous messages

Clinicians report intrusive alerts that are not critical
8-dimension Socio-Technical Model of Safe & Effective EHR Use
Human – Computer Interface (HCI) can lead to hazards...

Areas of concern include:

- hazards caused by a mismatch between the user’s mental model of a task and the software designer’s mental model
- hazards that lead to a loss of situation awareness on the part of users
- hazards contributing to inadvertent selection of the wrong item from a pick-list.
Red flags: User interface errors

Clinicians report errors or inconsistencies between the structured data fields and free-text comments.
Red flags: incorrect item selected from a list of items

The EHR user interface has multiple cascading or fly-out submenus

FIGURE 109. Fly-out menus
8-dimension Socio-Technical Model of Safe & Effective EHR Use
CPOE systems create new work for physicians, nurses, administration and IT professionals.

- Enter new data
- Respond to alerts
- Expend extra time in completing non-routine, complex orders
- Training to use the system becomes a major issue
Users often react differently than system designers expect...

When asked...
“Do you want to document your actions to satisfy this alert?”

“We take these alerts personally, and they’re like a slam. It’s like, “Well, they [the patient] just got here and I haven’t even had a chance to do anything and I’m getting the ALERTS!”
Personnel

- No record all clinicians have passed a test of basic EHR functions before getting their login
- No one with formal informatics training involved in the EHR design, configuration, training, or optimization efforts
- User audit log shows > 20% of active clinicians have not logged in to the EHR in the last month
- < 75% of clinicians asked about downtime policies or procedures answer all questions correctly
- No employees with extensive clinical experience in the clinical information systems department
8-dimension Socio-Technical Model of Safe & Effective EHR Use
CPOE alters communication among providers, ancillary services, and clinical departments.

Causes reductions in face-to-face communication.

“illusion of “communication” belief that CPOE ensures that the proper people will see it and act upon it.

Emergent orders placed using CPOE... also phoned in to assure immediate action.
Your hospital will be paperless, the same day my bathroom is...

Michael Shabot, M.D.
CPOE highlights mismatches between intended and actual work processes.

Shed light on clinical roles.

May not accommodate integrated clinical workflow.

Work shifting.
Red flags: Incorrect patient ID

Absence of documented processes and procedures for checking patient ID at essential stages of a patient visit
Red flags: Incorrect patient ID

Nurses have copies of patient barcode ID bands taped to their clipboard to “facilitate” BCMA
8-dimension Socio-Technical Model of Safe & Effective EHR Use

Organizational Policies, Procedures, & Culture

Workflow & Communication

Content

User Interface

Hardware & Software

People

JAMA 2009; 302(10):1111-3
Quality & Safety in Healthcare 2010; 3:i68-74
HIT changes the “power structure” within the organization.

- Can prevent MDs from ordering tests or medications they prefer
- CISs limit clinician’s narrative flexibility...structured rather than free-text clinical documentation
- Han et al. limit ordering until patient has been registered... NO registration before arrival!
Red flags: open or incomplete orders

Orders requiring co-signature are overdue according to the organization’s policy
Red flags: EHR time measurement translational challenges

Routine tests, medications, or procedures ordered “daily” continue long after they are clinically indicated
Red flags: EHR time measurement translational challenges

Clinicians report that critical medications have been cancelled automatically with no notice to clinicians
8-dimension Socio-Technical Model of Safe & Effective EHR Use

Organizational Policies, Procedures, & Culture

Workflow & Communication

User Interface

Content

Hardware & Software

People

External Rules & Regulations
State/Federal Rules & Regulations

- Regulations may act as barriers or facilitators for safe EHR use
- ARRA and “meaningful use” of EHRs
  - Legislation could result in suboptimal systems
- Patient privacy
- Policies must address safety and effectiveness of health information exchange across organizational boundaries
- State and federal governments should create an environment compatible with widespread use and interoperability
8-dimension Socio-Technical Model of Safe & Effective EHR Use

- Organizational Policies, Procedures, & Culture
- Workflow & Communication
- Measurement & Monitoring
- People
- Hardware & Software
- Content
- User Interface

External Rules & Regulations

JAMA 2009; 302(10):1111-3
Quality & Safety in Healthcare 2010; 3:i68-74
Monitoring/Measurement

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

The SAFER Guides for Safe and Effective EHR Implementation and Use
6 principles in 3 phases

**Phase 1** *Safe Health IT: Address Safety Concerns Unique to EHR Technology*

1. Data Availability
2. Data Integrity
3. Data Confidentiality

**Phase 2** *Using Health IT Safely: Optimize the Safe Use of EHRs*

4. Complete/Correct EHR Use
5. EHR System Usability

**Phase 3** *Monitoring Safety: Use EHRs to Monitor and Improve Patient Safety*

6. Safety Surveillance, Optimization, and Reporting
SAFER: Safety Assurance Factors for EHR Resilience
www.healthit.gov/safer/

Foundational Guides
- High Priority Practices
- Organizational Responsibilities

Infrastructure Guides
- System Configuration
- System Interfaces
- Contingency Planning

Clinical Process Guides
- Patient Identification
- Computerized Provider Order Entry with CDS
- Test Results Reporting and Follow-up
- Clinician Communication

### Recommended Practices for Phase 1 — Safe Health IT

<table>
<thead>
<tr>
<th>Practice</th>
<th>Description</th>
<th>Implementation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Data and application configurations are backed up and hardware systems are redundant.</td>
<td>Worksheet 1</td>
</tr>
<tr>
<td>2</td>
<td>EHR downtime and reactivation policies and procedures are complete, available, and reviewed regularly.</td>
<td>Worksheet 2</td>
</tr>
<tr>
<td>3</td>
<td>Allergies, problem list entries, and diagnostic test results (including interpretations of those results, such as “normal” and “high”), are entered/stored using standard, coded data elements in the EHR.</td>
<td>Worksheet 3</td>
</tr>
<tr>
<td>4</td>
<td>Evidence-based order sets and charting templates are available for common clinical conditions, procedures, and services.</td>
<td>Worksheet 4</td>
</tr>
</tbody>
</table>
Recommended Practice

3. Allergies, problem list entries, and diagnostic test results (including interpretations of those results, such as “normal” and “high”), are entered/stored using standard, coded data elements in the EHR.

Implementation Status

Rationale for Practice or Risk Assessment

Free text data cannot be used by clinical decision support logic to check for data entry errors or notify clinicians about important new information.

Suggested Sources of Input

- Clinicians, support staff, and/or clinical administration
- EHR developer

Examples of Potentially Useful Practices/Scenarios

- RxNorm is used for coding medications and NDF-RT for medication classes.
- SNOMED-CT is used for coding allergens, reactions, and severity.
Rationale for Practice or Risk Assessment

Free text data cannot be used by clinical decision support logic to check for data entry errors or notify clinicians about important new information.

Examples of Potentially Useful Practices/Scenarios
- RxNorm is used for coding medications and NDF-RT for medication classes.
- SNOMED-CT is used for coding allergens, reactions, and severity.
Recommended Practice

3. Allergies, problem list entries, and diagnostic test results (including interpretations of those results, such as “normal” and “high”), are entered/stored using standard, coded data elements in the EHR.

Rationale for Practice or Risk Assessment

Free text data cannot be used by clinical decision support logic to check for data entry errors or notify clinicians about important new information.

Suggested Sources of Input

Clinicians, support staff, and/or clinical administration

EHR developer

Examples of Potentially Useful Practices/Scenarios

- RxNorm is used for coding medications and NDF-RT for medication classes.
- SNOMED-CT is used for coding allergens, reactions, and severity.
Recommended Practice

Allergies, problem list entries, and diagnostic test results (including interpretations of those results, such as “normal” and “high”), are entered/stored using standard, coded data elements in the EHR. 

Suggested Sources of Input

Clinicians, support staff, and/or clinical administration

EHR developer

Assessment Notes
Examples of Potentially Useful Practices/Scenarios

- RxNorm is used for coding medications and NDF-RT for medication classes.
- SNOMED-CT is used for coding allergens, reactions, and severity.
- SNOMED-CT, ICD-10, or ICD-9 is used for coding clinical problems and diagnoses.
- LOINC and SNOMED-CT are used for coding clinical laboratory results.
- Abnormal laboratory results are coded as such.

See the Computerized Provider Order Entry with Decision Support Guide and Test Results Reporting and Follow-Up Guide for related recommended practices.
Interactive section of worksheet

Follow-up Actions

Person Responsible for Follow-up Action

Click on a link below to view the topic online:

» References  » Phases & Principles  » Meaningful Use  » HIPAA
References: **High Priority Practices**

References from the literature are included to support the recommended practices and to provide additional resources.


Summary

- EHRs one of the most important tools to improve patient safety
- Without careful and continuous surveillance of these systems as implemented, safety concerns can arise
- Organizations can reduce EHR-related serious safety events by addressing these red flags
- SAFER Guides can help organization proactively assess their EHR safety
Thank you

Dean.F.Sittig@uth.tmc.edu
@DeanSittig