Relationship of Usability and Patient Safety with Health Information Technology

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Improving People's Lives
through innovations in personalized health care

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Poll

Which best describes you?

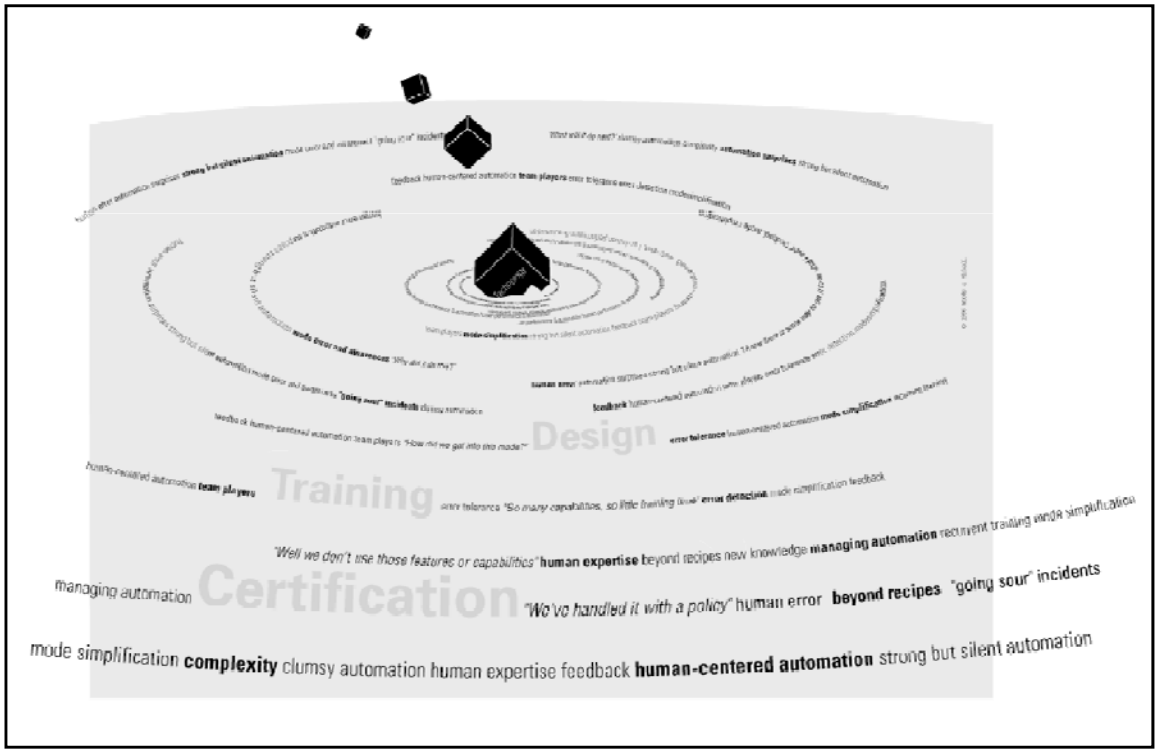
A. Researcher
B. Programmer
C. Usability expert
D. Patient safety expert
E. Administration/policymaker

Objectives

1. HIT: Transforming Complex Work
2. Definition of usability
3. Relationship between usability and safety
4. Usability testing methodologies
5. Evaluation scenarios that ensure complexity

The Era of HIT and Complexity

HIT Transforms Work



"Adopt a **proactive** approach: **examine new technologies** …for threats to safety and **redesign them** before accidents occur."

IOM report "To err is human" p. 150

Laments with Transformative HIT

- Some HIT **workflows** that do not match clinical processes create inefficiencies
- Poorly designed HIT **screens** that slow down the user and sometimes endanger patients
- **Large numbers of files** containing historical patient information that are difficult to search, navigate, read efficiently, and identify trends over time
- Confusing, and often conflicting, **error messages**
- **Alert fatigue** leading to users ignoring potentially critical messages
- **Excessive mouse clicks**, cursor movements, keystrokes, etc. during frequent tasks

Poll

What is your knowledge of usability testing?

A. Little knowledge
B. Know what it is
C. Have done a usability test
D. Expert in the area

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Definitions

Usability:
Extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use

Patient safety:
System attribute that influences the risk of patient harm due to errors

Q: What is the relationship between these for HIT?

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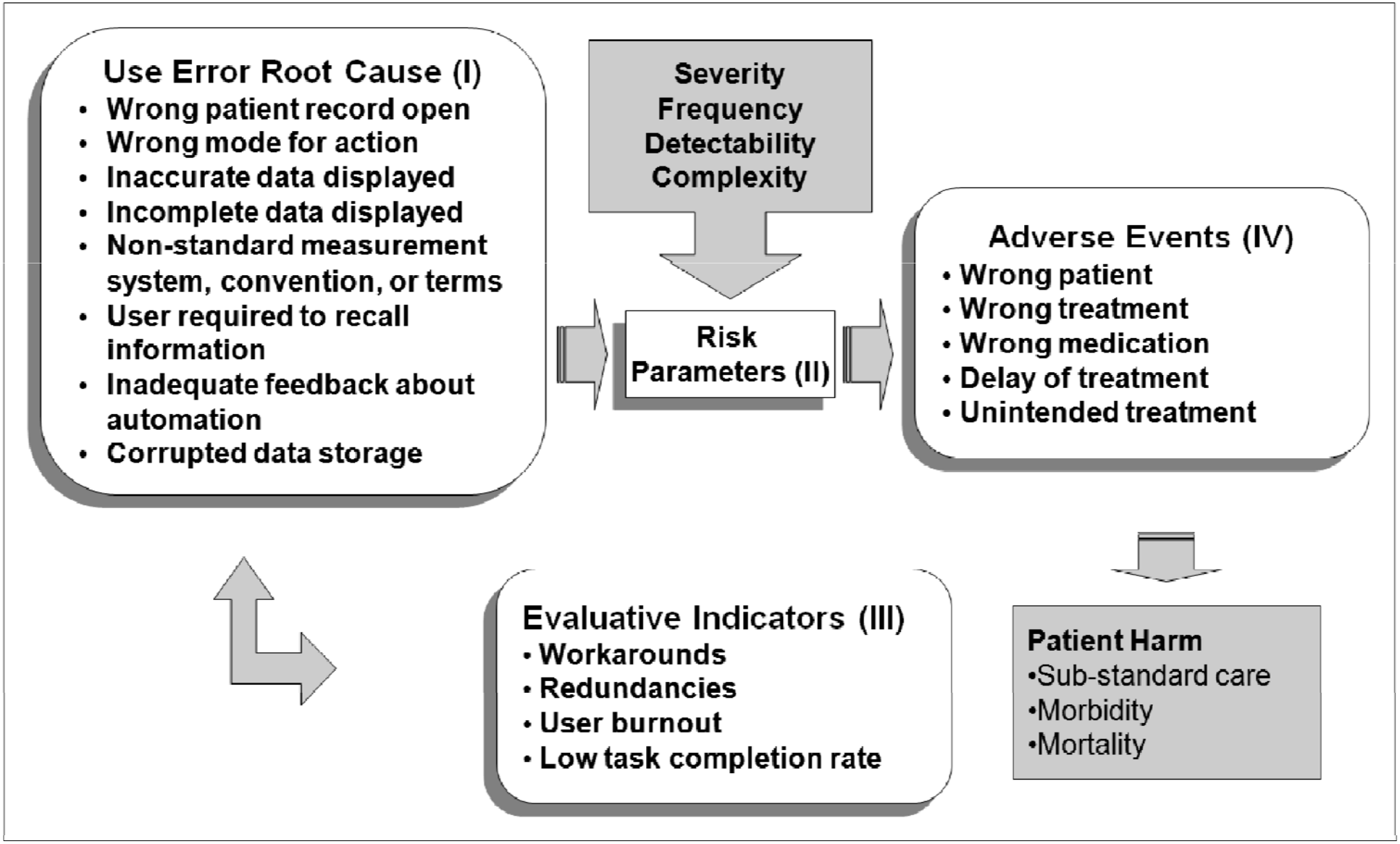
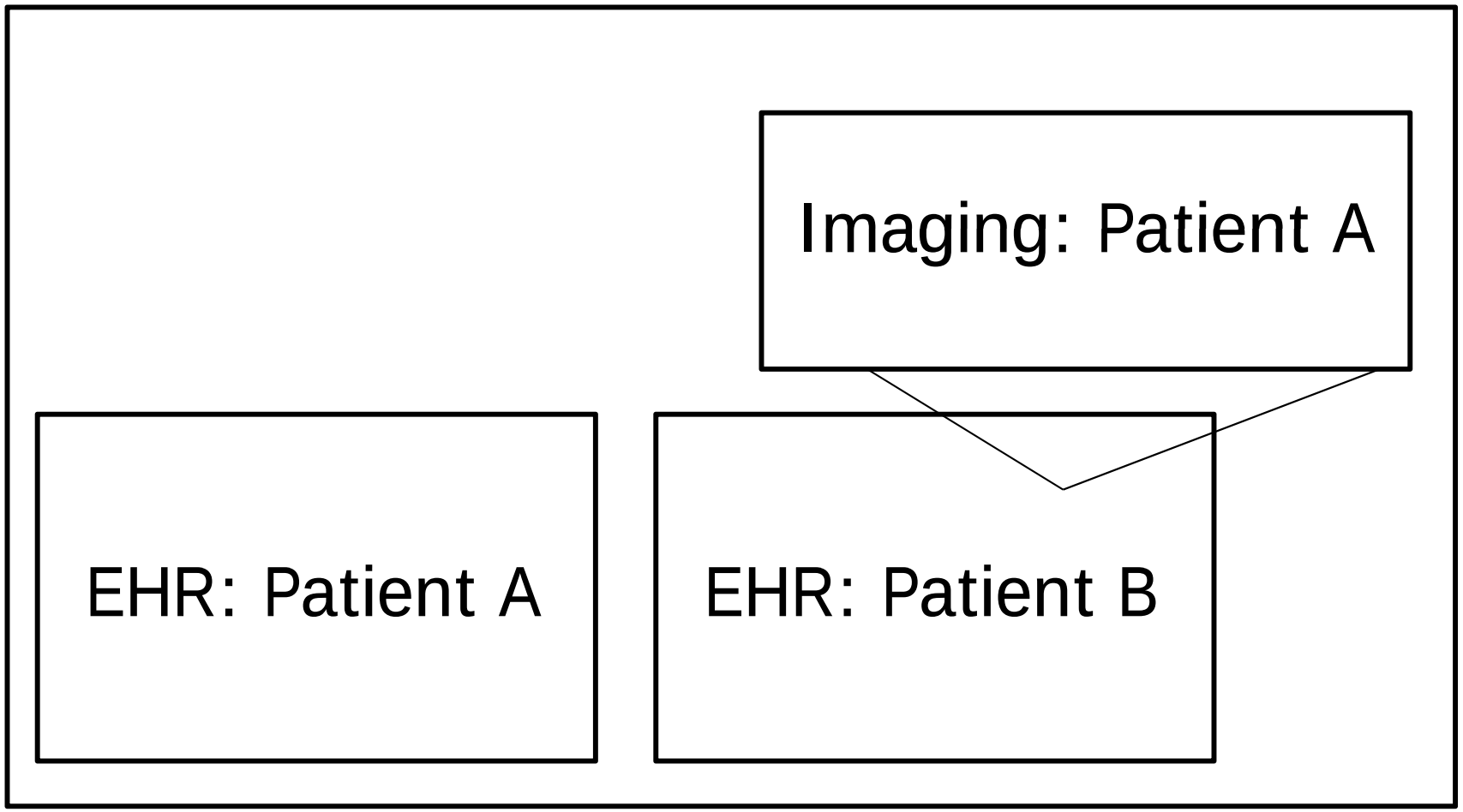
Framework: Use Errors and Patient Harm



Use Error: Wrong Patient Record Open



Use Error: Wrong Mode for Action

Direct Dose Mode (mcg/min)
Weight Dose Mode (mcg/kg/min)

Test Mode
Production Mode

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Use Error: Inaccurate Data Displayed

Lidocaine Hydrochlor

Use Error: Incomplete Data Displayed

80 mg

Use Error: Non-standard measurement system, convention, or terms

Kilograms or pounds?

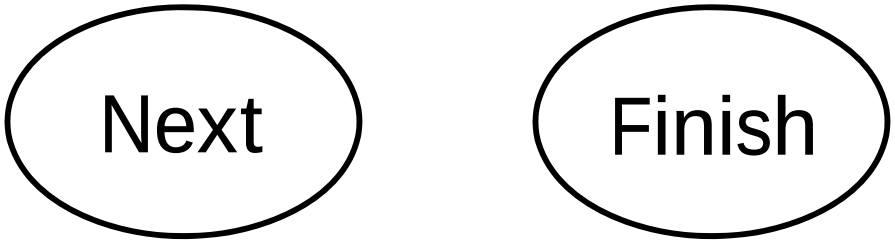
Use Error: User Required to Recall Information

One Time Dose

Use Error: Inadequate Feedback about Automation

1 tablet

Use Error: Corrupted Data Storage

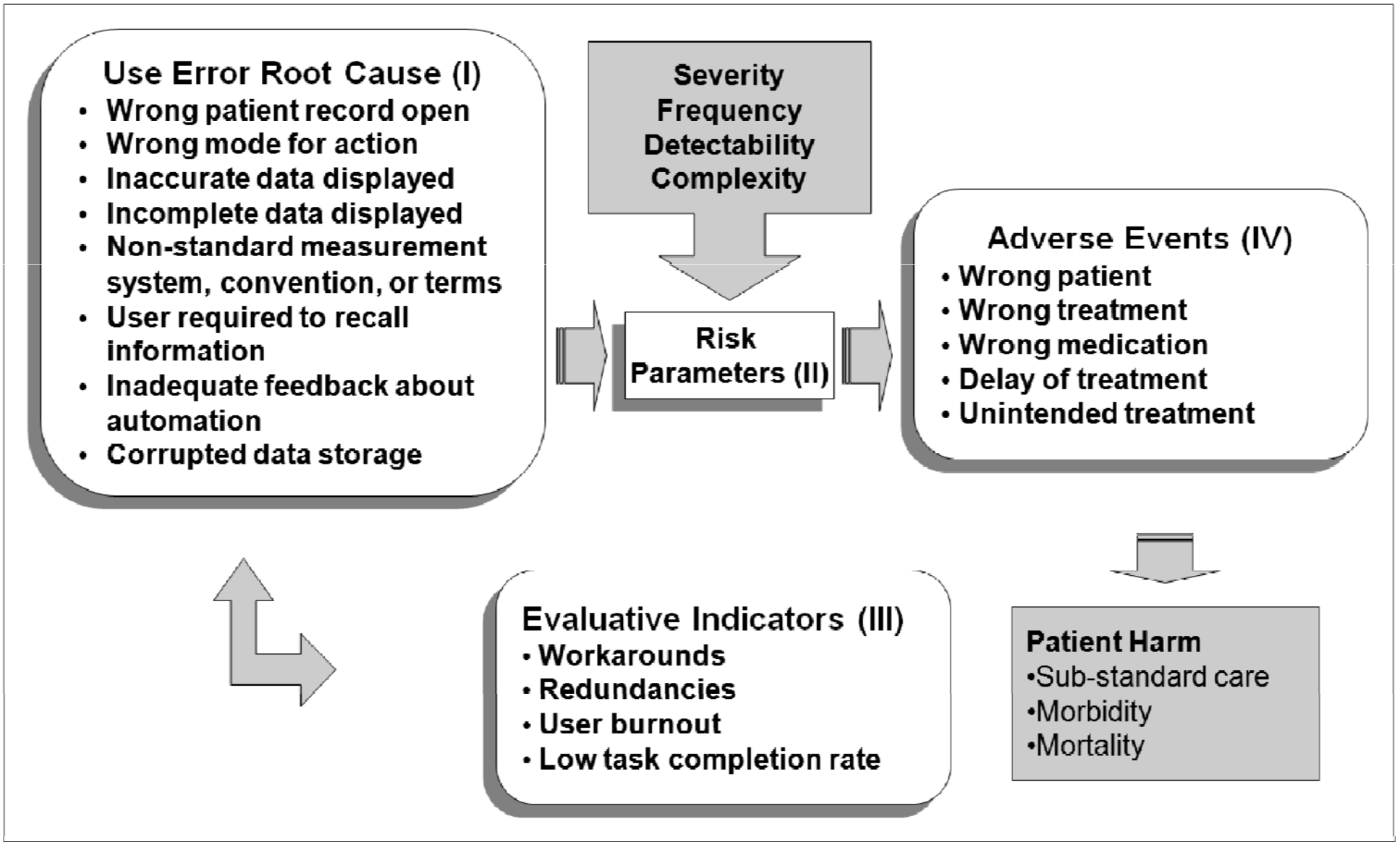


Poll

Have you or a family member experienced this at least partially due to a design flaw with HIT?

A. Wrong patient
B. Wrong treatment
C. Wrong medication
D. Delay of treatment
E. More than one

Framework: Use Errors and Patient Harm



Adverse Events

Wrong patient: Actions with potentially harmful consequences are performed for one patient that were intended for another patient or a patient is not informed of the need for treatment

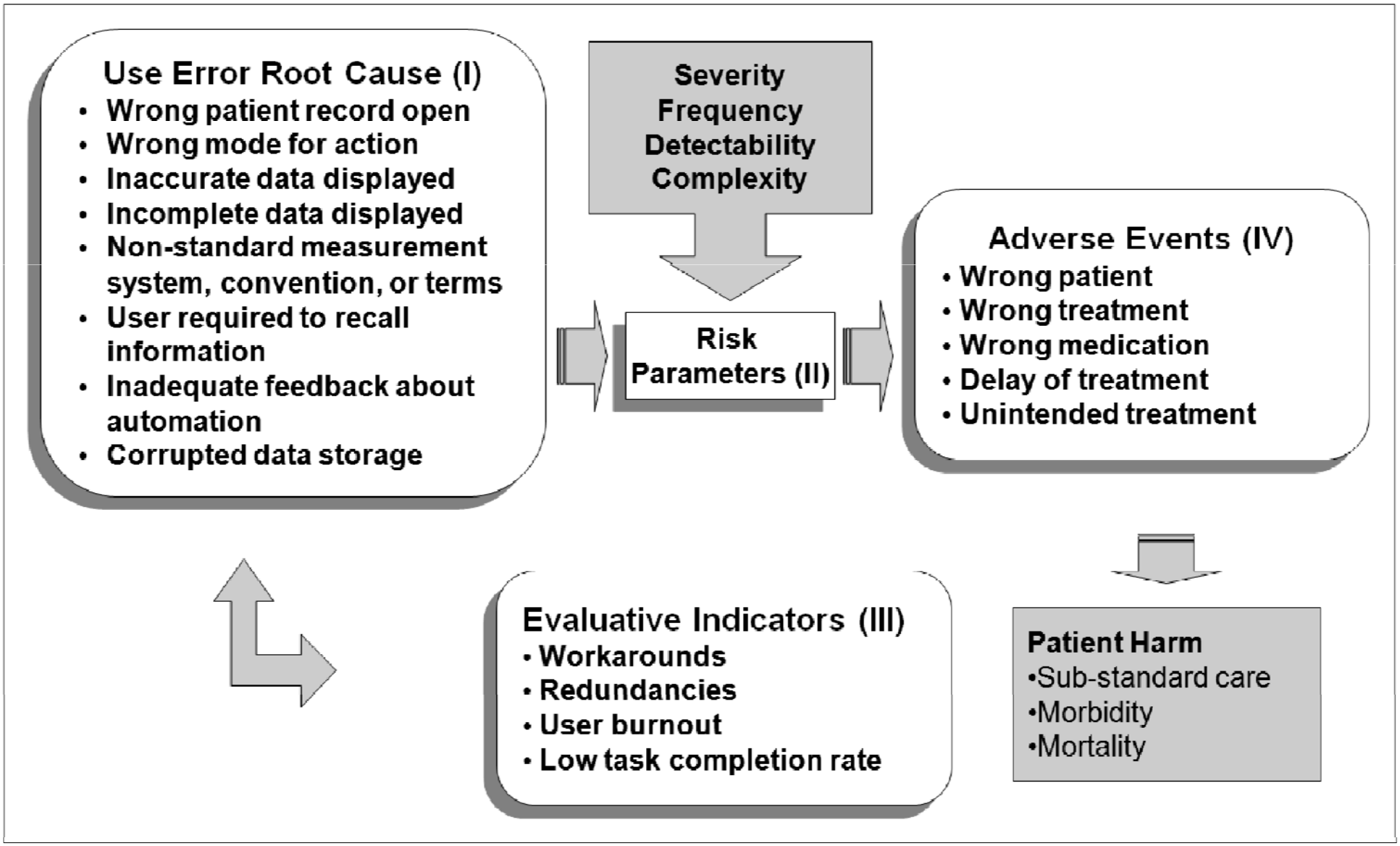
Wrong treatment: Treatments that were not intended for a patient are provided or missed

Wrong medication: A patient receives the wrong medication type, dose, or route

Delay of treatment: A patient receives a significant delay in the provision of care activities

Unintended or improper treatment: A patient receives unintended care due to confusion or due to actions taken to test software, train users, or demonstrate software to potential customers

Framework: Use Errors and Patient Harm



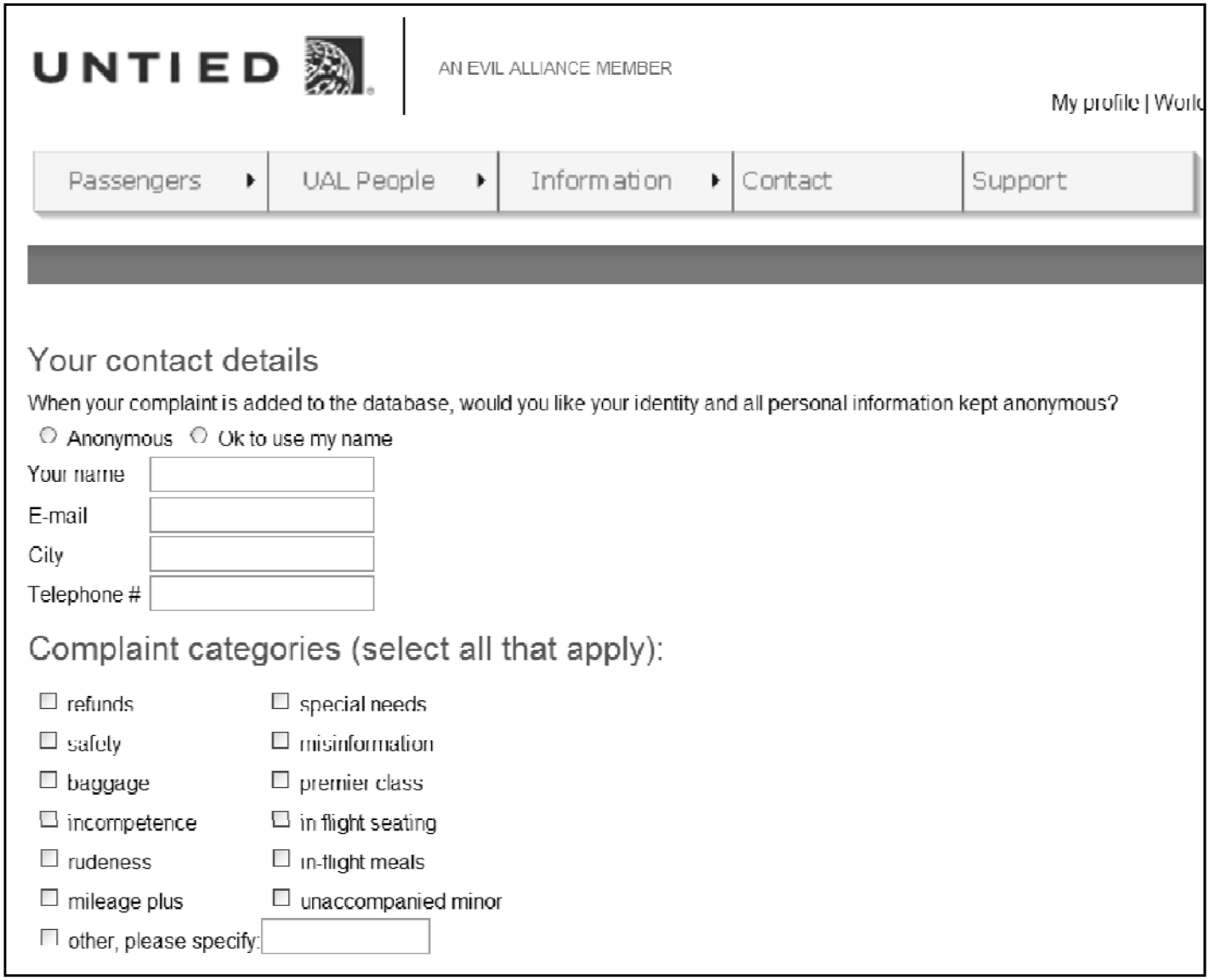
Solution 1: No Action

Solution 2: Sue the Builder

- Code of Hammurabi, 229

  If a builder builds a house for someone, does not construct it properly, and the house which he built falls in and kills its owner, then that builder shall be put to death.

Solution 3: Name and Shame



Solution 4: Summative Usability Testing

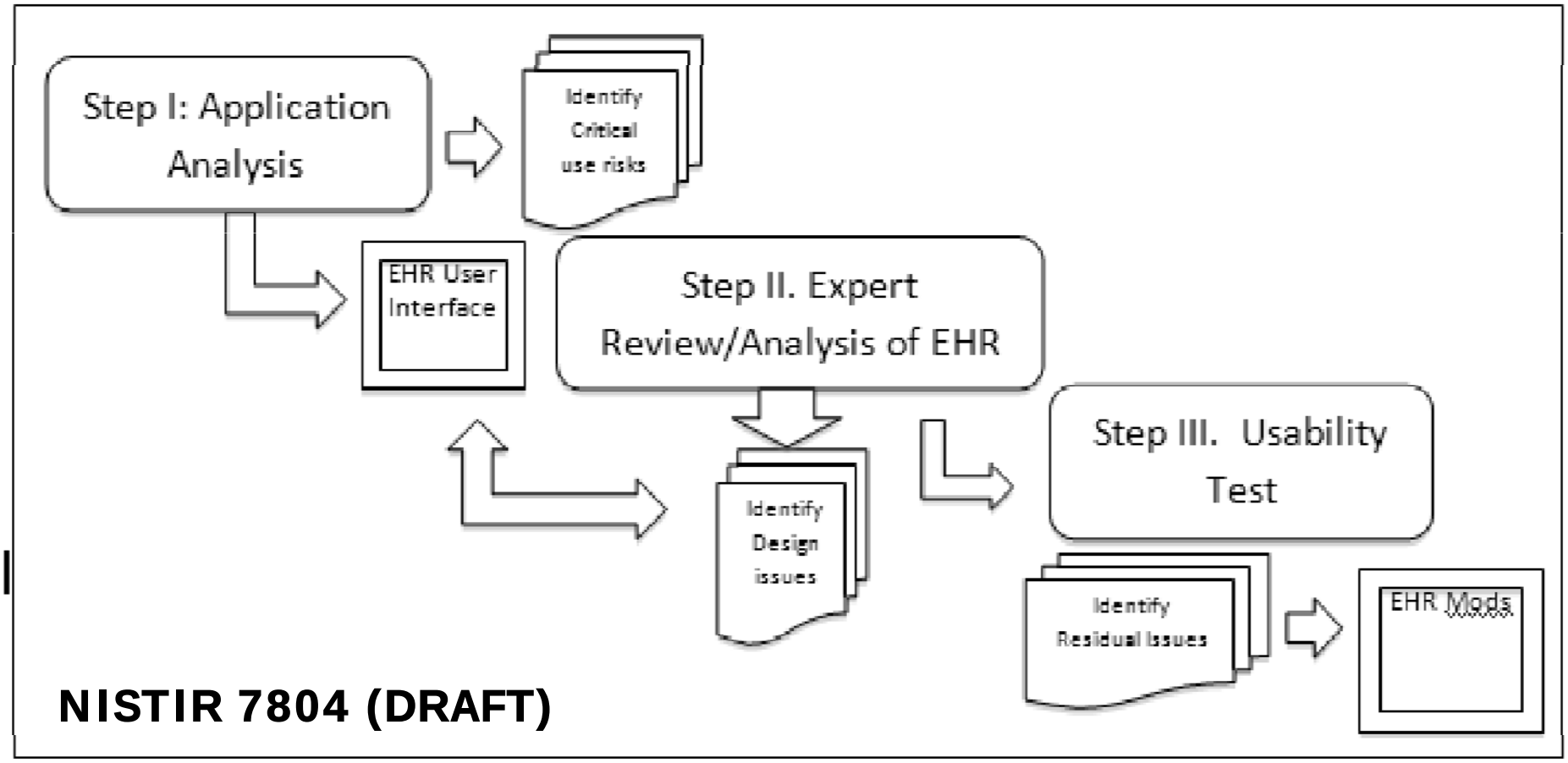


Figure 1. Three-step process for design evaluation and human user performance testing for EHR

Poll

What is your preferred primary approach to making HIT safer for patients?

A. No action
B. Patients sue the vendor
C. Anonymous reporting
D. Usability testing
E. Something else

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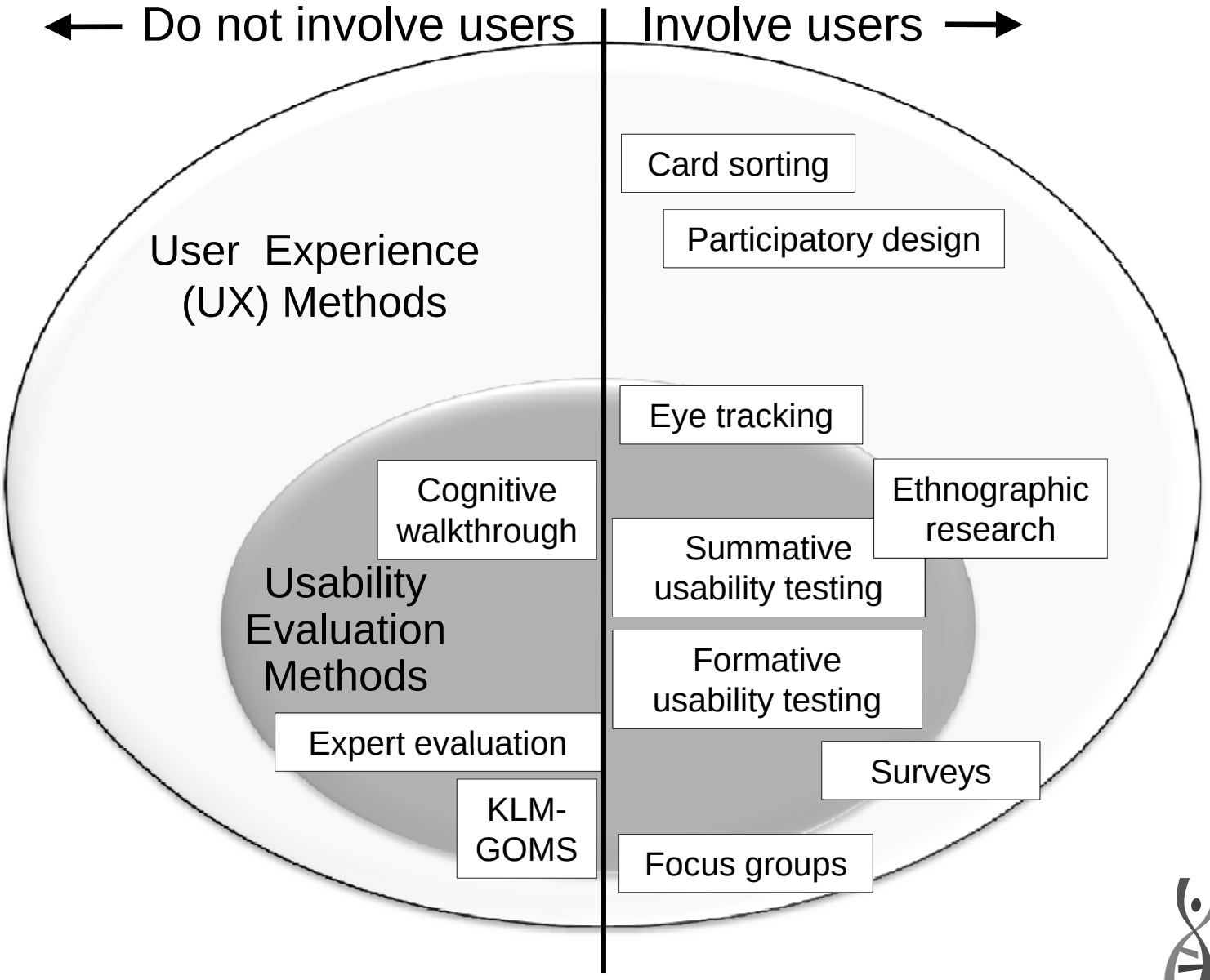
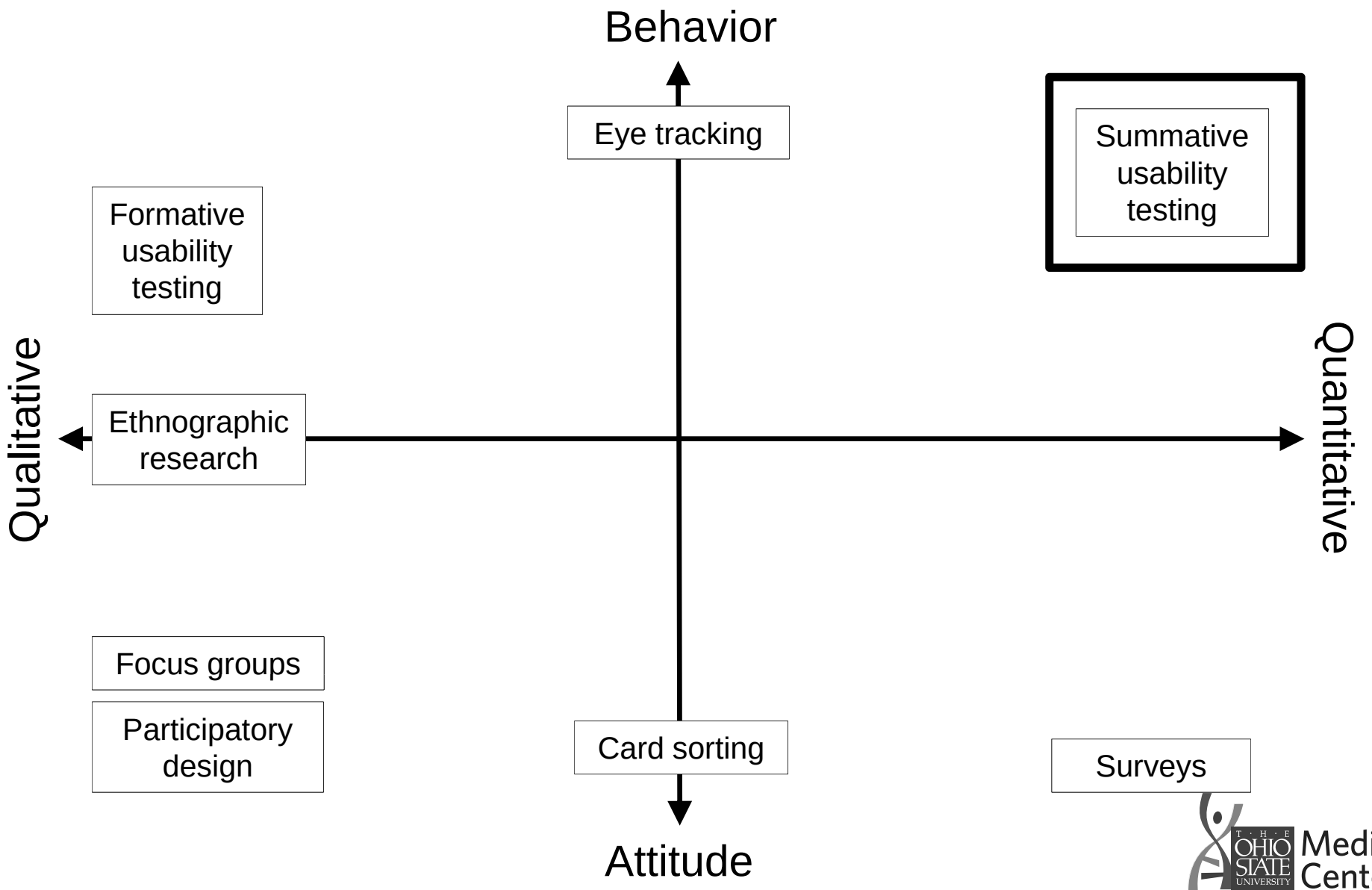
Usability Evaluation Methods: Overview



Summative is Not Formative Usability Testing



Usability Testing Process

Use Error Checklist Items: Example

1.A Patient Identification Error
When a second patient's record is open, is the first patient record automatically closed?
When a second user opens a patient chart, is the first user automatically logged out?
When another application (e.g., imaging) is opened from within the EHR, does the display have a title or header with an accurate unique patient identifier?
If an action will cause data to be destructively overwritten with another patient's data, is the user alerted?

Use Error Reporting Form: Example

No.	Potential use error	Mitigation Plan	Priority
1.C.1	**Data accuracy error:** Medication doses truncated in pick list menu makes it easy to pick the wrong dose	Do not truncate names at 40 characters, but instead display 75 characters and the remainder viewed upon mouse roll-over	High
1.F.6	**Recall error:** Physicians might forget that patients have allergies to medications while ordering, even though it is displayed	Provide pop-up “Are you sure?” alerts when a physician orders and a pharmacist verifies a medication order to which a patient has an allergy	High

Use Error Tracking Form: Example

No.	Date Found	Date Fixed	Date Fix Released	Reported?	Contact	Resolution	Related Issues	Priority
2011-1.C.1	5/31/11	6/2/11	6/6/11	Yes	Smith, John	Medication doses truncated in pick list menu makes it easy to pick the wrong dose	2011-1.C.3	High

Clear	Closed
Green	Awaiting fix
Yellow	Analysis ongoing
Red	Newly reported, awaiting analysis

Summative Usability Report Elements

- Introduction
- Method
  - Participants
  - Design
  - Tasks
  - Procedure
  - Test location and environment
  - Usability metrics
- Results
- Discussion
  - Overall Results
  - Potential Use Errors
  - Effectiveness
  - Efficiency
  - Satisfaction
- Appendices
  - Test plan
  - Screener
  - Moderation Guide
  - Tasks

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Scenarios: Target Characteristics

Level	Integrity Target
Surface validity	Professionals judge face valid and are engaged
Model of support	Impact on cognition; includes capability gaps
Justification for implementation	Assess claims; users' and organization's perspectives
Representative complexity	Nominal and challenging cases
Performance observability	Externally observable actions and utterances

Complexity Factors: Domain-Independent

- Data overload (Needle in a haystack)
- Attention demands (Attention bottlenecks)
- Missing information (Information gap)
- Uncertain Information (Unreliable data)
- No predefined procedure (Novel situation)
- Overconstrained task (Can’t do it all)
- Workload (Time pressured)

Embedded HIT Complexity Factors that Approach Real-World Complexity

- Increase dose of existing medication
- Drug interaction warnings: false alarms
- Taper dose for steroids
- First dose now and subsequent doses tomorrow
- Verbal order
- Change form of medication (PO to IV)
- Handoff
- Interruptions
- Follow-up documentation of prior work
- Batch transfer of medications

Scenario #1 Complexity Factors

- Documentation of activities dependent on provider recall (Removal of transdermal patch)
- Dealing with PRN Meds
- Dose escalation/”Taper” Dosing
- Sensitive Dx Documentation (Substance Abuse)

Ambulatory Care
Mid-level Provider
Diabetic Patient

Scenario #2 Complexity Factors

- Verbal order documentation
- Workflow interruptions
- Documentation of patient handoffs
- Inpatient to outpatient medication processing

Inpatient Care
Physician Provider
Cardiac Patient

Scenario #3 Complexity Factors

- Document change in DNR status (Removing DNR)
- Document I/O's
- Documentation of medication administration

Critical Care
Nurse Provider
Cardiac Patient

Concluding Thoughts: Infrastructure Investments Are Easier Earlier

With present equipment, flying is so difficult that many individuals cannot learn to pilot an aircraft safely, and…human errors account for a major proportion of aircraft accidents…As aircraft become more complex and attain higher speeds, the necessity for designing the machine to suit the inherent characteristics of the human operators becomes increasingly apparent.

Fitts, 1947, reprinted in Karsh et al., 2010, p. 621

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Thank you for your attention!

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