

# USABILITY IN HEALTHCARE IT: DATA COLLECTION AND ANALYSIS APPROACHES

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# Usability in Healthcare IT

Usability – Measures of “ease of use” and usage of a system

1. Learning
2. Effectiveness
3. Efficiency
4. Safety
5. Enjoyability



Usability engineering – scientific methods to improve system usability

# What Methods are Used in Usability Engineering?

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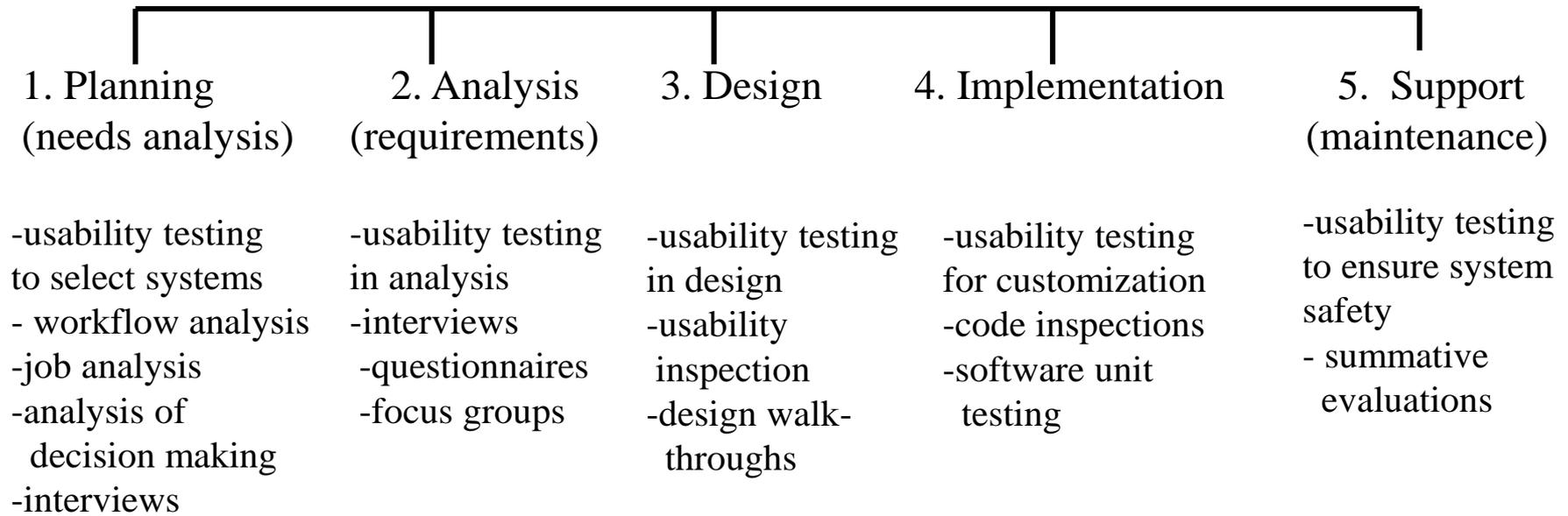
- Usability Methods
  - Usability Inspection
    - Usability “inspector” steps through system
  - Usability Testing
    - Representative users are observed doing representative tasks
    - Can code data for usability problems
  - Clinical Simulations
    - Representative users, tasks **and** contexts
    - Conducted in real or realistic setting
    - “in-situ” testing of systems (to ensure usability and safety)

# Usability Testing

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- Set of techniques to collect empirical data
  - ▣ observe representative end users of a system, carrying out representative tasks
- Video-record (screens and physical interaction)
- May ask users to “think aloud” while video recording them using system
  
- Provide information that can feed back information (to system design, customization, and selection) to result in systems that are:
  - ▣ Effective and efficient
  - ▣ Reduce errors (rather than inadvertently introducing them)
  - ▣ Fit into health professional workflow (and do not increase complexity or time to complete tasks)
  - ▣ Satisfying to use

# Usability Testing across System Development Life Cycle (SDLC)



Application of usability testing (and related methods) across the SDLC

# Where can Usability Studies take place?

## A Continuum of Studies



### LABORATORY

- Fixed usability lab
- Experimental tasks
  - “think aloud”
  - cognitive task analysis

- Simulations
- E.g. “simulated” doctor-patient interviews

### “IN-SITU” NATURALISTIC

- Testing in clinics
- Remote usability testing and data mining

# Basic Equipment for Low Cost Rapid Usability Engineering



Video camera to record user physical actions



Microphone to record user verbalizations

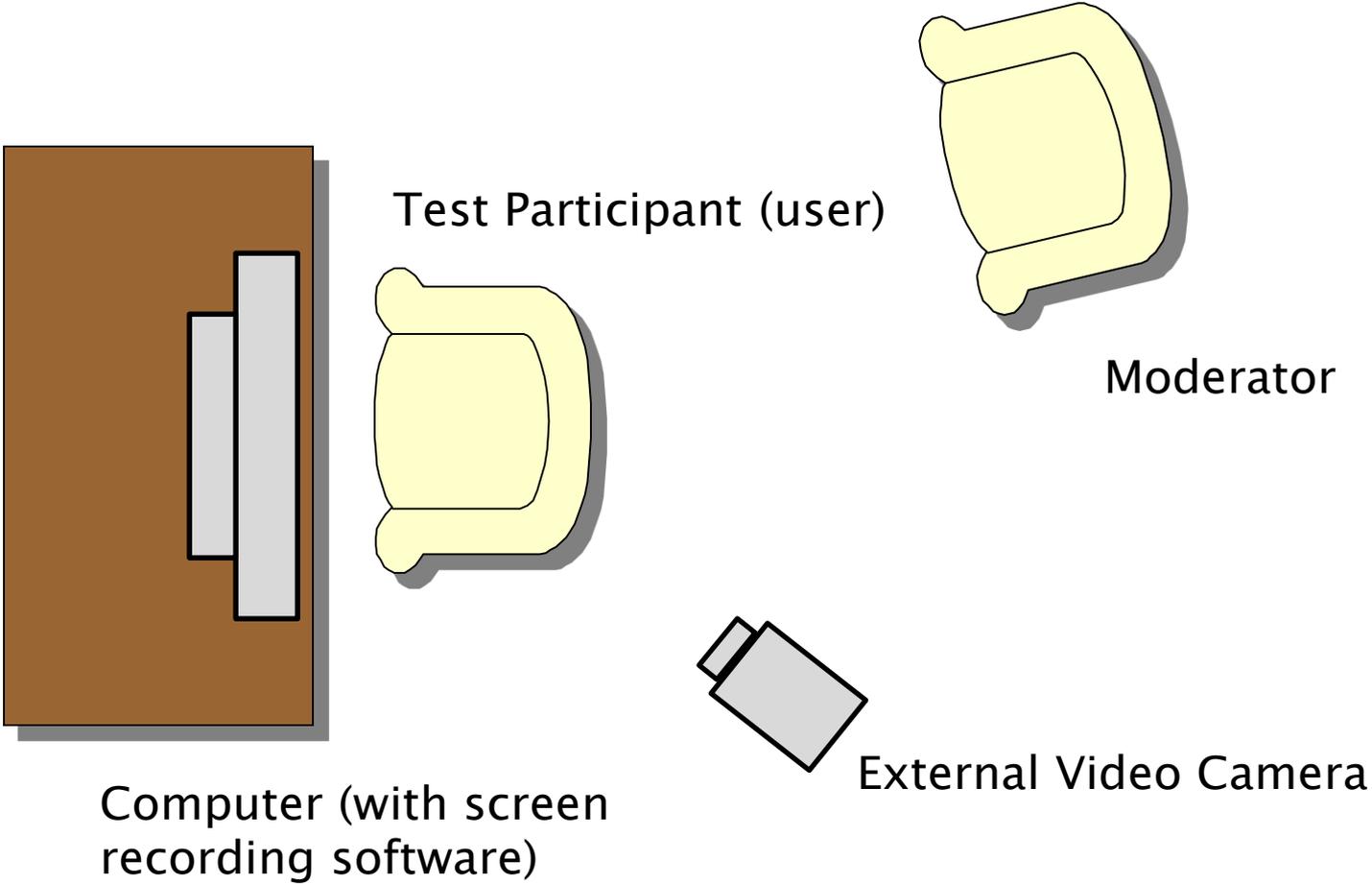
Screen cam to record user facial expressions

Recording of computer/PDA screens to CD using screen capture software e.g. Hypercam

# Low cost rapid usability engineering setup



# Usability Testing in the Clinician's Office



# Example: Basic Usability Analysis of a Software Tool

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- How effective is the interface and content of a decision support tool?
- Data
  - Video recording of doctors' and students' interaction with system
  - Audio recording of "think aloud"
  - Screen captures
  - Video coding of usability issues

# Coded Transcript

00:01:03 to 00:02:26 Introduction

“I’ve already had to loosen my tie”

Shifts in seat and studies screen

00:02:27 Risk Analysis Guidelines/Recommendations  
Screen

COMMENT: CRITIQUE-CONTENT

“My first comment is that this is a little old, I don’t  
know if any of this has been updated”

00:01:17 to 00:01:17 Checks out the sex factor

ACT: 00:01:44 Raises cholesterol levels by 1 to 6.3

ACT: 00:03:00 Goes to help screen

ACT: 00:03:12 surveys the powerbar choices (3) and  
selects the Introduction

GOAL:

“How do I fast forward?”

NAVIGATION PROBLEM

COMMENT:

“There is no way out of this?”

EXP:

“You can kill this”

COMMENT: STATE OF SYSTEM

“I can kill this, Sorry you told me that”

Stops the explanation

# Development of a Full Video Coding Scheme

- Principled coding schemes allow us to
  - Identify usability problems
  - Identify safety issues
  - Quantify issues and prioritize fixes

Kushniruk, AW, Borycki, EM. (2015). Development of a video coding scheme for analyzing the usability and usefulness of health information systems. *Studies in health technology and informatics*, 218, 68–73.

Problem Code	Code definition	Example
NAVIGATION	Coded when a review of the video data indicates the user has problems moving through a system or user interface.	e.g. A physician user cannot backtrack to a screen with patient allergy information in an electronic health record (EHR) system.
CONSISTENCY	Coded when a review of the video indicates the user has problems due to a lack of consistency in the user interface.	e.g. the way a user enters month, day and year has a different order in two parts of a health information system.
MEANING OF ICONS/TERMINOLOGY	Coded when a review of the video data indicates the user does not understand language or labels used in the interface.	e.g. A user does not realize that a button labelled “best practice advisory” contains drug alerting information.
VISIBILITY OF SYSTEM STATUS	Coded when a review of the video data indicates the user does not know what the system is doing.	e.g. A nurse does not know if a medication administration system is not working or just processing as there no indication of what the system is doing.
UNDERSTANDING ERROR MESSAGES	Coded when a review of the video data indicates the user does not understand meaning of error messages.	e.g. A pharmacist using a medication administration system receives a computer message “Error 102” and has no idea of what it means.
UNDERSTANDING INSTRUCTIONS	Coded when a review of the video data indicates the user does not understand user instructions.	e.g. A patient user of a personal health record (PHR) system does not understand the instructions for entering data into the PHR.

# Evaluating Impact of Health Information Systems in Clinical Use

- Evaluation of an EMR deployed in a clinic
- Study included think-aloud usability testing
- Also included video recording doctors interacting with “simulated patient” (while using the EMR)



- OC
- PERS H
- L STYLE
- PROFILE
- FAM H
- HPI
- RS
- PE
- DX
- INV
- TRMT
- SIGN

▼ **PHYSICAL EXAMINATION**: Normal examination

▼ **GENERAL CONDITION**: good

▼ **VS**: N

▼ **BP**: N 110 / 70 ▾ R: upper limb lower limb sitting up lying flat standing up ▾ L

▼ **pulse**: 76 /min regular irregular

▼ **T°**: N 37.5 °C ▾ buccal rectal axillary tympanic

▼ **RESP**: N \_\_\_ /min regular irregular

▼ **HEAD AND NECK**: N

▼ **thyroid**

▼ **nodule**

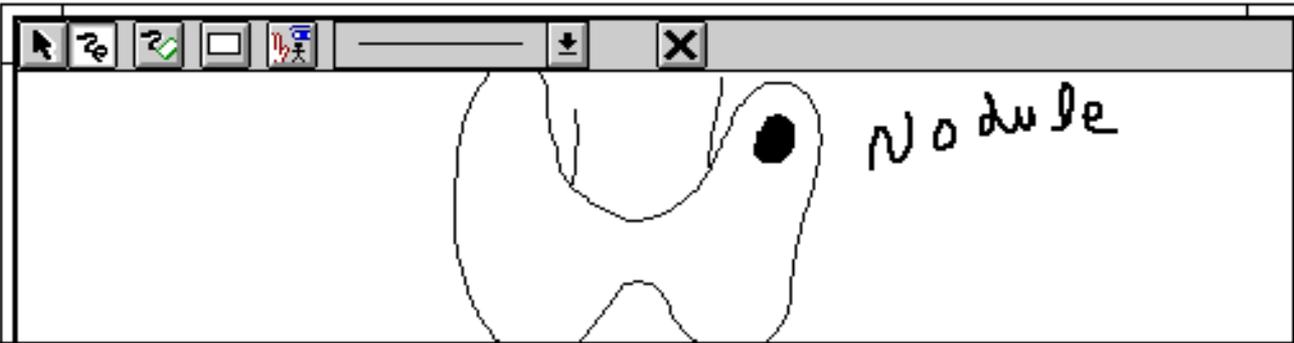
▼ **location**: isthmus ▾ **lobe**: upper lower R L

▼ **size**: \_\_\_ cm² ▾ 1 cm ▾ X \_\_\_ cm ▾

▼ **tenderness**: 0 + ++ +++ +++++

▼ **skin overlying the mass**: N edematous red retracted

▼ **tender**: 0 + ++ +++ +++++ skin adherent to the mass



# MI<sup>2</sup> COMPUTING

Endorsed by the American  
Medical Informatics Association

SEPTEMBER/OCTOBER 1996 / VOL. 13, NO. 5 / U.S. \$9.00 / CAN. \$12.50

**Virtual Reality  
at the Bedside**  
**Sexual Risk Assessment**  
**Automated Health  
Assessment**  
**Computerized  
Medication Instruction**



**EVALUATING PATIENT  
RECORD SYSTEMS**



**Springer**  
PRINTED ON ACID-FREE PAPER

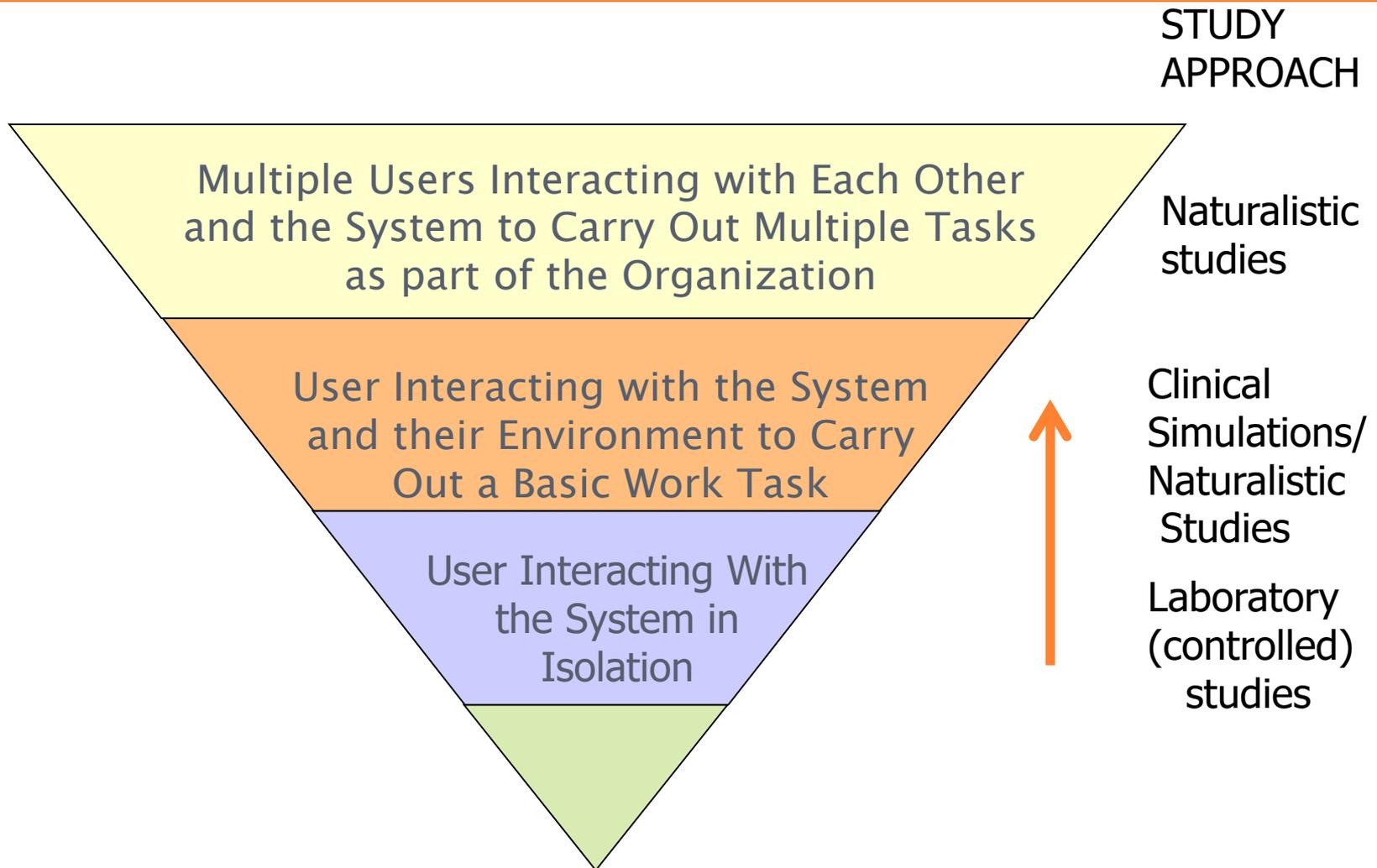
# Narrative of Doctor-Patient-Computer Interaction (Involving Experienced User)

<u>Time</u>	<u>Episode</u>
00:00-02:30	- Creates a Patient Visit
02:47-03:26	- Reviews Presenting Complaint - Starts to Select a Filter but stops
03:55-04:39	- Gathers info <u>without EMR</u> (paper)
04:39-08:48	- History of Present Illness - Hypothesis: hyperthyroidism
09:21-09:49	- Chooses <u>clinical note template</u>
09:54-13:25	- Collects personal history, in order of <u>categories on the screen</u> ("screen-driven behavior")

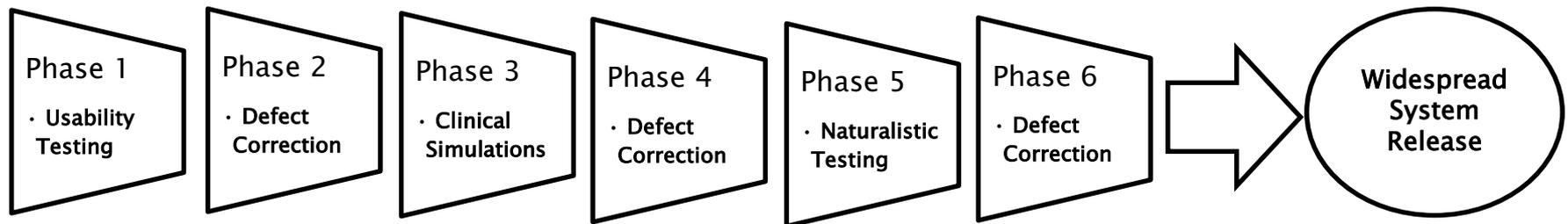
## Experienced users become "screen-driven"

- Affects reasoning and requests for information by physician
- An unintended consequence

# Conducting Analyses at Multiple Levels



# A Layered “Safety Net” Approach

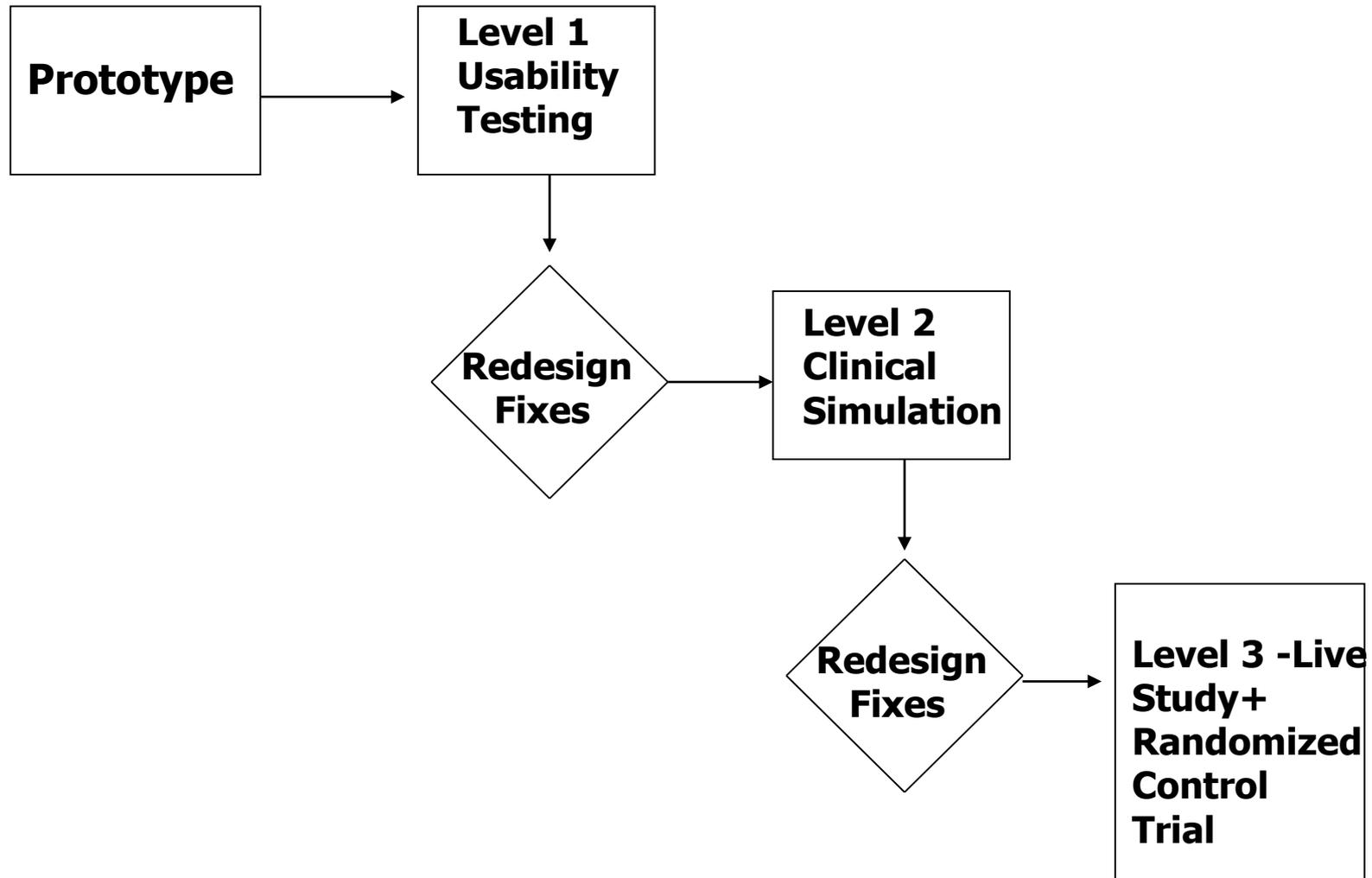


# Integrating Usability testing and think-aloud protocol analysis with “near-live” clinical simulations in evaluating clinical decision support

(Li, Kannry, Kushniruk, Chrimes, McGinn, Ebonyabo, Mann, International Journal of Medical Informatics, 2012)

- Example of series of studies that included all 3 levels described above
  - evaluation of iCPR decision support tool
- Study employed several phases of testing
  - Level 1 – Surface level usability testing (8 providers think aloud)
  - Level 2 – Clinical simulation (8 providers interact with digital patient)
  - Level 3 – Study of live interactions
  - Each phase identified different types of problems – e.g. BPA (best practice advisory) labelling issue at level 1, early/late triggering of rules at level 2
- Implications
  - Optimization of the guidelines (and resultant high uptake) required consideration of HCI at multiple levels

# Development and Testing of iCPR



# Coding categories, with examples

Code	Definition	Example coded statement
<b>USABILITY</b>	Refers to commentary on the perceived effectiveness, efficiency, and “ease- or lack-of-ease of use” of the iCPR CDS	"It's becoming a lot of clicking and reading and you want to do this thing quickly, especially if you have a lot of patients waiting"
<b>VISIBILITY</b>	Refers to commentary on the extent an image, text, or message is noticed or attended to	"I just see that BPA [alert] here. Normally I probably wouldn't see it since I don't usually look here; but, if it had been more prominent, I might have seen it— if it had popped up."
<b>WORKFLOW</b>	Refers to commentary on the general order and sequence of tasks and activities involved in a patient encounter.	"I think it depends on when you start using the tool because if you use it right from the beginning...you could get distracted and forget to go through other questions maybe...I just think these[(order] sets should come when you ask for them, not from the walk-in diagnosis"
<b>CONTENT</b>	Refers to commentary on the content of information provided by the iCPR CDS.	"I think the soup issue might be an issue with my patients, we see patients over 50 with hypertension and we wouldn't really tell them to take chicken soup because it is full of sodium."
<b>UNDERSTAND-ABILITY</b>	Refers to commentary on the extent to which the text within the CDS is comprehensible.	"Supportive care is weird [text phrasing] because it is saying pneumonia, and the patient does not have it."
<b>USEFULNESS</b>	Refers to commentary on the extent the tool (and information provided by it) is perceived as helpful during clinical decision making and care delivery	"I don't like this one [order set] as much...I realize this is all about evidence-based medicine... [but] I just think there is more in a clinical picture and this thing is pushing you in a direction without taking into account [the full clinical picture]."
<b>NAVIGATION</b>	Refers to commentary on the provider's ability to move through the system (i.e. where to go, how to move forward or backward)	"A prompt of some sort would be good. I would need a prompt; I don't know where to go next."

# RESULTS

- In Phase 1, navigation and workflow aspects of CDS were associated greatest number of issues/problems
  - Identification of usability problems and potential impact on workflow
  - Main coded issues/problems to do with
    - Usability
    - Visibility
    - Workflow
    - Content
    - Understandability
- In Phases 2 and 3, two predominant workflows emerged in using CDS
  - Early and late triggering of the rules
  - Triggering of BPA in near live and live encounters explored
  - Subsequent study of the use of the guidelines showed high uptake after optimization