

Can Physicians Be Empowered Consumers: Challenges of EHR Usability Testing in a Community Hospital Setting

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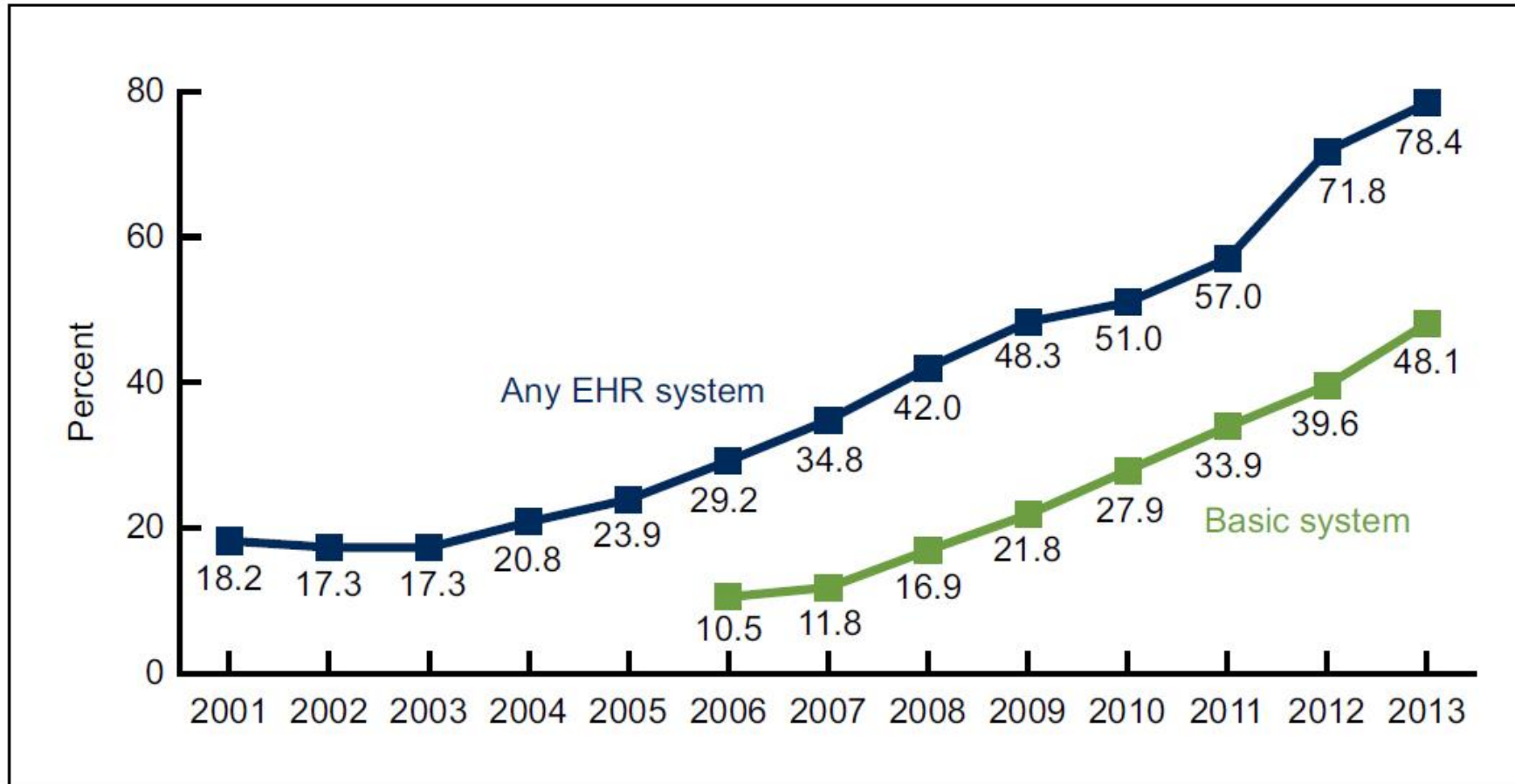
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Effect of ARRA on Physician Adoption of EHRs

Figure 1. Percentage of office-based physicians with EHR systems: United States, 2001–2013



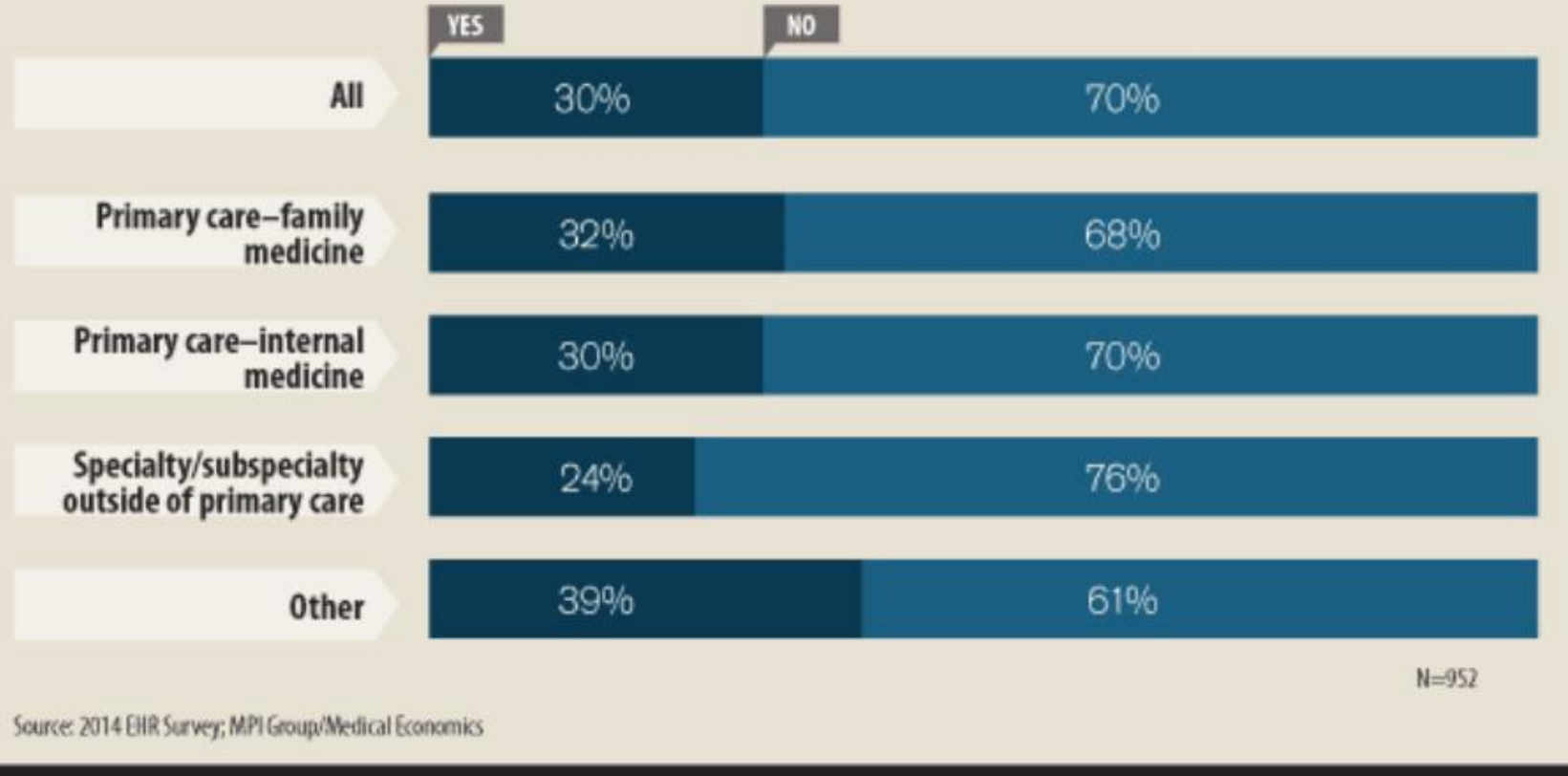
Hsiao C-J, Hing E. (2014). Use and characteristics of electronic health record systems among office-based physician practices: United States, 2001–2013. NCHS data brief, no 143. Hyattsville, MD: National Center for Health Statistics.



Medical Economics/MPI Provider survey

70% say EHRs *not worth it*

Q: Has your EHR investment been worth the effort, resources, and costs?



Verdon, D.R. (2014). Physician outcry on EHR functionality, cost will shake the health information technology sector. *Medical Economics* 91(3): 18-27



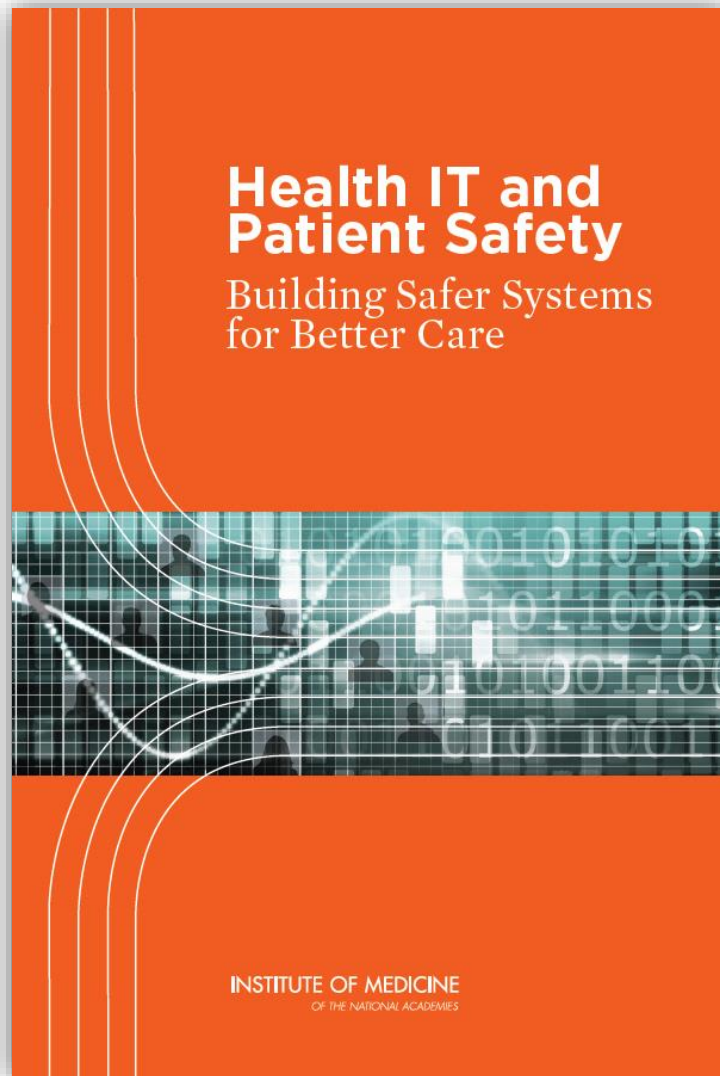
Healthcare Providers' User Experience



- EHRs not developed with clinical workflow in mind
- Information not formatted to fit physician cognitive models or support clinical decision making
- Entering structured data distracts physician's attention from the patient
- Structured data unable to adequately represent the complex nuanced details of patient history or clinician reasoning
- Increased cognitive load and decreased situational awareness.



EHR Usability Affects Patient Safety



- Designed and applied inappropriately, health IT can add an additional layer of complexity to the already complex delivery of health care, which can lead to unintended adverse consequences...
- The committee believes poor user-interface design, poor workflow, and complex data interfaces are threats to patient safety.



Usability Myth #1



- Clinicians are uncomfortable with technology
- Clinicians won't do the training and hard work necessary to become proficient with EHRs
- Clinicians are unwilling to change their practices in order to improve care quality and cost efficiency.

Staggers N, Xiao Y, Chapman L. (2013). Debunking health IT usability myths. *Appl. Clin. Inf.* 4: 241-250.

<http://dx.doi.org/10.4338/ACI-03-IE-0016>



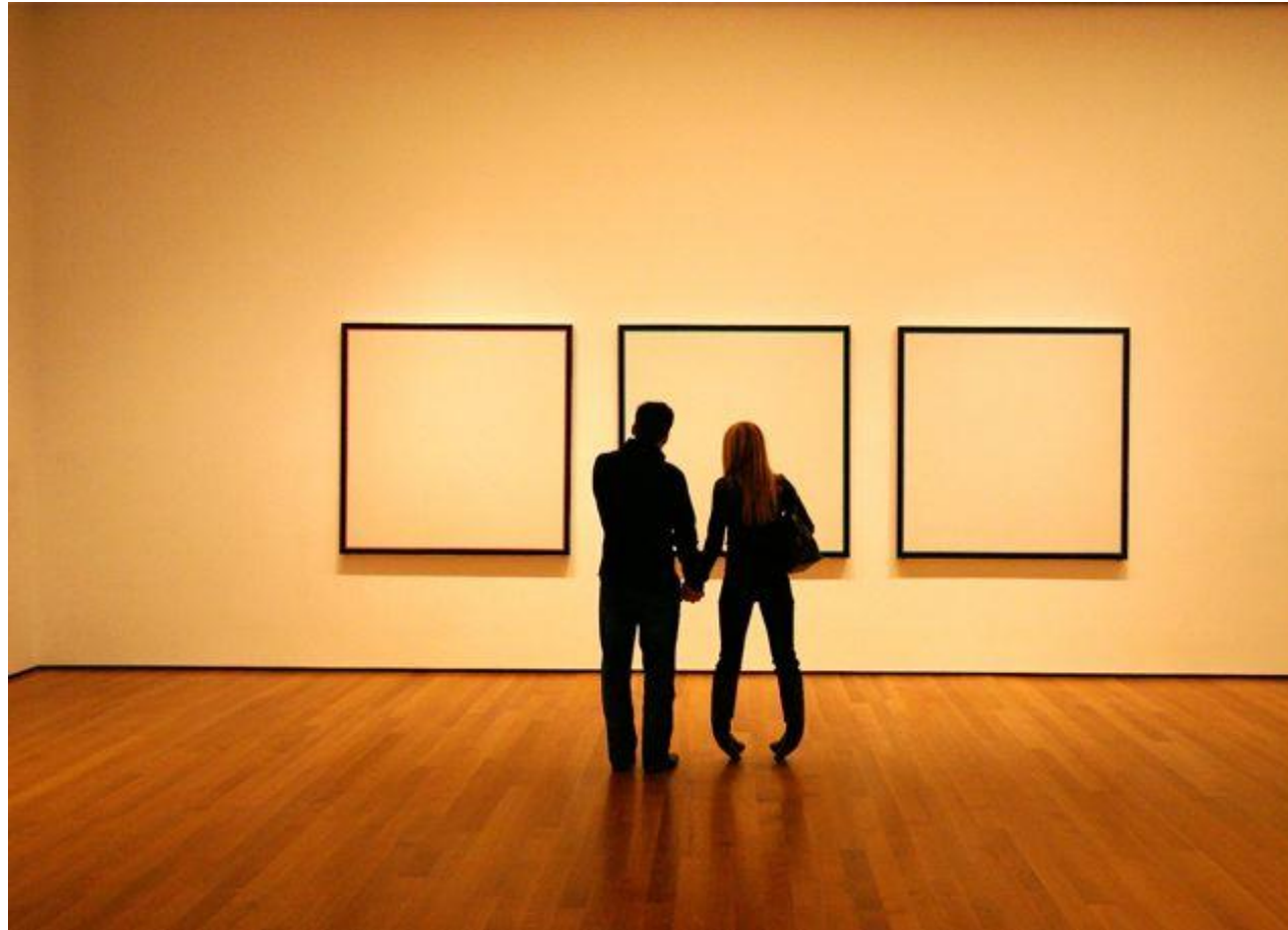
Reality: Clinicians Want the Right Technology

- Clinicians love technology but hate IT that slows down their work
- Current generation EHRs often don't fit the way physicians think and work
 - Can't get a “big picture” of the patient
 - No value returned for time as a data entry clerk
 - Too much information, too poorly organized
 - Can't see trends over time or across categories
 - Have to integrate information across screens
 - Too many clicks, system delays, ambiguous terminology
 - The most important information is hard to find
 - Lack of integrated systems even in one facility
 - Attention distracted from the patient



Usability Myth #2

Usability is all just subjective anyway



Staggers N, Xiao Y, Chapman L. (2013). Debunking health IT usability myths. *Appl. Clin. Inf.* 4: 241-250.

<http://dx.doi.org/10.4338/ACI-03-IE-0016>



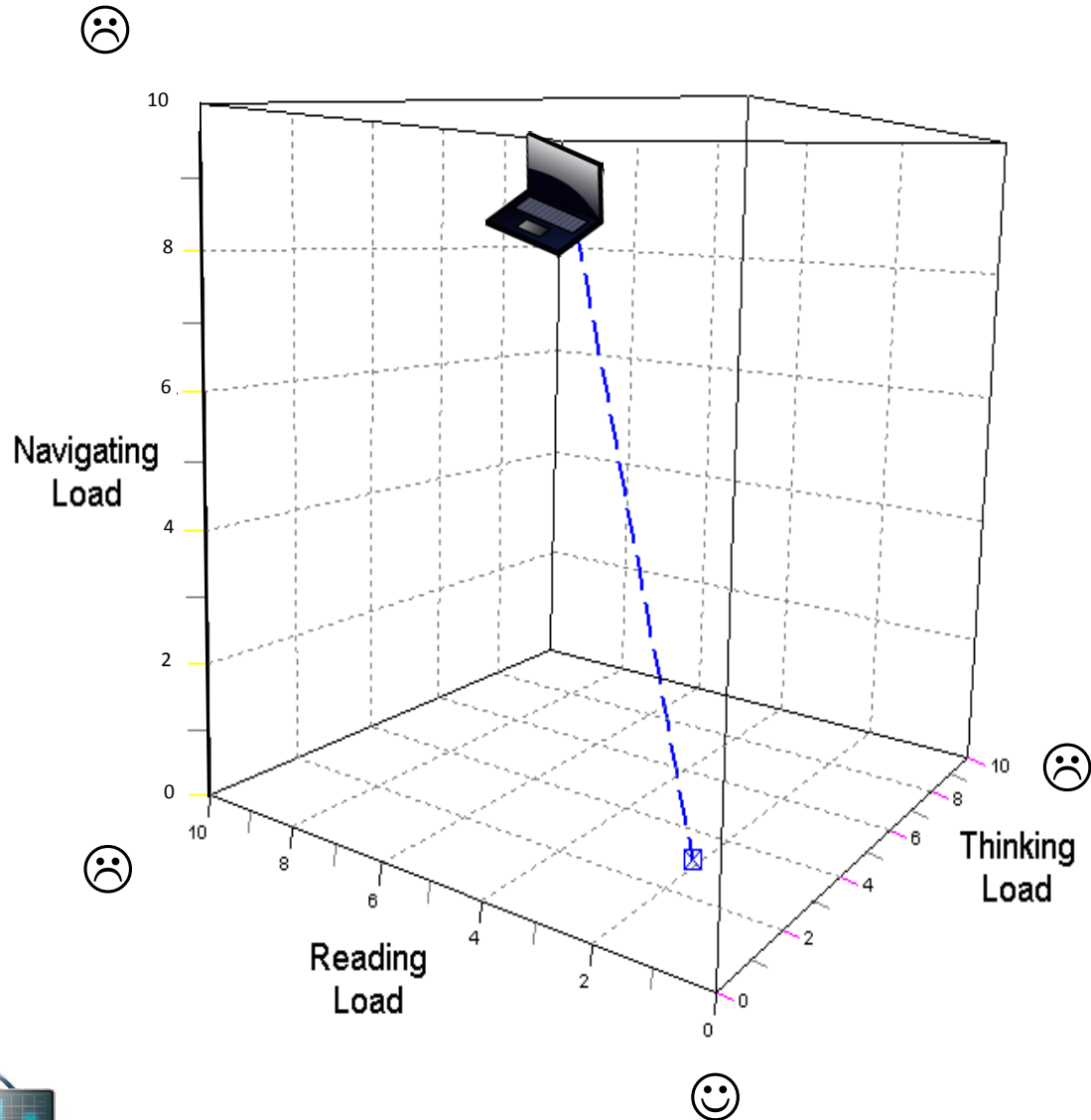
Reality: Usability Can Be Defined

International Organization for Standardization:
Usability is the effectiveness, efficiency, and satisfaction with which specific users can achieve a specific set of tasks in a particular environment.

ISO 9241-11 Schoeffel, R. (2003). *ISO Bull 34*: 6-7



Usability Involves Lightning “Loads”



- Navigation
 - Clicks, scrolls, keystrokes, mouse movements
- Reading
 - Legibility, signal to noise ratio, layout, emphasis, eye tracking
- Thinking
 - Icon meaning, recall vs. recognition, cognitive load
- Text Entry
 - Typing, pick lists, dictation
- Emotional Factors
 - Task stress, situational awareness, dissonance



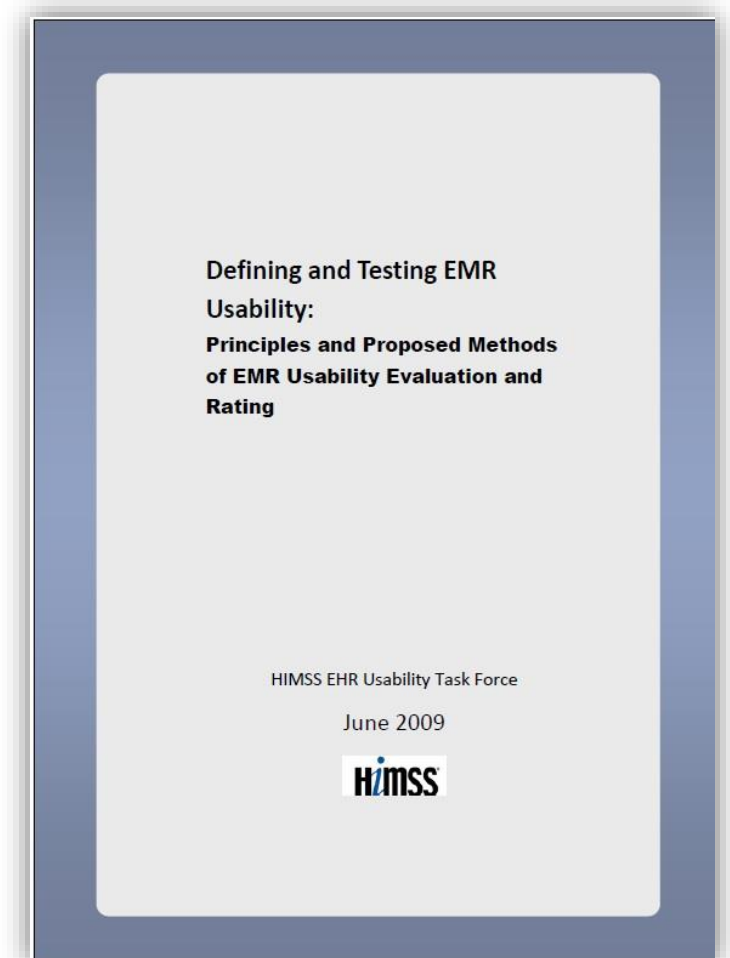
User Interface Design Heuristics

1. System status visibility
 - What's going on...
2. System matches real world
 - Natural, logical, clear
3. User control & freedom
 - Cancel, undo, redo
4. Consistency & standards
 - Words, actions, locations
5. Error prevention
 - Avoid errors, confirm before committing
6. Recognition, not recall
 - Objects, actions visible
7. Flexibility and efficiency
 - Accelerators, personalization
8. Aesthetic, minimalist design
 - Only relevant, commonly needed information
9. Help users recognize, diagnose, recover from errors
 - Clear error messages with constructive solutions
10. System help and documentation
 - Easy to search, concise, context sensitive, step-by-step



Attributes of EHR Usability: HIMSS

- Simplicity: Lack of visual clutter
- Naturalness: Map tasks to expectations
- Cognitive Load: Data fits the task at hand
- Efficient Interactions: Minimal steps per task
- Forgiveness: Reversibility and data protection
- Feedback: Information about actions taken
- Language: Clear, unambiguous, targeted
- Presentation: Density, color, readability, consistency
- Context: Visual focus, WYSIWYG



Belden, J., Grayson, R., Barnes, J. et al. (2009). Defining and Testing EHR Usability: Principles and Proposed methods of EHR evaluation and Rating. *Report of the HIMSS EHR Usability Task Force.*



Usability Can Be Measured

Qualitative Inquiry

- Field studies
- Surveys
- User focus groups

Inspection

- Expert evaluations
- Reviews based on validated principles
- Heuristic checklists

Testing

- Think aloud
- Scenario based simulations
- Testing lab vs. real world
- Usability testing software
 - MORAE
 - TURF
- Performance
 - Clicks, keystrokes, timings
 - Task success and failure
 - Appearance and verbalizations



Can Physicians Learn to Measure Usability?

- Demonstrate EHR usability problems in a more objective, quantitative, actionable manner
- Identify and correct EHR problems that can lead to user errors
- Develop semi-automated testing systems to make usability evaluation accessible to busy clinicians who are not experts in this area
- Assess and overcome barriers to summative scenario-based EHR usability testing in a private practice community hospital setting



Can Usability Testing Advance Other Goals?

- Open dialogues between physicians and software developers to reach consensus on measuring usability and on best practices for the application of user-centered design principles
- Contribute to the development of EHRs that provide better workflow and cognitive task support
- Inform the purchasing decisions of physicians and healthcare organizations and help them measure progress in improving usability



Usability Testing in a Community Hospital?



Boone Hospital Center Physician IT
Resource Center



NISTIR 7741: Guide to the Process Approach
for Improving the Usability of EHRs



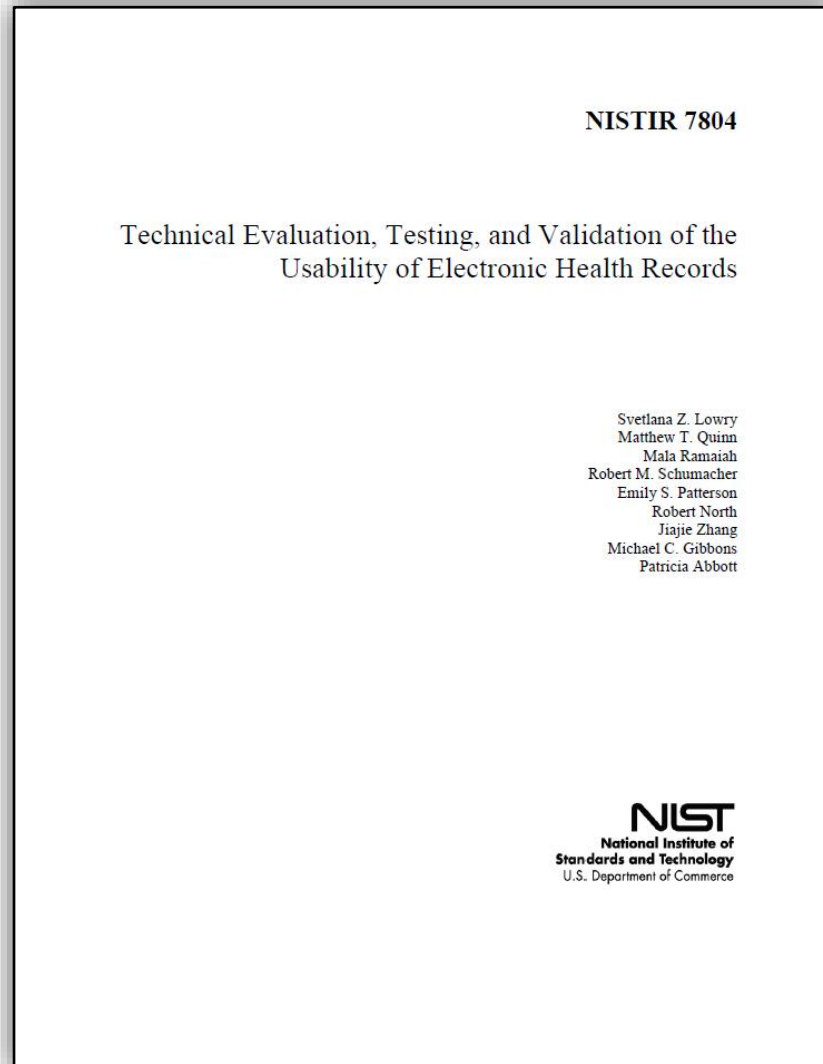
Acknowledgements



Challenge Number 1: Lack of Resources



Usability Testing Methods



- Create scenarios
- Define the tasks
 - Define success criteria
 - Define optimal paths
- Define markers
- Define surveys
- Construct measurement configuration



Next Challenges



Challenge Number 2: Time and effort



Challenge Number 3: Data Privacy and Security



Testing Scenario

Paul Usabilitymd is a 71 year old man you follow for type 2 diabetes, hypertension, hyperlipidemia, and history of coronary artery disease status post stent placement. He presents to your office complaining of cough, shortness of breath and production of green sputum. He has a temperature of 102.3° F, pulse of 125 bpm, oxygen saturation of 84% on room air, and dullness to percussion and absent breath sounds in a right lower lobe distribution, and a swollen left leg. You decide to admit the patient to the hospital for further treatment, and he needs admission orders.



Task List

- Open the EHR, find and open patient chart, and open the CPOE System
- Enter admission status, code status, primary and secondary diagnoses
- Enter condition, allergies, diet and vital signs orders, and MD notification orders
- Enter admission laboratory orders including at least CBC, CMP, ABG, blood cultures, urinalysis and culture, and PT/PTT
- Enter orders for imaging studies including at least a Chest X-ray and a Chest CT Scan with PE Protocol
- Enter orders for pulmonary medicine and other indicated consultations
- Enter home medications to be continued (list provided)
- Enter antibiotic regimen and other necessary treatment orders
- Save the orders and exit the CPOE System



System Recording with MORAE

The screenshot displays the MORAE software interface for recording EHR tasks. The main window shows a recording of a user's interaction with an EHR system, with a video feed of the user in the bottom right corner. The interface is divided into several sections:

- Left Sidebar:** A project tree showing the recording structure, including tasks and subtasks.
- Central Window:** A video recording of the user's interaction with the EHR system, showing a search results table and a list of markers.
- Search Results Table:** A table showing the results of a search for markers. The table has columns for Task, Event, Details, Owner, Notes, Title, and Score.
- Bottom Status Bar:** A status bar showing the recording duration and other metrics.

Task	Event	Details	Owner	Notes	Title	Score
Task 2 Status and Diagnoses	Marker	Q (Quote/comment)	David Schlossman (Manager)	Long poorly organized pick list for primary dx. High risk for improper dx coding.	Poorly organized dx list	0 - Severe
Task 2 Status and Diagnoses	Marker	Q (Quote/comment)	David Schlossman (Manager)	Nonstandard workflow: have to click Diagnose category in order pane each S...	Diagnosis workflow pr...	0 - Severe
Task 2 Status and Diagnoses	Marker	O (Observer)	David Schlossman (Manager)	DM diagnosis list is also long and confusing with poor sort order.	DM diagnosis list pro...	0 - Severe
Task 2 Status and Diagnoses	Marker	Q (Quote/comment)	David Schlossman (Manager)	Time to enter orders is excessive.	Poor order entry work...	0 - Severe

- Time for each task and subtask
- Success rate for each task
- Deviations from optimal path
- Errors during each task

- Use of the CDS in the EHR
- Usefulness of the CDS in the EHR
- Perceived effort of each task set
- Overall satisfaction with the EHR



If You Build it, Will They Come?



Challenge Number 4: Recruiting



Complaint Fatigue

“None of the pain points developed in that meeting have been fixed. I came into work on my day off to attend this meeting (unpaid time) just for the hope of improving my work environment and improving my ability to rapidly and effectively service mine and [Hospital’s] patients. I will not be attending any more meetings on improving [EHR Product]”

“End -users (physicians) have been IGNORED when tweaks requested. After implementation of system; the company providing the EHR assumed that if it worked, no matter how clunky, it was good enough”

“The current system has many clear problems, but it seems that the priority is preparing for meaningful use rather than fixing the day to day problems that plague physician work flow.”



Participants

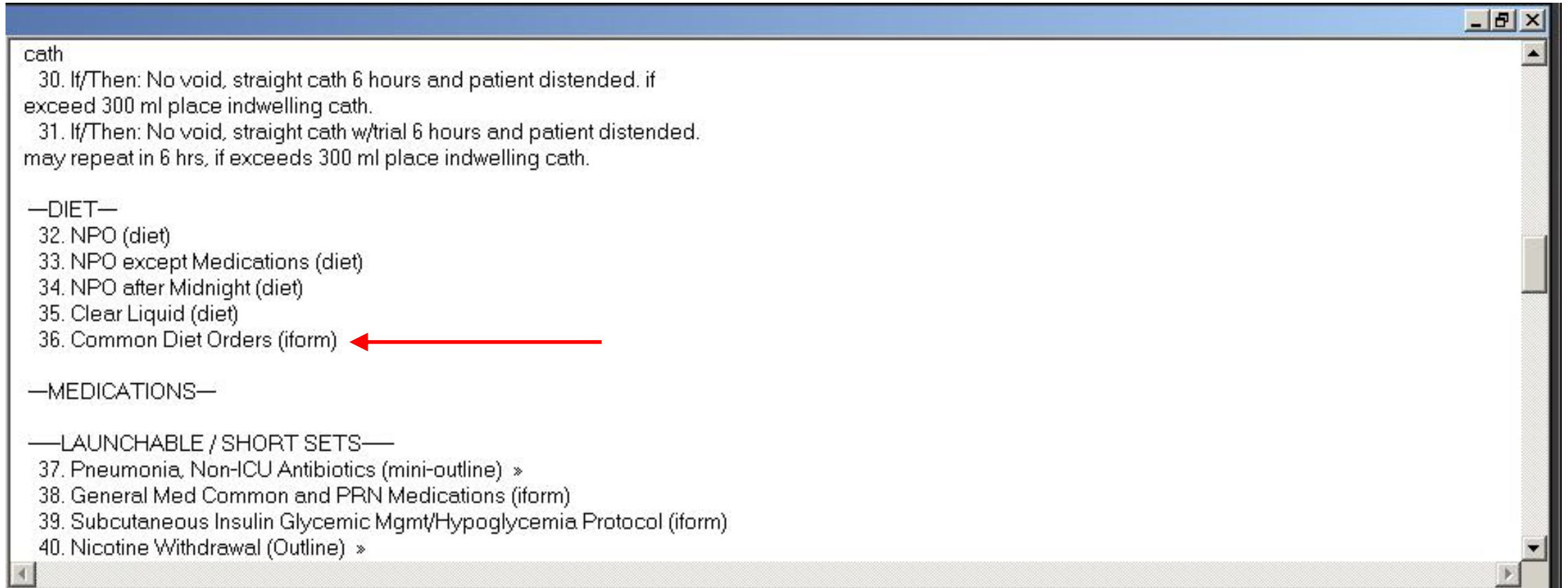
10 physicians (9M, 1F) from the BHC Medical Staff

- Average age 55.7 years
- Time in current position 21.7 years
- Number of EHRs used 3.4
- Experience with test EHR 6.8 years
- Self rated facility with computers: intermediate to advanced
- Specialties: medical oncology, general surgery, nephrology, emergency medicine, family medicine, hospital medicine



Findings: Order Sets Do Not Hold Place

1. After linking out of a main order set and entering details of an order on a sub-form, the user is returned to the very top of the order set



The screenshot shows a window titled 'cath' containing a list of medical orders. A red arrow points to item 36, 'Common Diet Orders (iform)'. The list is organized into sections: 'cath', '—DIET—', '—MEDICATIONS—', and '—LAUNCHABLE / SHORT SETS—'. Item 36 is the first item in the 'DIET' section.

cath

30. If/Then: No void, straight cath 6 hours and patient distended. if exceed 300 ml place indwelling cath.

31. If/Then: No void, straight cath w/trial 6 hours and patient distended. may repeat in 6 hrs, if exceeds 300 ml place indwelling cath.

—DIET—

32. NPO (diet)

33. NPO except Medications (diet)

34. NPO after Midnight (diet)

35. Clear Liquid (diet)

36. Common Diet Orders (iform) ←

—MEDICATIONS—

—LAUNCHABLE / SHORT SETS—

37. Pneumonia, Non-ICU Antibiotics (mini-outline) »

38. General Med Common and PRN Medications (iform)

39. Subcutaneous Insulin Glycemic Mgmt/Hypoglycemia Protocol (iform)

40. Nicotine Withdrawal (Outline) »



Findings : Order Sets Do Not Hold Place

Common Diet Orders

| Patient Name=USABILITYMD, PAUL | Med Rec Number=447629 | Age=15 | Gender=F | Weight=

BJC HealthCare

Start Over

Clear All Pre-Checks

Medical Nutrition:

Medical Nutrition Therapy

Reason:

Select Reason

Comment:

Common Diets

NPO

Enteral Tube Feeding

Supplements

Snacks

Common Diets

Start Time:

Now

Start Date:

Today

Common Base Diets:

- Regular
- Pediatric Regular
- Low Fat, Low Cholesterol, Low NA
- Consistent Carb (ADA) ←
- Renal
- Sodium Restricted (2gm)
- NAS / 4am NA
- BRAT
- Fat Controlled
- Fiber Restricted
- GI Soft
- Gluten Free
- High Calorie/High Protein
- High Fiber
- Mechanical Soft
- Pureed
- Vegetarian
- Low Cholesterol
- Dysphagia
- Liquid Consistency:
- Straw:



Findings : Order Sets Do Not Hold Place

Phosphorus	<input type="checkbox"/> Renal
Potassium	<input type="checkbox"/> Restrict Red Jello
Protein	<input type="checkbox"/> Sodium Restricted (2gm)
Vit K	<input type="checkbox"/> T + A Clear Liquid
anical Soft	<input type="checkbox"/> Thick - Honey
4gm Na	<input type="checkbox"/> Thick - Nectar
ffeine	<input type="checkbox"/> Thick - Pudding
raw	<input type="checkbox"/> Vegetarian
Gastrectomy	

SubmitOrder Exit Without Ordering

BJC HealthCare

Back Home Print

8:57 AM



Findings : Order Sets Do Not Hold Place

Pneumonia, Admission Non-ICU (Outline)

1. Pneumonia, Admission Non-ICU (evidence) »

—GENERAL—

-Patients that have been admitted to an extended care facility within the last 3 months or who are pseudomonas risk (more than 48 consecutive hours in the last 60 days inpatient or nursing home) should be treated according to health care associated infection guidelines.-

2. Core Measure: Pneumonia
3. Code 1 FULL CPR in case of cardiopulmonary arrest
4. Code 2 meds and defibrillation only
5. Code 2 meds only
6. Code 3 Do not resuscitate.

+ CQM Pneumonia Chartable Data 2014 comfort measures

7. Assign Patient Level of Care Status greater than or equal 2 midnights admit to inpatient
8. Assign Patient Level of Care Status less than or equal to 1 midnight

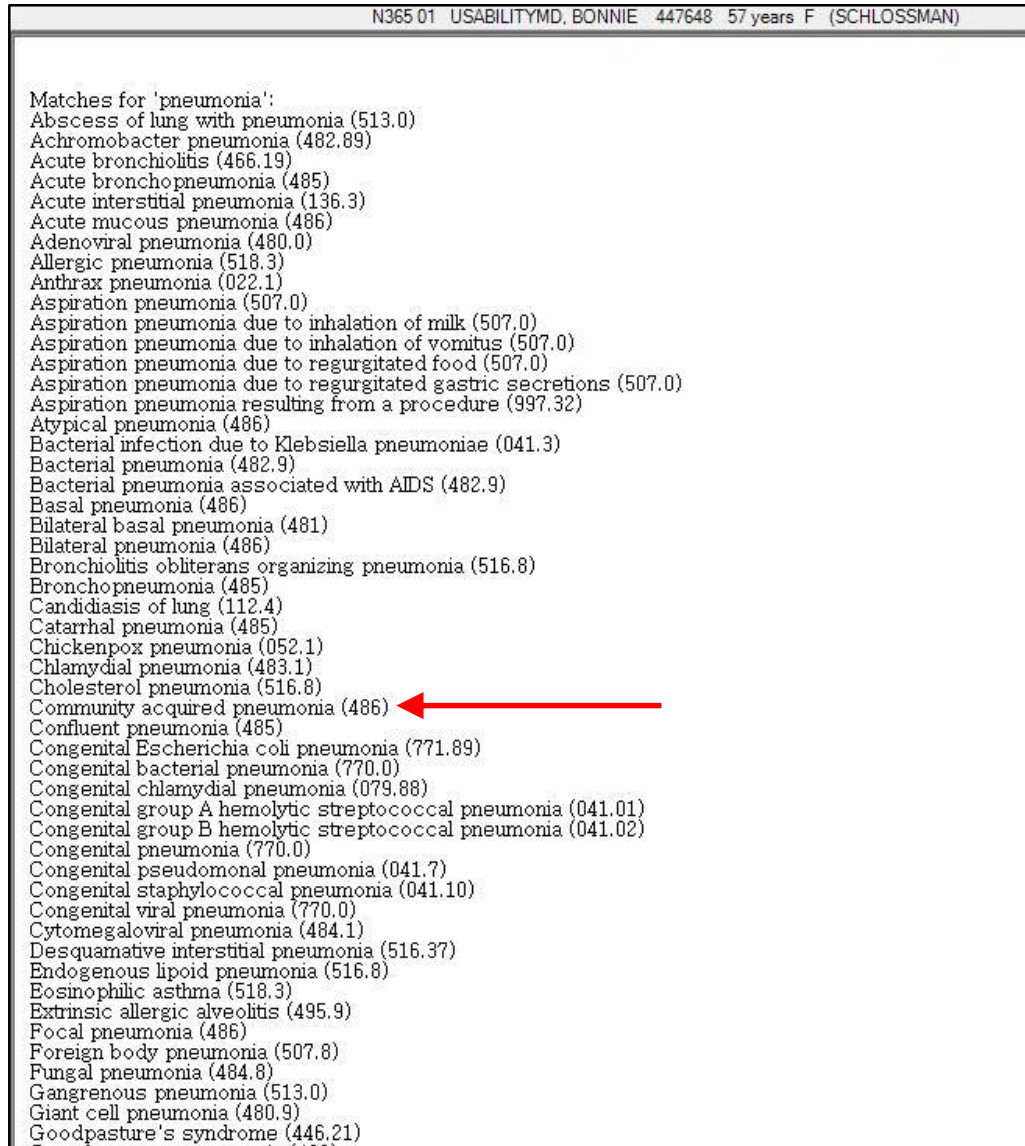


Prebuilt Order Sets Were Poorly Utilized

- 0/10 used the standard Pneumonia (non-ICU) admission order set
- 4/10 utilized any prebuilt admission order set (2 General Medical, 1 General Surgery, and 1 ED Transition orders)
- 1/10 utilized embedded selection logic to order guideline based antibiotics for community acquired pneumonia (CAP)
- 5/10 ordered correct guideline based antibiotics without help
- 1/10 accessed the hyperlinked reference material about community acquired pneumonia and immediately exited that system finding it too complex and verbose



Findings: Disorganized Pick Lists



- Over 150 choices displayed on 3 screens in alphabetical but not logical order
- Most appropriate choice, community acquired pneumonia, is obscured
- Many users chose a less appropriate option just to get on with the workflow
- Subsequent aggregation of such structured data could lead to errors
- Similar problems occur with entering medication and radiology orders.



Findings: Six Clicks to Enter an Allergy

N465 01 USABILITYMD, PAUL 447629 15 years 4 months F (SCHLOSSMAN)

ADC VAAN DISML display

Admission »

- **Assign Patient Level of Care Status** inpatient chest pain »Dec 04 10:07...
- height: 162.6cm/64in; »Dec 05 15:19
- weight: 60kg/132.3lb; »Dec 05 15:19

Diagnosis »

Condition »

Vital signs »

Activity/limitations

Allergies » ←

Nursing instructions

Diet »

Medications »

IV fluids »

TPN orders

Laboratory tests »

Radiographic studies »

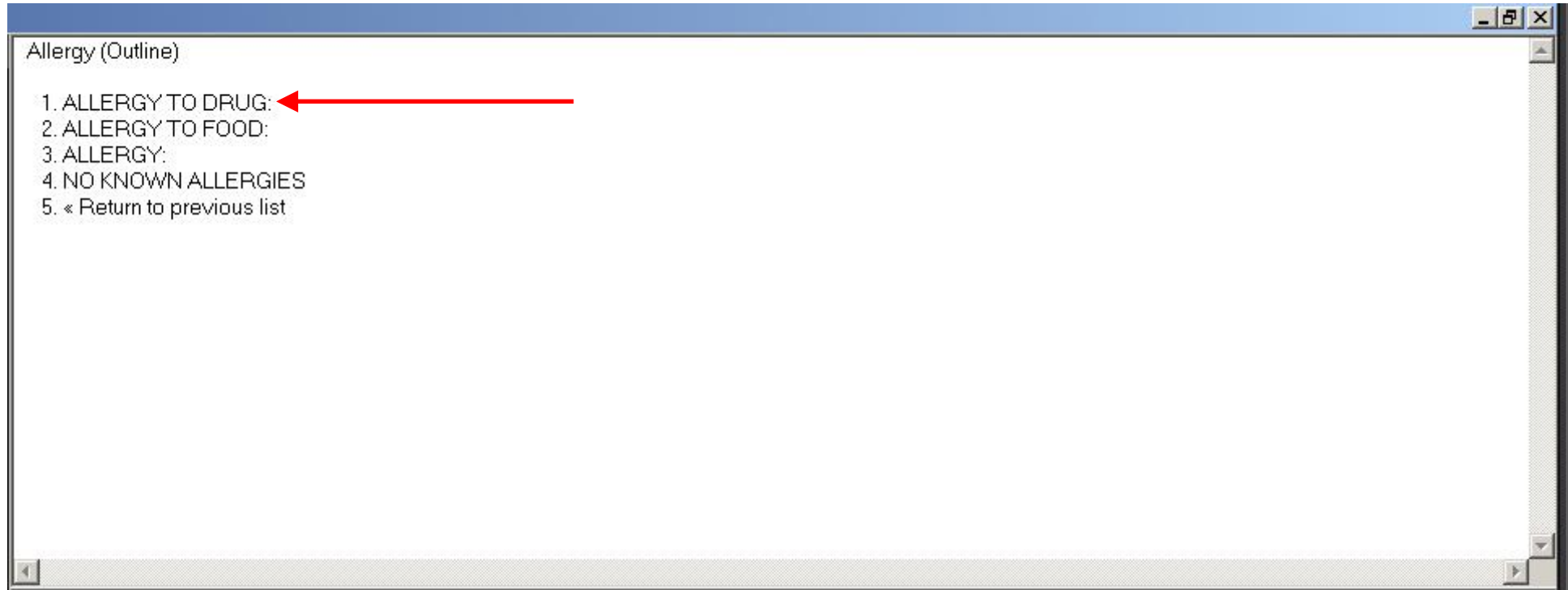
Miscellaneous orders

Procedures »
No Known Procedure

Past orders



Findings: Six Clicks to Enter an Allergy



Findings: Six Clicks to Enter an Allergy

N465 01 USABILITYMD, PAUL 447629 15 years 4 months F [SCHLOSSMAN]

Allergens

NKA
No Allergy Info
ACE INHIBITORS
Acetaminophen
Adhesive Tape
Amoxicillin
Aspirin
Augmentin
Bactrim
BARBITURATES
Bee/Wasp Stings
BETA BLOCKERS (BETA-ADRENERGIC BLOCKING AGENTS)
CEPHALOSPORINS
Cipro
Codeine
Demerol
Dilantin
DYE CONTRAST MEDIA (IODINE; IODINE CONTAINING)
Erythromycin
Fluvastatin
HEPARIN AGENTS
Imitrex
INSULINS
Iodine
IV CONTRAST DYE (IODINE; IODINE CONTAINING)
Latex
Lipitor
Meperidine
Mevacor
Morphine
NARCOTIC ANALGESIA (OPIOID ANALGESICS)
NSAIDS
PENICILLINS ←
Percocet
Phenytoin
Pollen Extracts
Prevachol
Septra
Shellfish
Stadol
STATINS (HMG-COA REDUCTASE INHIBITORS)
SULFA DRUGS (SULFONAMIDES)
Tegretol
TETRACYCLINES
THIAZIDE DIURETICS (THIAZIDES)
Toradol
Vicodin
Zocor
Benadryl
Egg
Keflex
Levaquin
Peanut
Silk Tape
Tetanus Toxoid



Findings: Six Clicks to Enter an Allergy

ALLERGY TO DRUG:
a) Allergy to: PENICILLINS

Reaction: HEORx
\$0.00
Literature
[Up to Date](#)

enter text (this is required!) ←

Order Source: Direct Ordering Clinician: SCHLOSSMAN, DAVID Search

Hives ←

Oops <F5> help <F6> complain <F7> more actions <F10> Stored Order <F9> done <F8>

8:45 AM



Findings: Six Clicks to Enter an Allergy

ALLERGY TO DRUG:
a) Allergy to: PENICILLINS
b) Reaction: Hives

Severity:

1	<u>MILD</u>	HEORx
2	<u>MODERATE</u>	\$0.00
3	<u>SEVERE</u>	Literature
4	<u>UNKNOWN</u>	<u>Up to Date</u>

or enter an allowed value

Order Source: Ordering Clinician:



Findings: Six Clicks to Enter an Allergy

Allergy (Outline)

- 2. ALLERGY TO FOOD:
- 3. ALLERGY:
- 4. NO KNOWN ALLERGIES
- 5. < Return to previous list

Select an item from the list

or enter another order
or press END to return to the previous list

HEORx
\$0.00
Literature
Up to Date

Order Source: Direct Ordering Clinician: SCHLOSSMAN, DAVID Search



Findings: Six Clicks to Enter an Allergy

N465 01 USABILITYYMD, PAUL 447629 15 years 4 months F (SCHLOSSMAN)

ADC VAAN DISML display

Admission -


- **Assign Patient Level of Care Status** inpatient chest pain »Dec 04 10:07...
- height: 162.6cm/64in; »Dec 05 15:19
- weight: 60kg/132.3lb; »Dec 05 15:19

Diagnosis -

Condition -

Vital signs -

Activity/limitations

Allergies - 

- ▣ **ALLERGY TO DRUG: penicillins - hives - severe - ; start on 5/14 at 08:47**

Nursing instructions

Diet -

Medications -

IV fluids -

TPN orders

Laboratory tests -

Radiographic studies -

Miscellaneous orders

Procedures -
No Known Procedure

Past orders

BHC Tree of Orders

2. BHC Physician IForms & Outlines (outline) >
3. BHC Common and PRN Meds (outline) >
4. potassium chloride inj [KCL] ivpb
5. potassium chloride oral ER [K-DUR]
6. furosemide inj [LASIX]
7. furosemide oral [LASIX]
8. BHC Common Labs >
9. BHC Common Labs for New Admissions >
10. Common Labs for Pharmacy >
11. BHC Common Diagnostic Orders (outline) >
12. BHC Respiratory Orders (outline) >
13. BHC Common Nursing Orders (outline) >
14. BHC Consult Orders (outline) >
15. BHC Wound/Skin Orders (outline) >
16. BHC Common CSF Orders >
17. Ancillary Dept Orders (outline) >
18. Discharge Instructions (ifom)
19. < Return to previous list

Select an item from the list

or enter another order
or press **END** to return to the previous list

Order Source: Direct Ordering Clinician: SCHLOSSMAN, DAVID Search

print <F1> display <F2> D/C <F3> renew cosign outlines <F4> Oops <F5> help <F6> complain <F7>



Confusing Order Review Screen

Common IV Fluids, Quick Pick Tracking Order ; start on 5/3 at 10:48, Direct
CBC with Auto Differential ; start on 5/3 at 10:50, Direct
Prothrombin Time INR ; start on 5/3 at 10:50, Direct
PTT Activated ; start on 5/3 at 10:50, Direct
Comprehensive Metabolic Panel (CMP) ; start on 5/3 at 10:50, Direct
.Nurse Collect: Urinalysis with Reflex Culture ; start on 5/3 at 10:50, Direct
Culture blood peripheral now ; start on 5/3 at 10:50, Direct
Culture blood peripheral separate site ; start on 5/3 at 10:50, Direct
.Nurse Collect: Culture Sputum sputum-expectorated ; start on 5/3 at 10:50, Direct
Blood Gas Arterial nasal cannula 2 lpm ; start on 5/3 at 10:50, Direct
.RT to collect: Blood Gas Arterial ; start on 5/3 at 10:50, Direct
Common Labs, Quick Pick (ifom) Tracking Order ; start on 5/3 at 10:50, Direct
XR Chest 2 Views stat indicate reason for exam pneumonia ; start on 5/3 at 10:52, Direct
CT Chest PE W stat sob/ rule out pe ; start on 5/3 at 10:52, Direct
Physician Consult jarbou, mohammad x (boone pulmonary medicine) i need help with pneumonia in a copd patient provider to notify consultant ; start on 5/3 at 10:58, Direct
Group Consult cardiology cap in a cad/copd pt provider to notify consultant ; start on 5/3 at 10:58, Direct
amlODipine oral [NORVASC] 5 mg oral daily ; start on 5/4 at 09:00, Direct
lisinopril oral [PRINIVIL , ZESTRIL] 10 mg oral daily ; start on 5/4 at 09:00, Direct
pioglitazone oral [ACTOS] 15 mg oral daily ; start on 5/4 at 09:00, Direct
atorvastatin oral [LIPITOR] 20 mg oral bedtime ; start on 5/3 at 21:00, Direct
aspirin oral 81 mg oral daily ; start on 5/4 at 09:00, Direct
clopidogrel oral [PLAVIX] 75 mg oral daily ; start on 5/4 at 09:00, Direct
omeprazole oral [PRILOSEC] 20 mg oral daily ; start on 5/4 at 09:00, Direct
albuterol-ipratropium inhaler 90-18 mcg/inh [COMBIVENT] 2 puff inhalation qid rt for shortness of breath ; start on 5/3 at 13:00, Direct
budesonide inhaler 180 mcg/inh powder [PULMICORT FLEXHALER] 2 puff inhalation q12 hrs rt ; start on 5/3 at 21:00, Direct
multivitamin oral [THERAGRAN] 1 tablet oral daily ; start on 5/4 at 09:00, Direct
Core Measure: Pneumonia ; start on 5/3 at 11:08, Direct
levofloxacin inj [LEVAQUIN] per pharmacy dosing guidelines for pneumonia ; start on 5/3 at 11:08, Direct
aztreonam inj [AZACTAM] 2 gm wpb q8hrs ; start on 5/3 at 14:00, Direct
Pneumonia/Critical Care, Management (ifom) Tracking Order ; start on 5/3 at 11:08, Direct
VL/US Venous Low Ext Bi stat swollen rie, r/o dvt ; start on 5/3 at 11:09, Direct
Lipid Panel in am ; start on 5/4 at 05:00, Direct
Common Labs, Quick Pick (ifom) Tracking Order ; start on 5/3 at 11:10, Direct
enoxaparin inj [LOVENOX] 40 mg subcut daily - 1200 ; start on 5/3 at 12:00, Direct
VTE Prophylaxis (ifom) Tracking Order ; start on 5/3 at 11:10, Direct
glucose oral 40% gel [DEXTROSE] 15 gm oral prn per hypoglycemia protocol if patient is able to swallow ; start on 5/3 at 11:11, Direct
D50-W inj [DEXTROSE 50%] 12.5 gm ivpush prn per hypoglycemia protocol if patient is unable to swallow and has iv access ; start on 5/3 at 11:11, Direct
glucagon inj [GLUCAGEN] 1 mg im-only prn per hypoglycemia protocol if iv access is unavailable and patient is unable to swallow ; start on 5/3 at 11:11, Direct
Hypoglycemia Protocol: Provide snack or meal continuous within 1 hour of the hypoglycemic event, as long as the patient is not npo ; start on 5/3 at 11:11, Direct
Call/Notify: Glucose less than per hypoglycemia protocol-50 mg/dl or 2 consecutive checks requiring treatment of less than 70 mg/dl. always treat patient first, call rrt as needed and then notify ; start on 5/3 at 11:11, Direct
If/Then: Hypoglycemia Protocol: Glucose less than continuous 70 mg/dl, or if bg is 71-100 mg/dl and symptomatic, treat 1st if symptomatic, but re-check bg immediately, if condition remains in 15 min give second dose
5/3 at 11:11, Direct
Bedside Glucose achs ; start on 5/3 at 17:00, Direct
Call/Notify: unexpected changes in nutritional intake, such as npo, nausea/vomiting, interruption of tube feedings or tpn ; start on 5/3 at 11:11, Direct
insulin lispro inj [HumaLOG] 1 - 5 unit subcut tid w/ meals
- low dose correctional scale
immediately within 15 minutes of meal
fsbs levels (mg/dl):
70-149 = 0 units
150-199 = 1 units
200-249 = 2 units
250-299 = 3 units
300-349 = 4 units,notify md
350 or greater = 5 units,notify md.
- start on 5/3 at 12:00, Direct
SQ Insulin (ifom) Tracking Order ; start on 5/3 at 11:11, Direct
acetaminophen oral tabs/caps [TYLENOL] 650 mg oral q4h prn for fever greater than 100.5 f (38 c) or mild pain (scale 1-3) ; start on 5/3 at 11:11, Direct
docusate oral [COLACE] 100 mg oral bid (hold if patient has diarrhea) ; start on 5/3 at 21:00, Direct

Please confirm all orders for **USABILITYMD, BONNIE , N365 01, 57 years, F**

Accept Orders and Exit Save Draft and Exit Modify Orders Do Not Exit

One physician commented
“This is the part I hate
because it’s so busy. It’s very
hard to look and see if you’ve
got everything.”

Another said “Totally useless.
There’s no way you’re going
to pick up a mistake in that.
It’s not laid out in any logical
order.”



System Usability Scale

The average System Usability Scale (SUS) for working with this CPOE system was 25.5 ± 14.16 , indicating very low user satisfaction (the average SUS for many hundreds of systems tested in the literature is approximately 68 with 0 being the worst and 100 being the best).



Barriers to Educating and Empowering Physician EHR Users

1. Financial Challenges

- a) Few resources for purchasing computer hardware and software
- b) Inability to compensate participants hindered recruiting
- c) Lost professional time creating protocol components and test patient data, conducting the testing, and analyzing the data



Barriers to Educating and Empowering Physician EHR Users

2. Technical Challenges

- a) HIPAA compliance: data privacy and security required use of the Training rather than the Production EHR environment
- b) Inserting test patient data into the EHR electronically was not possible, requiring cumbersome manual workarounds
- c) The responsiveness of the Training environment did not perfectly reflect that of the Production environment,
- d) Occasional system “freezes” with no feedback to the user about system status impacted user performance



Barriers to Educating and Empowering Physician EHR Users

3. Sociocultural Challenges

- a) The high level of complaints about EHR and CPOE suggested Medical Staff would welcome such research
- b) Despite broadcast emails, presentation at Medical Staff meeting, and personal appeals to multiple physicians with special interest in IT, recruiting physicians to participate in the study was extremely difficult
- c) The major recruiting challenge was a pervasive belief, based on 8 years experience, that rational arguments about IT best practices would not influence IT policy or functioning at BHC
- d) Multiple other professional, financial, and administrative factors competed for physician time
 - i. Decreased efficiency following the implementation of health IT (fewer patients per hour, longer workdays)
 - ii. Declining reimbursement rates and adapting to new physician compensation models (ACOs, value based payments)
 - iii. Increased regulatory burden (PQRS, Meaningful Use)
 - iv. Keeping current and providing best care in an era of explosive growth in the biomedical knowledge base



Study Limitations

- Clinician bias of the principal investigator
- Low participation, single institution, and focus on one functionality of a particularly outdated, poorly functioning EHR
- Despite limitations, a consistent set of usability deficiencies, affecting all users, was rapidly identified
- How could a user centered design process with clinician input have missed so many commonly identified problems?

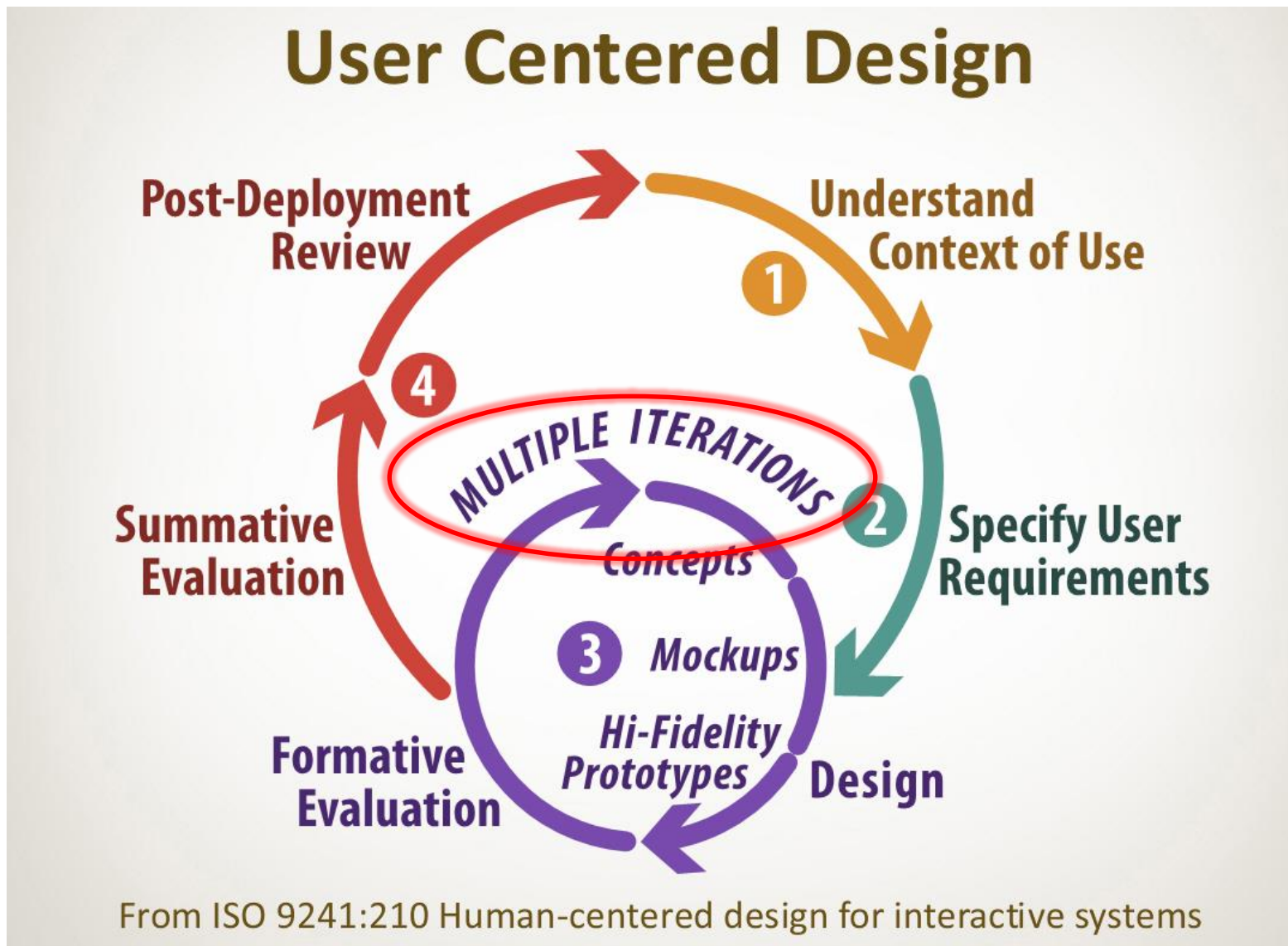


Policy Implications

- There is a factual basis for the my colleagues' belief that policymakers and regulators are unreceptive to physician attempts at constructive engagement.
- Stage 1 MU was highly successful in overcoming the adoption barrier.
- Experience from Stage 2 MU suggests that emphasizing burdensome data collection processes, which detract from improving software design and productivity without clear benefits to care quality and safety is not the best strategy
- The NPRM for Stage 3 continues to emphasize the same rigid, prescriptive, process oriented measures.



Usability Arises From User Centered Design (UCD)



Improving Usability Is a Shared Responsibility



“The clinical systems of today are great advances from what were available a decade ago but are still imperfect. Progress depends on further research, a vibrant vendor community that collaborates well with academia to enhance features such as interoperability and usability, and highly trained applied informaticians, many of whom are also practicing clinicians.”

Detmer, D.E. and Shortliffe, E.H. (2014). Clinical Informatics: Prospects for a New Medical Subspecialty. *Journal of the American Medical Association* 311 (20): 2067-2068 [doi: 10.1001/jama.2014.3514](https://doi.org/10.1001/jama.2014.3514).



Solutions?

- Resources, such as clinically plausible test scenarios and task lists, test patient data, validated best practices in user centered design, and compensation for lost professional time are needed to attract clinicians to participate in summative, and even more importantly formative, usability testing
- Policy innovations that refocus Meaningful Use incentives on value and outcomes rather than processes, and provide the support and time needed for software developers and clinicians to engage in robust UCD, based on common real world use cases, and leading to intuitive health IT which improves clinical workflow efficiency and decreases cognitive load.
- Open platform architectures with publicly accessible APIs for healthcare (FHIR, ReSTful APIs)



Comments and Questions

