CHCANYS DEFINING NEW DIRECTIONS
Community Health Care Association of New York State

CHCANYS-HCCN Webinar
Part 1: Optimizing the Electronic Health Record Using a Human Factors Approach

Raj Ratwani, PhD
Director, MedStar Health National Center for Human Factors in Health Care

July 9th, 2019

COMMUNITY HEALTH CENTER FQHC QUALITY

Agenda

- Introduction to today's presenter
- Human factors and EHR Usability
- Understanding specific usability issues across different EHRs and impact on
  - Direct clinician burnout and
  - Patient safety implications
- Identifying usability and safety issues
- Announcements and Evaluations

Introductions

MedStar Health National Center for Human Factors in Healthcare

Raj Ratwani, PhD

- *Director*, MedStar Health National Center for Human Factors in Healthcare
- *Associate Professor*, Georgetown University School of Medicine

Optimizing the Electronic Health Record Using a Human Factors Approach

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Disclosures

- Research is funded by:
  - Agency for Healthcare Research and Quality
  - The Pew Charitable Trust

- Member of the 21st Century Cures Act Health Information Technology Advisory Committee

National Center for Human Factors in Healthcare

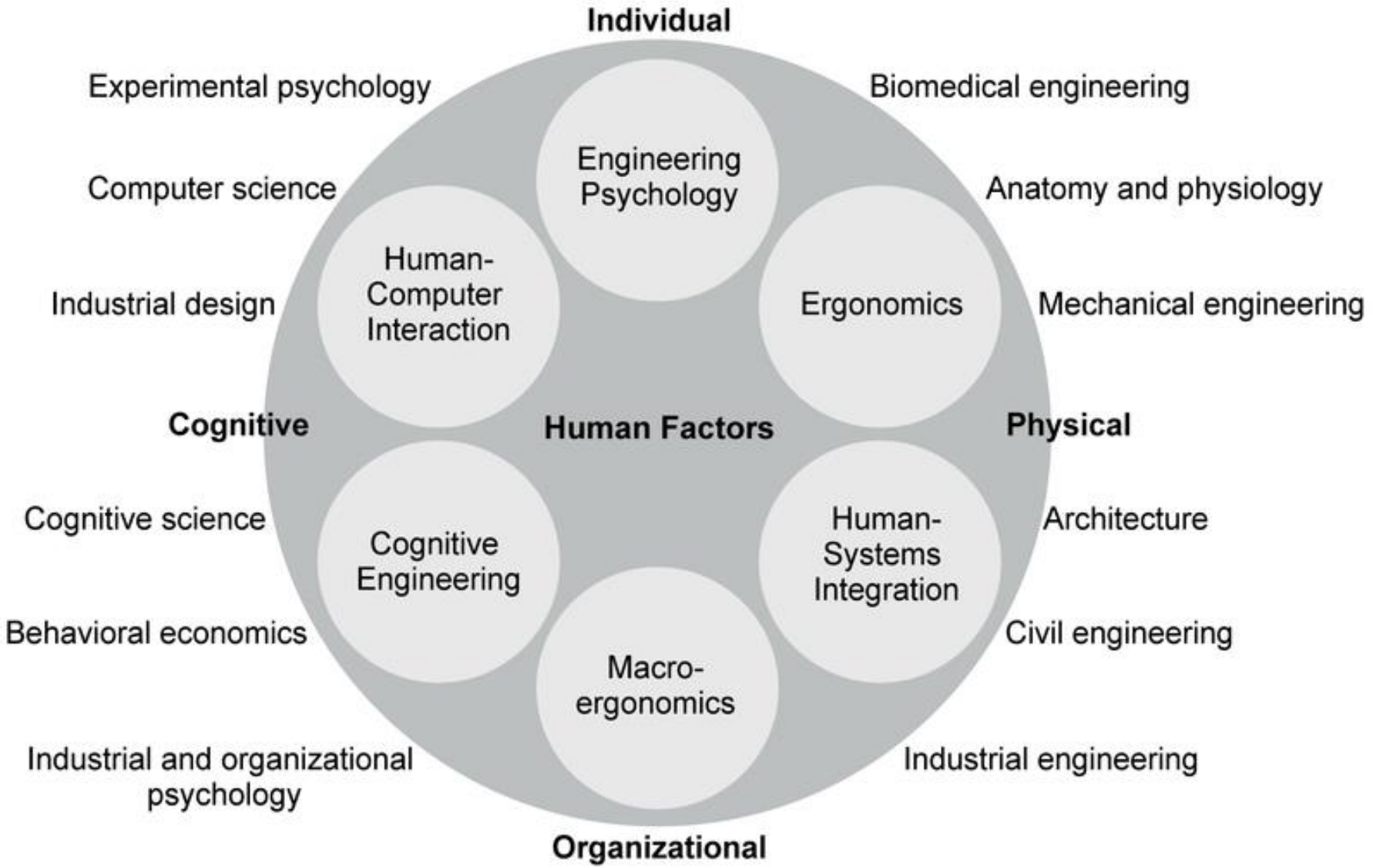
We focus on studying human capabilities and *designing technology, systems, and processes to meet these capabilities* for safety, efficiency, & quality

Multidisciplinary approach:

- Human factors
- Medicine
- Engineering
- Computer Science
- Psychology

The Central Tenant of Human Factors

"We don't redesign humans;
We redesign the system within which humans work"


Individual
Experimental psychology
Biomedical engineering
Computer science
Anatomy and physiology
Industrial design
Mechanical engineering
Engineering Psychology
Human-Computer Interaction
Ergonomics
Cognitive
Human Factors
Physical
Cognitive science
Architecture
Behavioral economics
Civil engineering
Industrial and organizational psychology
Industrial engineering
Cognitive Engineering
Human-Systems Integration
Macro-ergonomics
Organizational

Our Health IT Usability Expertise

Health IT Policy

- Senate and federal advisory committee testimonies
- Analysis of policy implications
- Recommendations for new policies and policy optimization

Frontline Provider Practice

- Operational optimization efforts
- Health IT safety teams
- Usability & safety surveillance

Vendor Processes

- 2 AMA/MedStar usability initiatives
- 3 ONC contracts
- Vendor partnerships

Applied Research

- 3 R01 awards
- 2 Go-live observational studies
- Toolkit and method development

Committees

- **UK** Advisory Committee
- **AAMI** Committees
- **DC HIE** Advisory Board
- **21st Century Cures Act Health IT Advisory** Committee
- **Health IT Safety Center** Task Force
- **AMA** Usability Task Force

Defining EHR Usability

Usability: Interface Design and Usefulness

User Interface Design

Context Independent

Font Sizes

Icons

Colors & Contrast

Layout

Cognitive Task Support

Context Dependent

“Workflow Design”

Visualization

Memory Aids

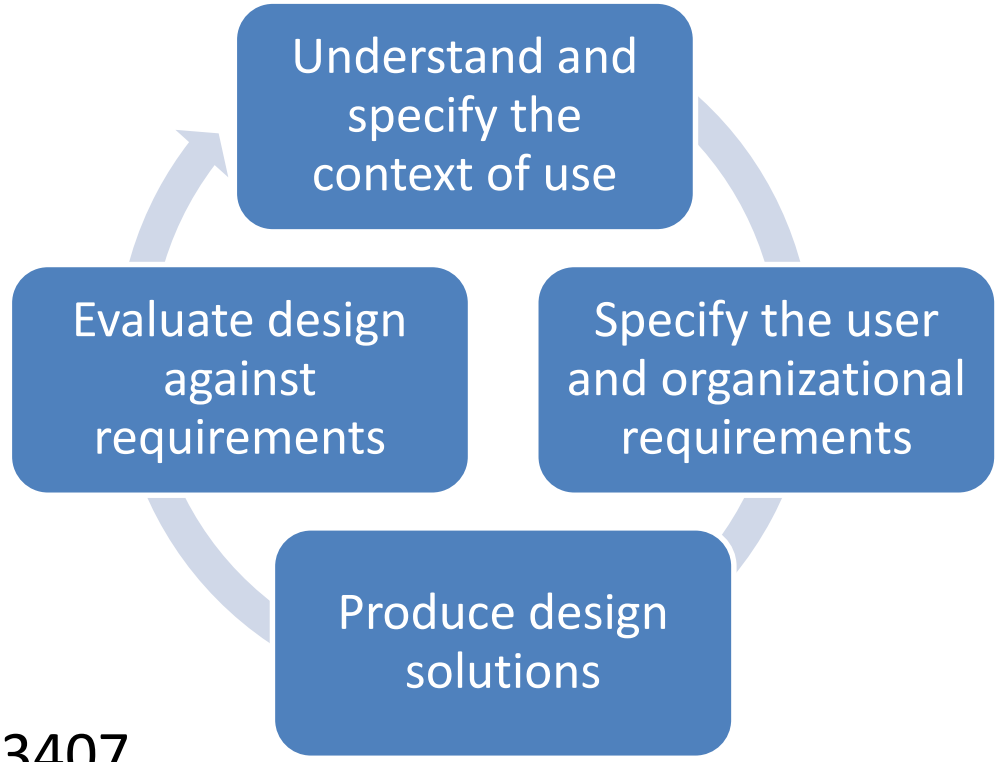
Error Anticipation

Usability and User Centered Design

- 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

- Usability is measurable

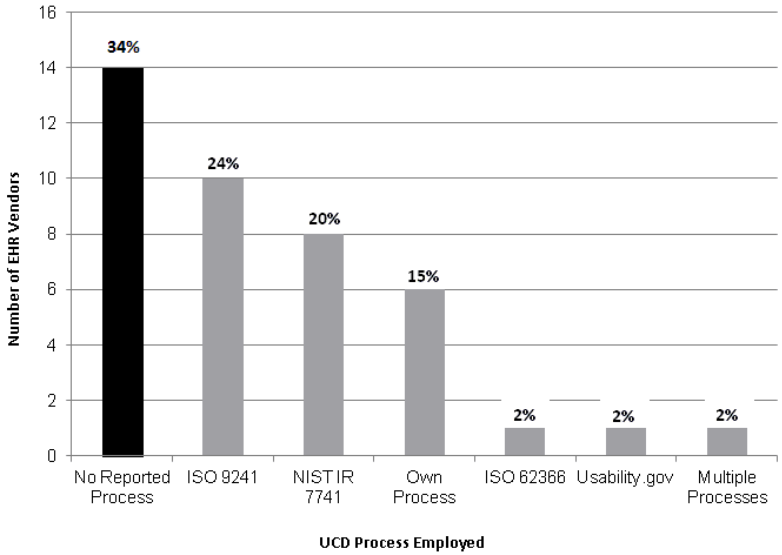
- User centered design is a process for developing usable systems

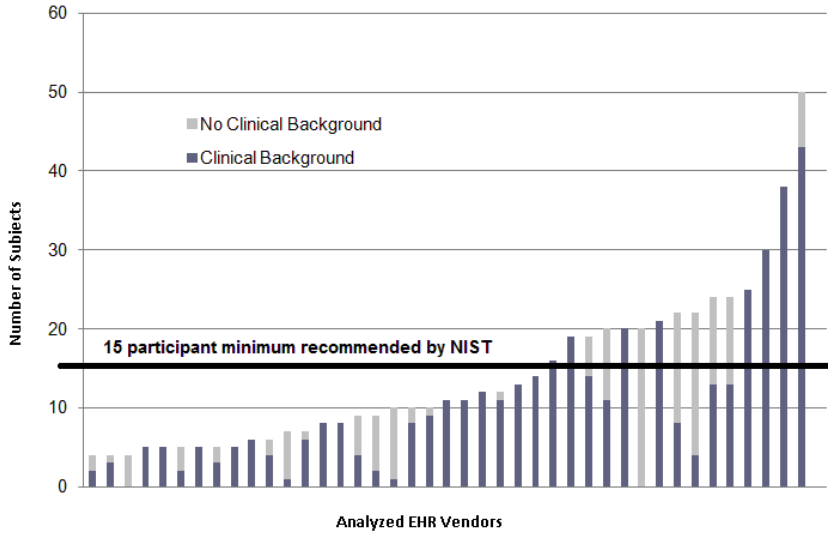


ISO 3407

Government Policies to Promote Usability

- Office of the National Coordinator (ONC) has certification requirements in place to promote usability:
  - Vendors must attest to a UCD process
  - Vendors must conduct a summative (final) usability test on a subset of functions and report their method and results
- The information for certified vendor products is publically available





Ratwani, R. M., Benda, N. C., Hettinger, A. Z., & Fairbanks, R. J. (2015). Electronic health record vendor adherence to usability certification requirements and testing standards. *JAMA*, *314*(10), 1070-1071.

Prominent Usability Challenges

Factors Impacting EHR Usability

- EHR usability is shaped by more than vendor design & development:
  - Site Customization/optimization choices
  - Personal modifications (favorites etc)
  - Training
  - Hardware (screen size etc)
  - Upgrades

Identifying Usability and Safety Hazards

- Analyzed patient safety event report data
  - 1.7m reports
  - Explicit mention of top five EHR vendor and categorized as a harm event

[DATE] 1842 by [NAME]--- 9 mg dose Gentamicin AND a 9.9 mg dose Gentamicin were in patient bedside med drawer, **EACH ONE was scheduled to be given at 1000** (on the EHR worklist, in EHR Current Scheduled Medications, and each one had an entry on the MAR as being due at 1000). I notified pharmacy and she discontinued one of these doses. **Concern that [Vendor Name] EHR allowed both doses to be ordered**, and if these were timed farther apart there is a possibility that **both doses may have been given**. I printed the information from EHR and placed it in the NICU PCS mailbox.

Usability Issue	Definition	Example
Data Entry	Data entry is difficult or not possible preventing the clinician from entering desired information.	The height and weight fields are reversed depending on where in the EHR you are entering information.
Alerting	Alerts or other feedback is incorrect, ambiguous or absent.	Allergy alert did not fire to prescriber even though the allergy was documented in the EHR.
Interoperability	Communication of information is hindered within components of the same EHR or from the EHR to other systems	Lab results did not flow into the EHR used by the primary care physician.
Visual Display	Display of information is confusing, cluttered, or inaccurate.	The list of the patient's medications does not clearly indicate which are active without clicking on each medication name.
Availability of information	Clinically relevant information is not available because it is in the wrong location or is otherwise inaccessible.	The patient's last ejection fraction is not easily found in the EHR without searching through all the historical documentation.
System automation and defaults	The EHR automates or defaults to information that is unexpected, unpredictable, or not transparent to the clinician.	When entering a medication order to start today the EHR defaulted to the next day.
Workflow support	Clinician workflow is now supported due to a mismatch between the EHR and the mental state of the end user.	A test ordered by the office through the EHR was "thyroid group"; the specimen was drawn but one part of the test was not performed because it was a confusing translation between the physician order and the EHR.

Usability and Harm Events

1.735m Patient Safety Event Reports

1,956 (.11%) explicitly mentioned EHR vendor and reported patient harm

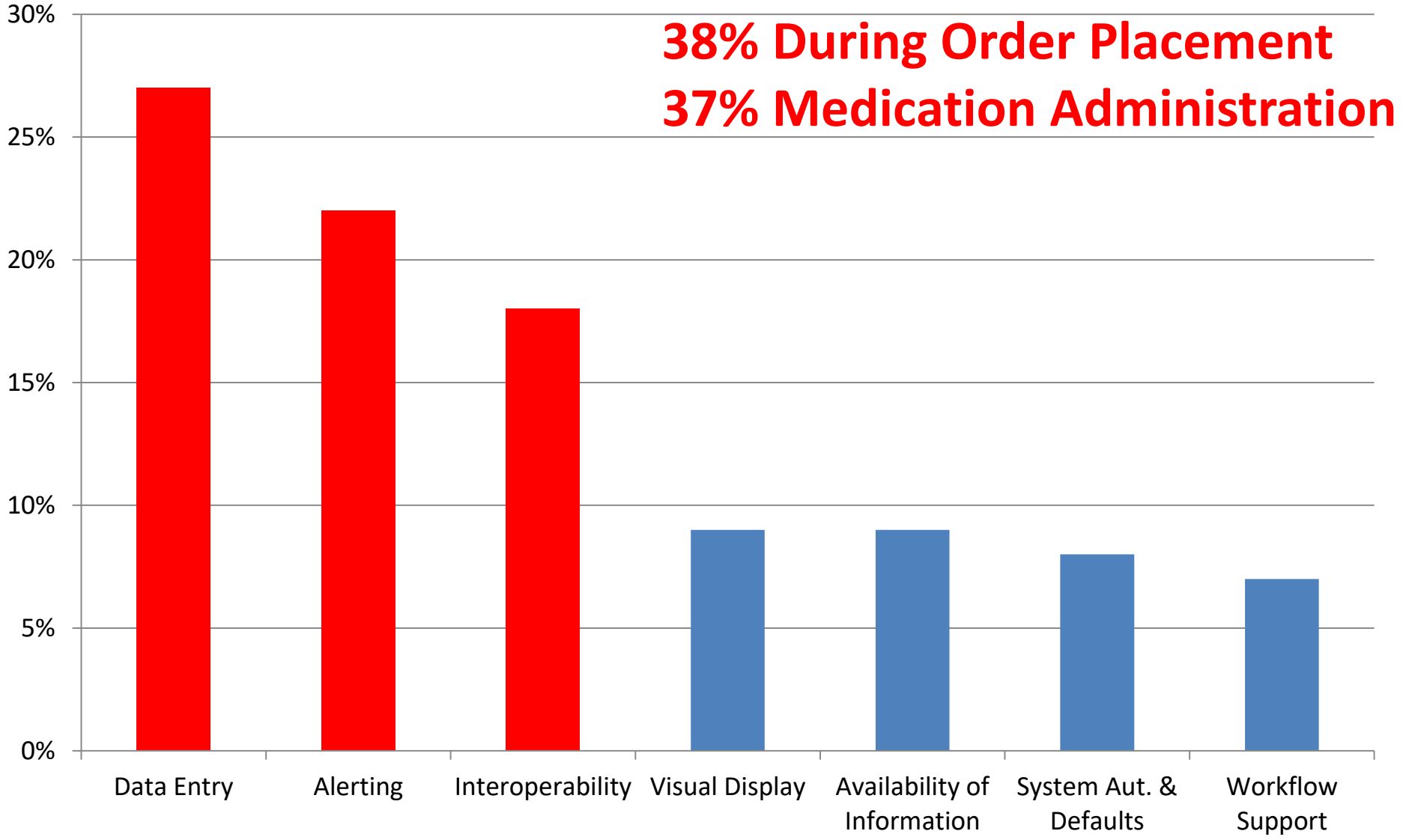
557 (.03%) contained language suggesting usability as an issue

Howe, J., Adams, K., Hettinger, A. Z. & Ratwani, R.M. (2018). Electronic Health Record Usability Issues and Potential Contributions to Patient Harm. *JAMA*

Harm Levels Associated with Usability Events

Harm Level	Percent (count)
Reached patient and potentially required monitoring to preclude harm	84% (468)
Potentially caused temporary harm	14% (80)
Potentially cause permanent harm	1% (7)
Could have necessitated intervention to sustain life or could have resulted in death	<1% (2)

Usability Challenges



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Common Usability Challenges

	Function	Usability Challenge
Medication	Medication-allergy alerts	Poor alerting
	Weight-based dosing	Data entry issues
	Duplicate orders	Poor alerting
	Med Rec	Data entry issues
	Pending/Active Order	Data entry, system state
Lab	Entry of order	Data entry, interop
	Reporting of results	Interop, display
Imaging	Receiving results	Interop, display
General	CPOE	Automation without user awareness
	Patient selection	Data entry, display

EHR Usability and Pediatric Harm

QUALITY OF CARE

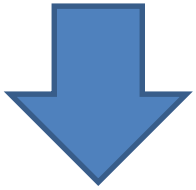
By Raj M. Ratwani, Erica Savage, Amy Will, Allan Fong, Dean Karavite, Naveen Muthu, A. Joy Rivera, Cori Gibson, Don Asmonga, Ben Moscovitch, Robert Grundmeier, and Josh Rising

Identifying Electronic Health Record Usability And Safety Challenges In Pediatric Settings

ABSTRACT Pediatric populations are uniquely vulnerable to the usability and safety challenges of electronic health records (EHRs), particularly those related to medication, yet little is known about the specific issues contributing to hazards. To understand specific usability issues and medication errors in the care of children, we analyzed 9,000 patient safety reports, made in the period 2012–17, from three different health care institutions that were likely related to EHR use. Of the 9,000 reports, 3,243 (36 percent) had a usability issue that contributed to the medication event, and 609 (18.8 percent) of the 3,243 might have resulted in patient harm. The general pattern of usability challenges and medication errors were the same across the three sites. The most common usability challenges were associated with system feedback and the visual display. The most common medication error was improper dosing.

9,000 EHR related medication events from 3 institutions (2 Epic, 1 Cerner)

3,243 (36%) has a usability issue that contributed to the event



609 (18.8%) may have resulted in harm

Multi-site EHR Usability & Safety Study

- 2 Cerner and 2 Epic sites
- Six emergency medicine clinical scenarios
- 12-15 resident and attending physicians per site
- Performed tasks on their own EHR training system
- Collected eye movement, keystroke, and video capture data

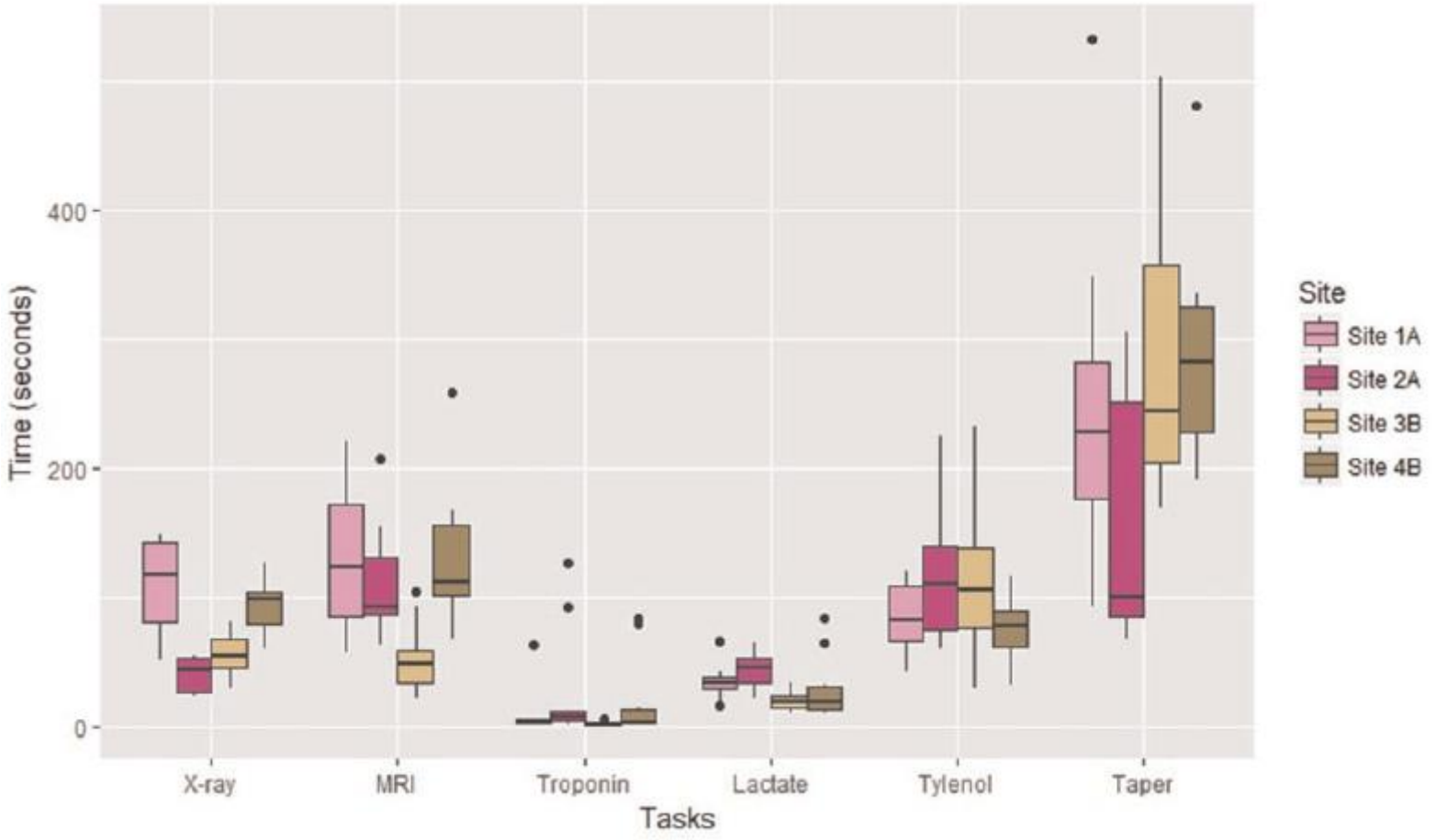
Ratwani et al. (2018) A Usability and Safety Analysis of Electronic Health Records. Journal of the American Medical Informatics Association.

EHR Usability & Safety Testing

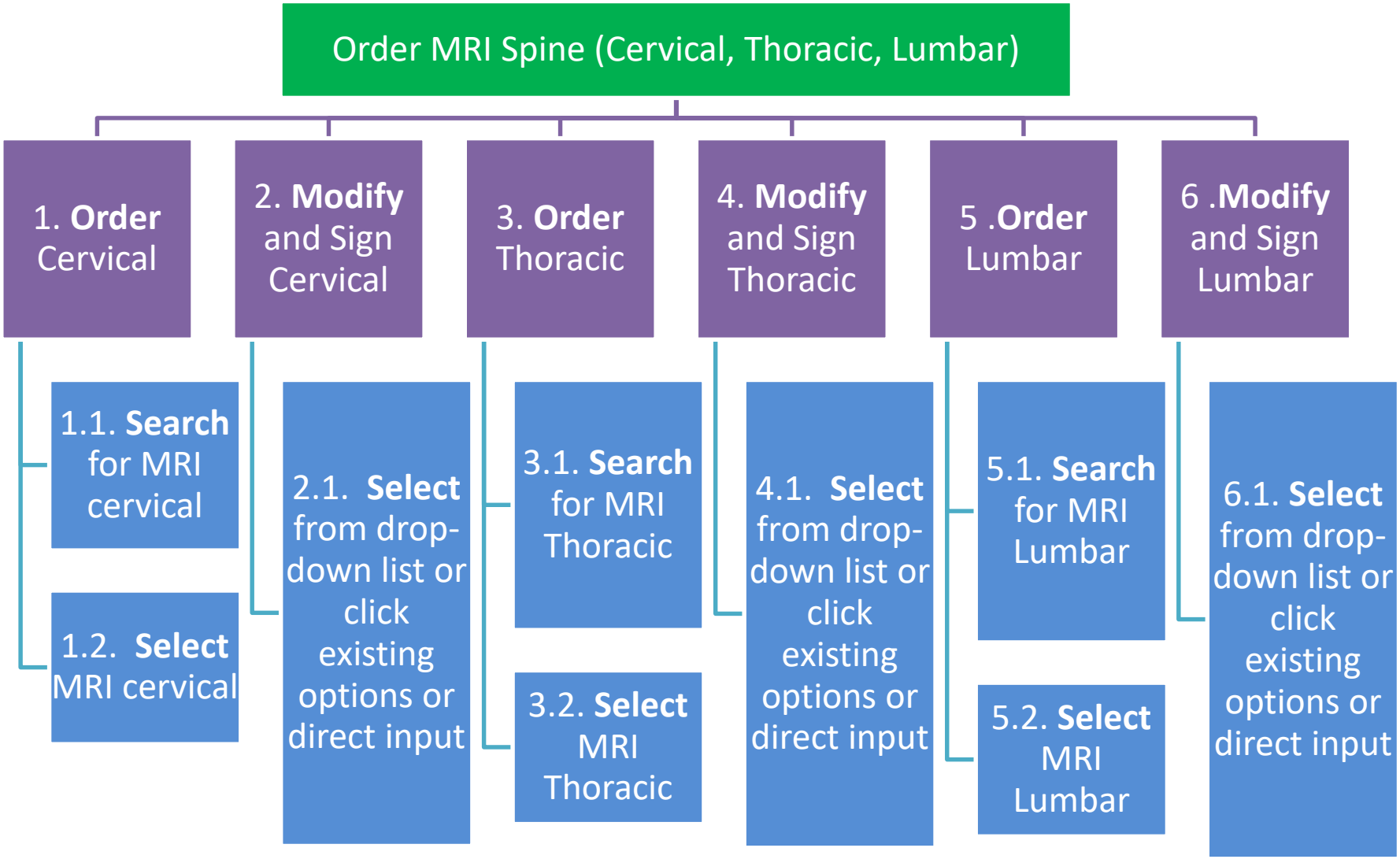
EHR Functions	Usability & Safety Metrics	Vendor A-Site 1	Vendor A-Site 2	Vendor B-Site 3	Vendor B-Site 4
X-ray (left elbow, wrist, forearm)	Time (sec)	64.1	24.3	33.3	55.5
	Clicks	31.1	7.7	8.1	15.5
	Error Rate	25%	16.7%	**35.7%**	20%
Prednisone Taper (60mg, reduce by 10mg every 2 days for 12 days)	Time (sec)	148.6	152.7	175.1	178.7
	Clicks	34.9	20	42.3	28.2
	Error Rate	16.7%	**41.7%**	**50%**	**40%**

Ratwani et al. (2018) A Usability and Safety Analysis of Electronic Health Records. Journal of the American Medical Informatics Association.

Physician Variability



Workflow Variations



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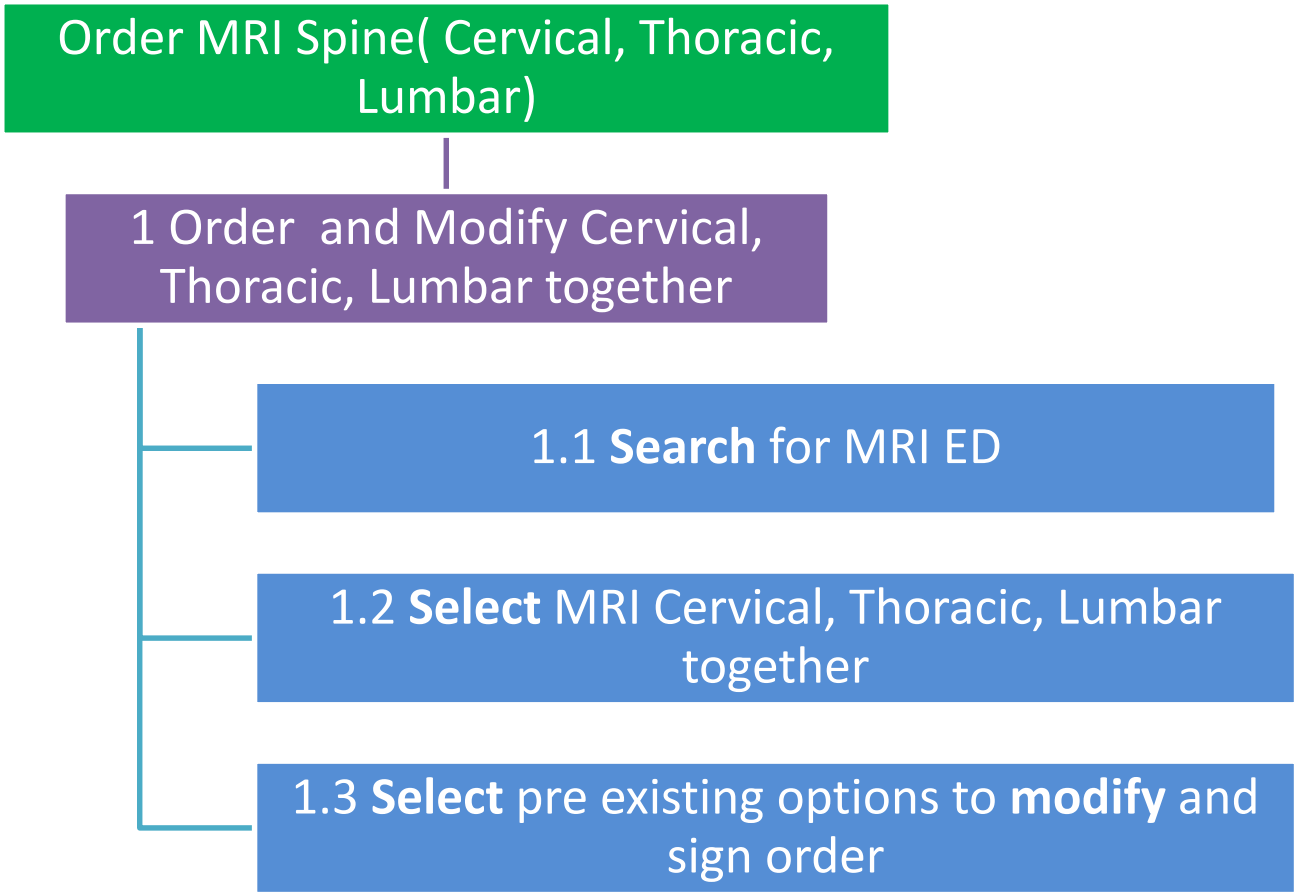


Methods to Identify Usability Challenges

Methods

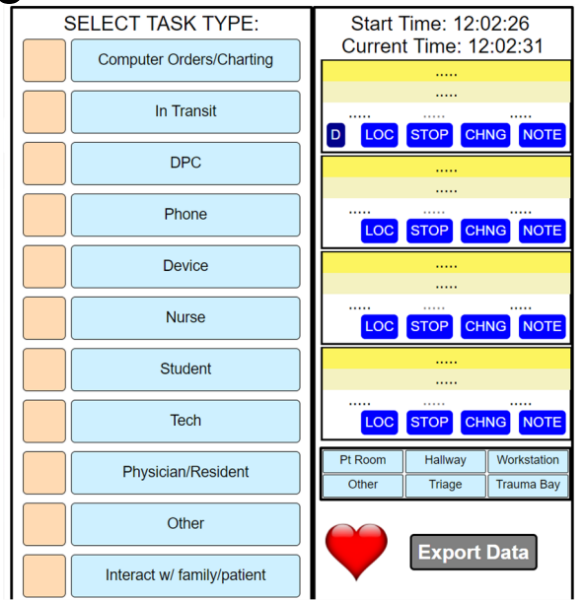
Method	Description	Advantages	Drawbacks
Surveys, interviews, & focus groups	Solicit information directly from providers, and other stakeholders, about usability issues.	• Timely • Detailed • Contextually rich	• May not reflect reality
Observations	Directly observe how providers are interacting with the EHR.	• Detailed • Contextually rich • Accurate	• Time intensive • Expertise
Usability tests	Perform usability tests of currently fielded products with rigorous test cases.	• Rigorous metrics • Identification of specific issues	• Time intensive • Expertise
Safety event report data	Analyze safety reports to identify EHR usability issues.	• Patterns/trends • Serious concerns	• Data overload • Limited context
IT Ticket/bug data	Identify issues through analysis of clinician reported EHR issues.	• Large volumes of data • Targeted improvements	• Limited context
EHR Usage/Log data	Identify safety near misses, inefficient workflows, and providers that are facing specific challenges.	• Large volumes of data • Targeted improvements	• Limited context

Surveys, interviews, & focus groups

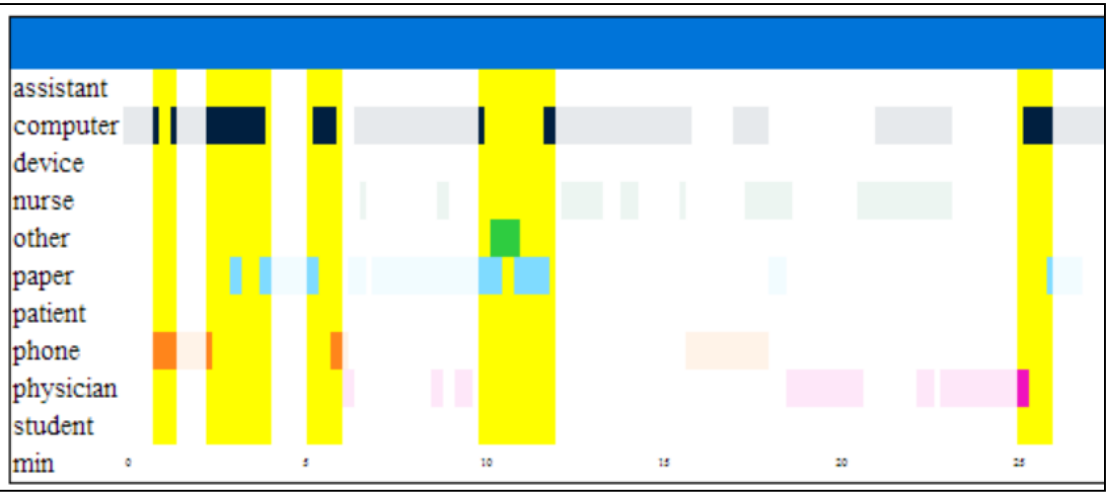
- Surveys
  - System usability scale (10 items)
    - Can provide a baseline to measure improvements against
  - Open-ended questions provide great insights
- Interviews & focus groups
  - Open ended questions
  - Solicit improvement suggestions
  - Explain challenges in implementing changes

Observations

- Use an observational tool
  - Recommend: TaskTracker
    - Tablet based tool to track workflows (freely available)
  - Develop your own
    - Simple paper and pen tools work well too
- Observe at least 5-6 per specialty/location
- Follow-up with brief interview



Workflow Visual Analytics Tool



Common State Transitions

From	To	Frequency
computer	computer+physician	26
computer+physician	computer	21
computer+paper	computer	19
physician	computer+physician	16
phone	computer+phone	15
computer+paper	paper	13
computer+nurse	nurse	13
computer+phone	phone	12
paper	computer+paper	12
nurse+other	nurse	12

Usability tests

- Clinical scenarios widely available:
  - NIST
  - SHARPC
  - MedStar/Pew/AMA
- Recommend at least 5 participants
- Measures:
  - Efficiency (time on task)
  - Effectiveness (error rates)

Safety Event Report Data

- Manually review those events flagged as health IT related
- Natural language processing methods to identify events
  - Model to identify health IT events

Features	50	100	150	200	250	300	350	400	450	500	550	600
duplicate	2.8	2.7	2.5	2.6	2.7	2.3	2.2	2.4	2.5	2.8	2.9	3.1
mismatch	2.2	1.8	1.4	1.4	1.3	1.5	1.5	1.5	1.5	1.4	1.5	1.6
computer	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.2	1.3	1.3	1.5	1.5
prescription	1.1	1.1	1.2	1.2	1.2	1.2	1.3	1.2	1.3	1.4	1.3	1.3
incorrect	1	0.9	1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
system	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.8
label	0.9	0.6	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.8
enter	0.8	0.9	0.9	0.9	0.8	0.8	0.9	0.9	0.9	0.8	0.9	0.9
order	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.8
schedule	0.7	0.8	0.7	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.9	0.9
administer	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.5
dose	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
give	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4

Usage/Log Data

- Vendor tools
  - Many vendors provide tools to examine user behaviors
    - Use of order sets, searching for meds etc
    - Pajama time
    - Workflows
- Trigger patterns
  - Identify specific patterns that may signify a usability challenges
    - Retract and reorder (Adelman, 2013)

Summary, Takeaways, & Next Steps

Summary

- Usability is driven by design, development, configuration, customization, and updates
- Multiple methods are needed to identify usability issues

Takeaways

- For access to the observation app and algorithms please contact me directly

Next webinar on 7/16 @ 2PM EST will focus on prioritizing usability issues and optimization

Thank You

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MedStar Health

MedStar Health
National Center for
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Announcements

- Part 2: **Optimizing the Electronic Health Record Using a Human Factors Approach**
  - July 16th, 2019 from 2-3pm
- HCCN Upcoming Workshop – **Leveraging Data from External Sources to Optimize Practice & EHR Workflows**
  - July 30th, 2019 from 9:30am-4:30pm
  - Metropolitan College, 60 West Street, New York, NY 10006

SURVEY LINK

https://www.surveymonkey.com/r/KDR6KNY

Questions?

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