



/ White Paper

Improving EHR Usability with User-Centered Design

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Improving EHR Usability with User-Centered Design

User-centered design (UCD) in Health IT can improve usability, which in turn improves patient safety and clinician efficiency. This article will review best practices and illustrate UCD concepts with examples from Allscripts electronic health records (EHR).

What is User-Centered Design?

UCD is a process in which software designers give extensive attention to the needs, wants and limitations of end users.

It requires researchers and designers to analyze and predict how people will use the software, and test the validity of those assumptions with actual users. The ultimate goal of UCD is to make software that is satisfying to use by making it easy to learn, efficient and effective for users, and safe for patients.

“UCD focuses on making the product fit user needs and wants, rather than forcing the users to change behavior to accommodate the product,” Allscripts Director of User Experience Ross Teague, Ph.D. said. “Overcoming these challenges is particularly important in health care, where EHRs should enable clinicians to deliver better, safer patient care.”

Many EHR vendors collect input from users, but most do not follow the methods associated with a rigorous UCD process.¹ As a result, the feedback may be incorrect, misleading or misused, resulting in the belief that designers are not listening to users’ voices. A rigorous UCD process is the ideal way for clinicians to be involved in EHR software design.

EHR usability is a patient safety issue

EHRs help improve patient safety in several ways. For example, EHR clinical decision support (CDS) and computerized provider order entry (CPOE) can reduce errors in prescribing that can lead to adverse events.^{2,3}

Unfortunately, bad design and poor usability can increase the risk of mistakes while ordering tests or medications.⁴ A Joint Commission analysis found that human-computer interaction problems were to blame for one-third of patient safety events.⁵

Not all usability problems are immediately recognizable by users. When poor usability leads to unnecessary cognitive effort, it creates a hidden “cognitive tax” and can affect provider efficiency and focus, which impacts patient safety.

Even a date format can create confusion or unnecessary work for the user. For example, users in most parts of the world would translate the date 10/05/15 as May 10, 2015. But in the United States, most users probably interpret it as October 5, 2015.

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- 1 Ratwani, Fairbanks, Hettinger, Benda, “Electronic health record usability: analysis of the user-centered design processes of eleven electronic health record vendors,” J Am Med Inform Assoc. 2015 Nov;22(6):1179-82. <http://www.ncbi.nlm.nih.gov/pubmed/26049532>.
 - 2 Kaushal R, Shojania KG, and Bates DW, “Effects of Computerized Physician Order Entry and Clinical Decision Support Systems on Medication Safety: A Systematic Review,” Archives of Internal Medicine, Vol. 163, 2003, pp. 1409–1416.
 - 3 Adelman JS, Kalkut GE, Schechter CB, et al., “Understanding and Preventing Wrong-Patient Electronic Orders: A Randomized Controlled Trial,” Journal of the American Medical Informatics Association, Vol. 20, 2013, pp. 305–310.
 - 4 Koppel R, Metlay JP, Cohen A, Abaluck B, Localio AR, Kimmel SE, and Strom BL, “Role of Computerized Physician Order Entry Systems in Facilitating Medication Errors,” Journal of the American Medical Association, Vol. 293, 2005, pp. 1197–1203.
 - 5 http://www.jointcommission.org/assets/1/6/Safe_Health_IT_infographic_1-26.pdf

Even in the U.S. using all numbers to represent a date requires translating a number (10) into a month (October), which takes cognitive effort and time away from the primary task.

While these “switch costs” may only be a few tenths of a second per item, they add up when users must switch repeatedly back and forth between tasks.⁶ This activity limits cognitive resources, which can increase risk of error.⁷ Design can eliminate switch costs with simple changes, such as a date format with no ambiguity: **05-Nov-2015**.

It’s also important to reduce the number of unnecessary clicks for the healthcare user. “I understand frustration when steps that take three or four extra clicks, because over the course of a day with 30 patient visits, those clicks add up,” Urgent Care Physician and Allscripts Chief Medical Officer, TouchWorks Solutions Management, Jeanne Armstrong, M.D., said. “Poor EHR usability is more than frustrating; it is a patient safety issue.”

5 Key components of best-practice UCD

Recommendations from The Office of the National Coordinator for Health Information Technology (ONC) shape expectations for UCD in the health IT industry. There are a number of different UCD methods that ONC recommends (e.g., NISTIR 7741, ISO 9241-11, ISO 13407), but at their core, they reflect similar key components:



1. CLIENT
PROFILES



2. USABILITY
METRICS



3. PATTERNS &
STANDARDS



4. FORMATIVE
TESTING



5. SUMMATIVE
TESTING

6 American Psychological Association. “Multitasking: Switching Costs” March 20, 2006

7 Wickens, C.D. (1984). “Processing resources in attention”, in R. Parasuraman & D.R. Davies (Eds.), *Varieties of attention*, (pp. 63–102). New York: Academic Press.

Client Profiles

Know who your users are

The first step in UCD is developing a deep understanding of the people who will be using the solutions. There are often both primary users and secondary users. This understanding is best achieved from research with and in the context of these users: watching them work, listening to their problems, needs, and goals, and understanding the environmental impacts.

When designing an immunization feature for an EHR, the primary group of users are those who order and administer vaccinations, including physicians, mid-level providers and nurses. It's important to also consider a secondary group—the front office staff and medical records team—who may also need to obtain information from the solution.

“Once we identify the primary and secondary users, we summarize all of that knowledge into personas, or profiles,” Teague explained “Throughout the process, we refer to these profiles to guide decisions and prioritize features. Also, it’s surprising how differently members of a product team can view who their users are. Creating profiles helps to align teams and design a solution that is a better fit for user needs and goals.”

While there are many different ways to document who your users are, profiles generally include a name, archetype, title, role, short- and long-term goals, quotes and frustrations. In later stages of UCD, these profiles can help identify the right people to participate in formative and summative testing.



Name, Archetype:

Dr. Peter Clug, “Note Averse”

Title/Role:

ENT Surgeon

Quotes:

“I live and die based on consults. I want to do whatever I can do to maintain and improve the number of consults I get.”

“Other doctors are going to see my note. I care a lot about what it looks like. I don’t want misspellings; I want good indenting and white space. Hate giving up control of what the output of the note looks like. It says a lot about me.”

“I have substantial support staff to help me in completing the documentation, however when I am creating a note on my own, I prefer to use dictation.”

Short and Long Term Goals (day, week, month, year, career):

- Want and care about access to documentation from everywhere and all the time when I am providing care
- To do as little noting as possible. Do not become a clerk.
- Do as much and only what my specialty can do and not what another provider can do.
- Good patient communication. Understands what is going to happen to them and what they can expect to happen after the procedure. Good for them to have expectations set and so I don’t have to answer a lot of phone calls.
- Stay up to date on the most recent trends in my field.

Frustrations, Pain points, or constraints:

- Documenting data from the patient that comes up during a visit and needs to be recorded in a patient medical record, but is irrelevant to the specialist
- “All normal” is very important for them to be able to document quickly
- The final output of their EHR is not professional looking and doesn’t present a good reflection of him

Figure 1: Example of a Client Profile, which summarizes information about a typical user

Usability Metrics

Define how you measure success

An important step in UCD that often gets overlooked is to set specific, operationalized usability goals that design teams can track throughout the development process. They answer the question: What does 'better usability' really mean? These goals help teams to continually assess progress toward success and guide tradeoffs in design to meet the most important priorities.

Most development projects have performance goals and feature requirement lists, but meeting those objectives does not guarantee a positive user experience. Usability metrics are important to include as a measure of success.

These measures can be objective (e.g., time on task, clicks, errors) as well as subjective. An example of a common subjective evaluation in usability is the System Usability Scale (SUS).⁸

Each metric should name an owner, a target value (including minimum acceptable) and assessment tool. "It's okay to have goals such as 'more modern looking' or 'reduce the number of clicks,' but designers also should articulate how they know when they have achieved those usability goals," Teague said. "We'll know it when we see it!" doesn't count as a measurement of a goal."

For example, in an effort to improve the usability of a module in the Allscripts Sunrise™ Patient Record suite, designers wanted to provide users with a cleaner look and feel and kept specific performance goals in mind.

As a result, while the new product was evaluated as more visually appealing, the team could also quantify specific usability enhancements, such as reducing the task time from 40.8 seconds to 21.8 seconds (48% faster), number of clicks from 32 to 11 (66% fewer) and thinking time from 14.4 seconds to 8.4 seconds (42% faster).

Metric	Owner	Minimum Acceptable	Goal	Assessment Tool
Physician Goals				
User is able to completely document a visit without help.	Ross Teague	90%	100%	Usability test
Documentation workflow fits how user wants to work.	Ross Teague	4.63*	6 on 1–7 scale	Survey, Usability testing
Documentation is easy to read.	Ross Teague	3.76*	6 on 1–7 scale	Survey
User evaluates the tool as easy to use	Ross Teague	52.00*	Score of 70 (out of 100)	SUS survey

Note: *Based on Benchmarking Survey data.

Figure 2:
Example of usability metrics for a clinical documentation tool.

8 Brooke, J. (1996). "SUS: a "quick and dirty" usability scale". In P. W. Jordan, B. Thomas, B. A. Weerdmeester, & A. L. McClelland. Usability Evaluation in Industry. London: Taylor and Francis.

Patient Search Window

Patient/Visit Search

Patient First Name
m*

Patient Last Name
test

MRN

Visit ID

Facility
All

Clear Fields Advanced Search Search

First Name	Last Name	Date Of Birth	Age	Gender	MRN	Social Security	Facility
MSP	TEST	1/10/1940	75	F	000930903	222112323	PIH
MARISA	TEST	5/3/1975	40	F	000000777		PIH
MSP	TEST	10/24/1940	75	F	000941490	000000468	PIH
MSPINFO	TEST	3/14/1941	74	F	000941542	000000801	PIH
MSPCOPY	TEST	5/14/1940	75	M	000941569	000000001	PIH
MALIA	TEST	1/13/2009	6	F	000941760	000000001	PIH
MARISA	TEST	5/3/1975	40	F	000000010		PIH
MEDPARTAB	TEST	3/29/1938	77	F	000941786	999856699	PIH
MRI	TEST	8/14/1980	35	F	000941836	000000970	PIH
MUSE	TEST	7/16/1941	74	M	000970224	892570293	PIH
MARIPOSA	TEST	6/15/1960	55	F	000982111	999685454	PIH
MARY	TEST	4/1/1963	52	F	000982124	999688888	PIH

Auto Load Visits Select Patient

Visit ID	Visit Date	Visit Type
000040391708	1/29/2009	OP1

Before

Sunrise Patient Record Chart Explorer Joann Smithfield Settings Help

Reports Bookmarks

Search for a patient's medical record

Load a Saved Search
Select a Saved Search

MRN

Visit Number

Last Name
Starts with ...

Soundex

First Name Middle Name

Birthdate Social Security

Use Document Indicator Use Notes Indicator

Facility
Select a Facility

Filter patient's medical record

Admission Discharge Service Created

Start Date End Date

Visit Type
Select Visit Type(s)...

Financial Class
Select Financial Class(es)...

Save Search Search

Search Results (6) Save Search

Last	First	Middle	Birthdate	Visit Number	MRN
BROWN	Jack	John	08-Jun-2003	288475644098	000948575623
BROWN	Jack	Allen	12-May-1946	288475644098	000948575623
BROWN	Jack	Alan	10-Jul-1970	288475644098	000948575623
BROWN	Jack	Ted	09-Feb-1932	288475644098	000948575623
BROWN	Jack	Will	01-Jan-1974	288475644098	000948575623
BROWN	Jack	Robert	05-Mar-1948	288475644098	000948575623

Recently Viewed

Last	First	Middle	Birthdate	Visit Number	MRN
PHILLIPS	Collin	Mark	12-May-1946	288475644098	000948575623
ACTON	Carson		12-May-1946	288475644098	000948575623
DEMETRIUS	Neal	Alan	12-May-1946	288475644098	000948575623
CANTRELL	Kelsie	May	12-May-1946	288475644098	000948575623
ELLIOT	Blake	Robert	12-May-1946	288475644098	000948575623
DAWSON	Allen	B	12-May-1946	288475644098	000948575623
DEMETRIUS	Neal	Jordan	12-May-1946	288475644098	000948575623
CANTRELL	Kelsie	Lynn	12-May-1946	288475644098	000948575623
ELLIOT	Blake	John	12-May-1946	288475644098	000948575623
DAWSON	Allen	Jackson	12-May-1946	288475644098	000948575623

Bookmarks (6)

Last	First	Birthdate	Visit Number	MRN	Bookmarks
PHILLIPS	Collin	12-May-1946	288475644098	000948575623	4
ACTON	Carson	12-May-1946	288475644098	000948575623	2
DEMETRIUS	Neal	12-May-1946	288475644098	000948575623	10
CANTRELL	Kelsie	12-May-1946	288475644098	000948575623	6

After

Figure 3: Designers achieved a cleaner look and feel, and set specific usability metrics to measure efficiency

Patterns & Standards

Build solutions based on known research

When designing, it makes sense to use patterns and standards that have been proven safe and effective. In addition to understanding users needs and goals, good design leverages human factors and cognitive psychology principles that are based on years of research and evidence-based understanding of human performance, cognition and accessibility. Additionally, there are standards specific to Health IT that are available to design teams related to the presentation of clinical data, use of color in a display and much more.⁹

UCD PRINCIPLES¹⁰

These are a few examples of general UCD principles, which are based on proven research, patterns and standards.

CONSISTENT TERMS

Don't use different words, situations or actions to mean the same thing. Follow platform conventions.

VISIBLE SYSTEM STATUS

The system should keep the user informed about what is going on, through appropriate feedback within a reasonable amount of time.

REAL-WORLD CONCEPTS

The system should use words, phrases and concepts familiar to the user. Follow real-world conventions, making information appear in a natural and logical order.

USER CONTROL AND FREEDOM

Users should be free to select and sequence tasks (when appropriate). Users need a clearly marked "emergency exit" if they accidentally select the wrong area. The system should support undo and redo.

SIMPLE ERROR NOTIFICATION AND RECOVERY

Express error messages in plain language (NO CODES). Even better than a good error message is a careful design that prevents a problem from occurring in the first place.

RECOGNITION RATHER THAN RECALL

Make objects, actions and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable.

⁹ Examples include ismp.org, drugguide.com, nngroup.com, w3.org/WAI

¹⁰ These usability principles draw from Nielsen Heuristics <https://www.nngroup.com/articles/ten-usability-heuristics/>

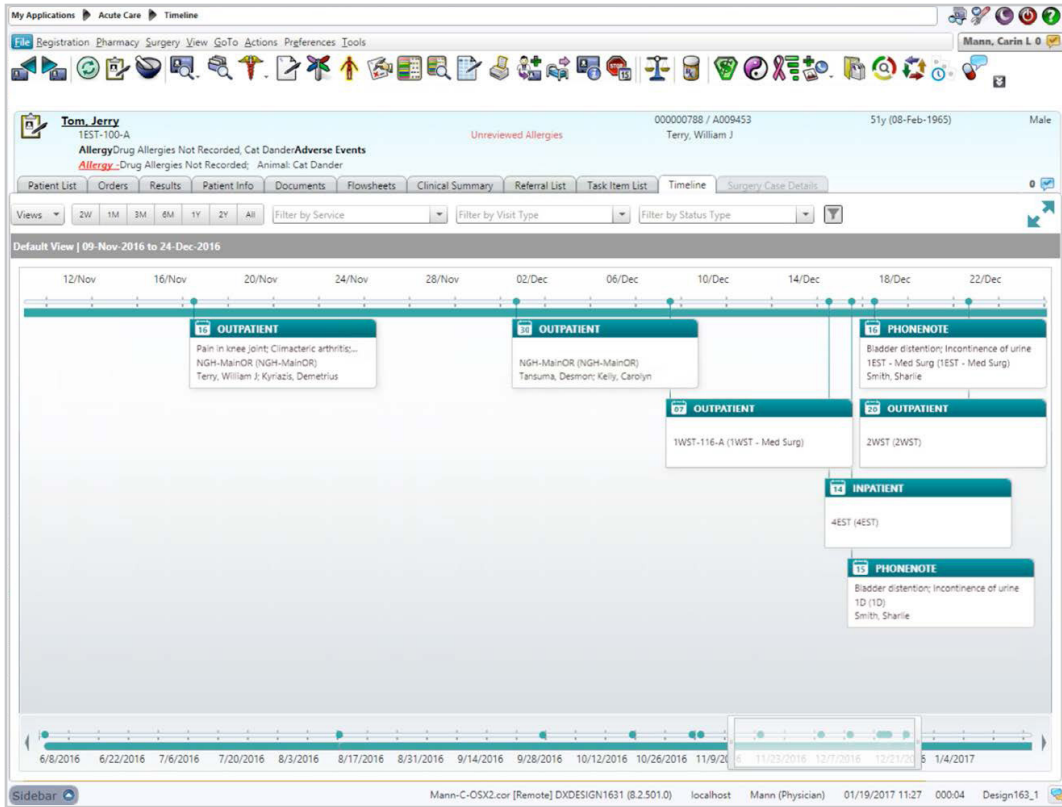


Figure 4: The new design for the Sunrise Patient Timeline incorporates UCD principles, such as real-world concepts, user control and freedom, and appropriate use of color and contrast.



Figure 5: Reflecting several principles, Sunrise Patient Avatar is a visual documentation option, enabling users to 'drag and drop' the exact location of injury or issue.

Formative Testing

Collect regular input from users

Comments received during formative testing:

"You see a better summary here than what we have now."

"Clean and simple."

EHR vendors collect user feedback in various ways. Often, someone from the vendor stands in front of an audience of clinicians, explains how a new product works and what features it contains, and asks for input. This activity has minimal value and is not a replacement for the more in-depth, task-based formative user testing that is a hallmark of UCD.

In a formative usability test, a trained moderator conducts an evaluation of the product with users, typically in one-on-one meetings, using a variety of levels of product fidelity (e.g., sketches, lists, wireframes, prototypes). These sessions happen throughout the development process and involve small numbers of users. Gathering feedback early and often enables teams to identify design flaws while there is time to address them before making the product publicly available. Usability metrics help determine which tasks to evaluate, risks to assess and clinicians to involve.

When designing a new task management module for Sunrise Acute Care, called Sunrise Compass, a usability team conducted a study with ambulatory physicians. Compass helps clinicians navigate the tasks of care to achieve desired outcomes.

Overall feedback on the prototype was positive. On average, users rated the interface 49% more enjoyable, 40% more intuitive and 36% better at giving the right information at the right time.

"As a clinician, I help ensure that the scenarios we use in formative testing are clinically realistic and relevant, to maintain our credibility with clinicians," Dr. Armstrong said. "For example, we could ask clinicians to test scenarios with patients who have two diagnoses and three medications. But the reality is, with the prevalence of chronic diseases, clinicians often have to treat patients with multiple diagnoses and sometimes dozens of medications. Testing with real-world scenarios leads to clinically sound and relevant design choices."

"We have also done formative testing for solutions that sit above the EHR, such as the dbMotion EHR Agent," Teague said. "To make it more intuitive for users, we're testing it early with internal and external clinicians to make sure that we were going in the right direction."

"Formative testing is where we make the greatest strides with usability, not demos," Teague said. "We've found that about 40% of all usability issues related to patient safety are caught during formative testing, and this early feedback enables designers to correct these issues before releasing the product."

Example:

PHYSICIANS TEST NEW IMMUNIZATION DISPLAY

The Allscripts TouchWorks® EHR team conducted a series of formative tests for a new immunization display. One early round of testing involved four physicians who completed a series of five tasks, such as identifying the number of doses given.

The goal was to enable users to complete each task in less than eight seconds and achieve a SUS rating of 85 or greater. On the task related to identifying the number of doses given, users completed the task in less than 8 seconds and the average SUS rating was 97.5. However, the testing also identified some confusion with a specific notification that led to re-wording the alert for clarity.

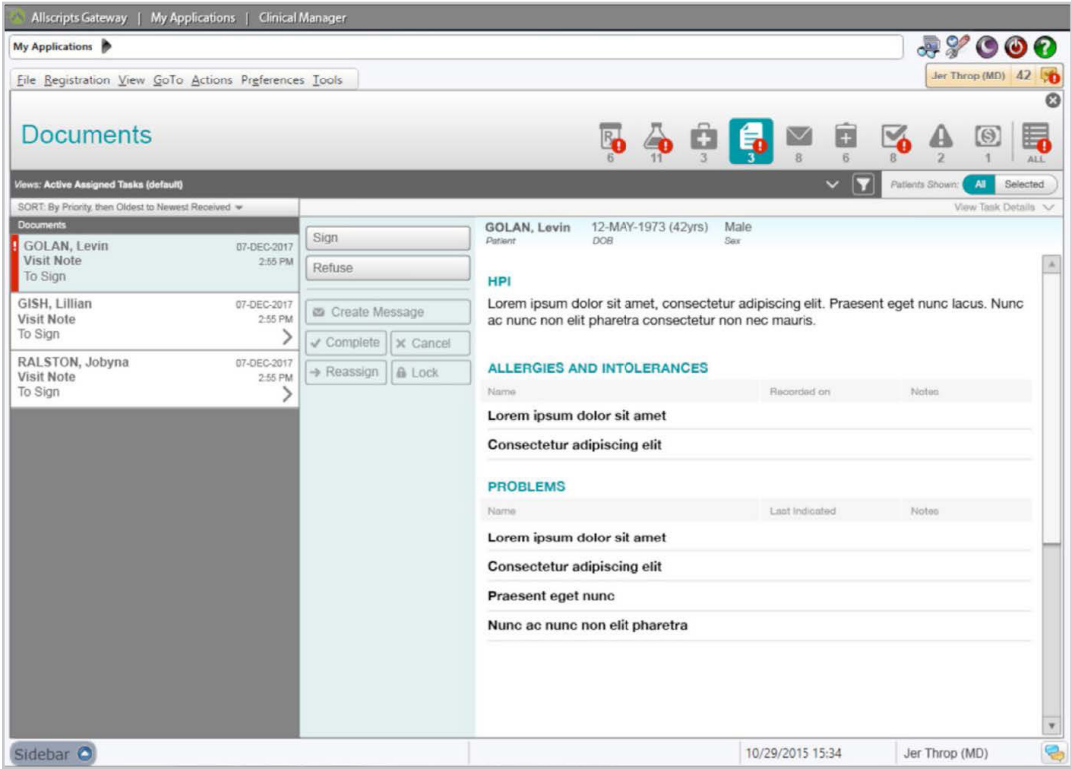


Figure 6: Formative testing with ambulatory physicians helped improve usability for a task management module, Sunrise Compass.

Summative Testing

Evaluate the final product with users

While UCD is an iterative, continual process, the final step prior to product launch is summative testing. This step involves having a large number of users evaluate a real-world version of the product. The focus is on task completion (e.g., pass/fail, time on task). The summative test report is the only UCD deliverable required to achieve Safety-Enhanced Design certification from the ONC. Unbiased, trained moderators conduct these tests before launching it to the market.

“Some EHR vendors only use summative testing,” Dr. Armstrong said. “But if these tests identify a problem, it’s often too late or costly to fix it, and the product goes out with problems.”

The documentation of the summative testing that vendors are required to submit are made available to the public. The American Medical Association (AMA) and MedStar Health used these reports to evaluate alignment with best practices for UCD related to the use of summative usability testing, using a framework focused on eight principles.

Allscripts Enterprise EHR (now called Allscripts TouchWorks® EHR) and Allscripts Sunrise™ Acute Care are two of the three technologies to achieve perfect scores, out of the 20 technologies evaluated by the framework.¹¹

EHR VENDOR	UCD PROCESS	TESTING METHODOLOGY				TESTING RESULTS		TOTAL SCORE
		Reported Process	Participants	Clinical Expertise	Use Cases	Metrics	Effectiveness	
Allscripts TouchWorks® EHR v11.4.1								15
Allscripts Sunrise™ Acute Care v15.0-c INPATIENT								15
Allscripts Paragon® 12&2.0 INPATIENT								15
McKesson iKnowMedEHR v6.7								14.5
Athena Clinicals v14.9								13.5

Figure 7: The American Medical Association and MedStar Health used summative testing results to evaluate the rigor of UCD processes for each EHR. Source: <http://www.medicalhumanfactors.net>

11 <http://www.medstarhealth.org/mhs/2015/10/27/ama-andmedstar-health-partner-to-drive-improvements-in-ehrusability/#q={}>

Conclusion

While a number of aspects can influence the usability of an EHR—such as implementation, customization, training, technology and regulations—UCD is a critical component in software design. Following a rigorous UCD process is necessary to improve customer experience with a product.

Success with usability requires vendors to place the same level of importance on UCD as timeline, feature set and performance goals. It will also require certification evaluators to dig more deeply into EHR vendor processes, beyond summative testing, to achieve the levels of transparency they are interested in supporting.

“At its core, a good UCD process is about involving users early and often, and using proven patterns in software design,” Teague said. “EHR vendors must be vigilant when it comes to UCD; patient safety is at stake.”



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