

EHR Usability Test Report of EndoVault EHR Version 3.2

This document describes the user centered design processes that were applied to the twelve 2015 Edition certification criteria to be included in the Safety Enhanced Design – 45 CFR 170.315(g)(3) for which EndoSoft is seeking certification. The report is based on ISO/IEC 25062 Common Industry Format for Usability Test Reports. NISTIR 7742 formatting was also used to create the document.

EndoVault EHR Version 3.2

Date of Usability Test: Usability Tests conducted from July 31st, 2019 - August 27th, 2019

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EXECUTIVE SUMMARY

A usability test of EndoVault EHR, version 3.2, Inpatient, Outpatient and Ambulatory was conducted from July 31st, 2019 through August 27th, 2019 at the Sir Mortimer B. Davis Jewish General Hospital. - Segal Cancer Center Clinical Staff participated. The purpose of this test was to test and validate the usability of the current user interface and provide evidence of usability in the EHR Under Test (EHRUT).

During the usability test, 10 healthcare providers, both clinical and non-clinical staff matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks.

This study collected performance data on 12 tasks typically conducted in an EHR:

- Write orders for Medication
- Ordering a lab
- Order an X-Ray
- Drug-drug / drug-allergy check
- Find patient's information in the patient summary screen
- Review the problem list
- Review the medication list.
- Review the Allergy List
- Interacting with Clinical Decision Support
- Check the Medical/Implantable Device List
- Reconciling and incorporating clinical data
- Send a Prescription

During the test, clinical and non-clinical staff members along with new employees were requested to participate (but not required) in the Usability test. They were instructed that they could withdraw at any time. During the Usability testing, some participants (physicians) had experience with EndoVault 3.2's EHR. Others along with ancillary staff at the site did not have prior experience with the EHR.

The administrator introduced the test, and instructed participants to complete a series of tasks (given one at a time) created by EndoSoft LLC using the EHRUT guidelines. During the testing, the administrator used data logger(s) who recorded the participants' performance data on paper. The administrator did not give the participants assistance in how to complete the tasks.

NO training or help materials were provided.

Usability test scenarios for all twelve situations were designed based on real end-user needs to perform the tasks needed to provide for the patient on a day to day basis.

The following types of data were collected for each participant:

- Number of tasks successfully completed.
- Number and types of errors
- Path deviations (Correct path, Minor deviations, Major Deviations)
- Participant's satisfaction ratings of the system
- Ease of use. (Easily Completed, Completed with Difficulty or Help, Not completed)
- Time on Task

All participant data was de-identified – no correlation could be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants were thanked for their help. No dollar amount was exchanged. Various recommended metrics, in accordance with the examples set forth in the NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records, were used to evaluate the usability of the EHRUT. Following is a summary of the performance and rating data collected on the EHRUT.

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 82.8 and was easily completed by the majority of the clinical and non-clinical staff.

In addition to the performance data, the following qualitative observations were made:

o Major findings

The majority of the people who participated in the Usability test found the application to be comprehensive, quite straight forward and easy to use. There were occasional users that had minor deviations from the optimal path mostly due to the lack of experience with EHR's. Some just didn't notice certain obvious and non-obvious choices and had reactions such as: "just not used to the application, but the more you use it the easier it is" as was reported by the administrator of the usability test. The more inexperienced usability testers had some difficulty navigating through certain sections as they were unaware of the clinical flow of a patient and completed certain tasks with some difficulty however, none of the participants had major deviations, errors or failed to complete the tasks. Several participants commented that their overall impression of the system was

that it was an “easy system”, “user friendly”, faster than others that they used, and most all would recommend it to colleagues.

o **Areas for improvement**

- According to the feedback received certain users mentioned that there were double clicks required in certain sections and did not realize it.
- The print/font size was too small was a comment that we will be working on in certain sections indicated by the users.
- Additional keyboard shortcuts also were suggested.

INTRODUCTION

The EHR tested for this study was EndoVault, Version 3.2. Designed to present medical information to healthcare providers in Inpatient/Outpatient and Ambulatory facility types and specialties such as Oncology (Medical, Surgical, Hematology, Gynecology and Dermatology), Breast Surgery, Gastroenterology, Pulmonology, and Administration (placing orders such as medication renewal). The EHRUT consists of realistic scenarios and we were asked to demonstrate the uses of application as a trained user would use in real life patient care. The usability testing attempted to represent realistic exercises and conditions. The purpose of this study was to test and validate the usability of the current user interface, and also provide evidence of usability in the EHR Usability Test (EHRUT). To this end, measures of effectiveness, efficiency and user satisfaction, such as ease of use, flexibility of the application, most used section being the highlight and were asked to complete the tasks necessary for any facility using the EHR. Tasks such as: Reviewing patient summary, Checking Lab results, Reviewing Procedure notes, Reviewing Consults, CPOE, Drug-Drug/ Drug –Allergy check, Medication List, Allergy List, Clinical Decision Support, Reconciliation, ePrescription, etc. were captured during the usability testing.

METHOD

PARTICIPANTS

A total of 10 participants were tested on the EHRUT(s). Participants in the test were Physicians, Nurses, Medical Technicians, Clerical Staff and Non-Clinical staff. Participants were recruited by facility administrators where EndoVault is available and installed currently. Participants were not influenced or contacted by EndoSoft other than providing a usability testing document. There was no compensation

provided to the users in efforts to reduce biased opinions. In addition, participants had no direct connection to the development of or organization producing the EHRUT(s). Participants were not from the testing or supplier organization. Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received. The users were provided no training other than given a “User ID and password for login and a test patient on the Patient Search screen already scheduled for testing purposes.” For the test purposes, end-user characteristics were not requested by the developing company but were released by the administrators after the testing was complete.

	ID	Age	Gender	Education	Profession	Occupational Role	Computer Experience (Months)	Experience (Months)	Product Experience (Months)	Assistive Technology Needs
1	ID01	30-39	Female	Bachelor’s degree	Practice Admin	Administrator	180	48	48	None
2	ID02	20-29	Female	Bachelor’s degree	Admin Asst	Administrator	24	60	0	None
3	ID03	20-29	Female	Bachelor’s degree	Admin Asst	Administrator	120	36	12	None
4	ID04	30-39	Male	Doctorate degree	Physician	Gastroenterologist	120	24	24	None
5	ID05	40-49	Male	Bachelor’s degree	Admin Asst	Administrator	36	180	60	None
6	ID06	30-39	Male	Doctorate degree	Physician	Gastroenterologist	36	300	36	None
7	ID07	40-49	Female	Bachelor’s degree	RN	RN	72	72	0	None
8	ID08	30-39	Unknown	Bachelor’s degree	Pharmacist	Pharmacist	72	180	36	None
9	ID09	30-39	Unknown	Bachelor’s degree	Pharmacist	Pharmacist	48	120	60	None
10	ID10	40-49	Female	Doctorate degree	Physician	Gastroenterologist	36	240	24	None

Table 1: Participant Demographics

STUDY DESIGN

Overall, the objective of this test was to uncover areas where the application performed well – that is, effectively, efficiently, and with satisfaction – and areas where the application failed to meet the needs of the participants. The data from this test may serve as a baseline for future tests with an updated version of the same EHR and/or comparison with other EHRs provided the same tasks are used. In short, this testing serves as both a means to record or benchmark current usability, but also to identify areas where improvements must be made.

During the usability test, participants interacted with EndoVault 3.2 EHR. Each participant used the EndoVault 3.2 under the supervision of the site administrator. The Usability test was conducted in a Medical University Teaching Hospital. All were provided with the same instructions. The system was evaluated for

effectiveness, efficiency and satisfaction as defined by measures collected and analyzed for each participant:

- Number of tasks successfully completed without assistance
- Number and types of errors
- Path deviations
- Participants' verbalizations (comments)
- Participants' satisfaction ratings of the system

TASKS

A number of tasks were constructed that would be realistic and representative of the kinds of activities a user might do with this EHR, including:

- Write orders for Medication
- Ordering a lab
- Order an X-Ray
- Drug-drug / drug-allergy check
- Find patient's information in the patient summary screen
- Review the problem list
- Review the medication list.
- Review the Allergy List
- Interacting with Clinical Decision Support
- Check the Medical/Implantable Device List
- Reconciling and incorporating clinical data
- Send a Prescription

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users.

This study was also conducted to test and validate the usability of the EHRUT user interface, and provide evidence of ISO/TR 16982:2002 and ISO 9241-210 (2010) Common Industry Format, User Centered Design methodologies to support certification according to the twelve criteria outlined in Safety Enhanced Design §170.315(g)(3). (See Appendix 4)

ID	Task	Safety Enhanced Design Criteria
A1.1	Write orders for Medication	170.315 (a)(1) Computerized Provider Order Entry (CPOE) – Medications

A2.1	Place order for a lab	170.315 (a)(2) CPOE – Laboratory
A3.1	Order an X-Ray	170.315 (a)(3) CPOE – diagnostic imaging
A4.1	Drug-drug / drug-allergy check	170.315 (a)(4) Drug-drug, Drug-allergy Interaction Checks for CPOE
A5.1	Find patient’s information in the patient summary screen	170.315 (a)(5) Demographics
A6.1	Review the patient’s problem list	170.315 (a)(6) Problem List
A7.1	Review the patient’s medication list	170.315 (a)(7) Medication List
A8.1	Review the patient’s allergy List	170.315 (a)(8) Medication Allergy List
A9.1	Interact with Clinical Decision Support	170.315 (a)(9) Clinical Decision Support
A14.1	Check the patient’s implantable device list	170.315 (a)(14) Implantable Device List
B2.1	Reconcile and incorporate clinical data	170.315 (b)(2) Clinical Information Reconciliation and Incorporation
B3.1	Send a Prescription	170.315 (b)(3) Electronic Prescribing

Table 2: Representative Tasks

PROCEDURES

Participants were selected at random from the site administrator where the Usability tests were conducted. Participants were asked to volunteer to take the Usability Test therefore consenting verbally and then the time and date were confirmed by the administrators on site. To ensure that the test ran smoothly, the site administrator did one on one testing therefore data logging and recording any verbalizations from the testers. The usability testing staff conducting the test were experienced usability practitioners with medical experience, a practice management background and a number of years of experience in the field of medicine.

The administrator moderated the session including administering instructions and tasks. The administrator also monitored, obtained post-task rating data, and took notes on participant comments. They also served as the data logger and took notes on task success, path deviations, number and type of errors, and comments.

Participants were instructed to perform the tasks as quickly as possible making as few errors and deviations as possible. (See specific instructions below):

All participant data has been de-identified and kept confidential.

- Without assistance; administrators could give immaterial guidance and clarification on tasks, but not instructions on use.
- Without using a think aloud technique.

For each task, the participants were given verbal commands for each of the tasks.

Tasks began once the administrator finished reading the question.

Following the session, the administrator gave the participant the post-test verbal questionnaire (e.g., the System Usability Scale, suggestions), and thanked the individual for their participation.

Participants' demographic information, task success rate, time on task, errors, deviations, verbal responses, and post-test questionnaire were recorded into the testing script for the participants.

TEST LOCATION

The test facility included a waiting area and a quiet testing room with a table, computer for the participant, and recording desk for the administrator. Only the participant and administrator were in the test room. To ensure that the environment was comfortable for users, noise levels were kept to a minimum with the ambient temperature within a normal range. All of the safety instruction and evacuation procedures were valid, in place, and visible to the participants.

TEST ENVIRONMENT

The EndoVault EHR would typically be used in a healthcare office or facility.

In this instance, the testing was conducted in a Medical University Teaching Hospital, Jewish General Hospital – Segal Cancer Centre. For testing, participants used a Lenovo thin computer running on Windows10.

The participants used a mouse and keyboard, when interacting with the EndoVault EHR. The EndoVault EHR was displayed on a 23inch Lenovo monitor with 1920x1080 resolution. The application was set up by the vendor in advance according to the vendor's documentation describing the system set-up and preparation. The application itself was running on a windows platform using a test database on a LAN connection. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation. Additionally, participants were instructed not to change any of the default system settings (such as control of font size).

TEST FORMS AND TOOLS

During the usability test, various documents and instruments were used, including:

1. Moderator’s Guide (testing script)
2. Post-test Satisfaction Verbal Questions by the administrator

Reaction and verbal comments were recorded by administrators and conveyed to the developing company EndoSoft.

PARTICIPANT INSTRUCTIONS

The administrator reads the following instructions aloud to the participant:

Thank you for participating in this study. Your input is very important. Our session today will last about 15-20 minutes. During that time you will use an instance of an electronic health record. I will ask you to complete a few tasks using this system and answer some questions. You should complete the tasks as quickly as possible making as few errors as possible. Please try to complete the tasks on your own following the instructions very closely. Please note that we are not testing you we are testing the system, therefore if you have difficulty all this means is that something needs to be improved in the system. I will be here in case you need specific help, but I am not able to instruct you or provide help in how to use the application. Overall, we are interested in how easy (or how difficult) this system is to use, what in it would be useful to you, and how we could improve it. I did not have any involvement in its creation, so please be honest with your opinions.

Following the procedural instructions, participants were shown the EHR and as their first task, were given time- 5 minutes to explore the system and make comments.

Participants were then given 12 tasks to complete as listed above(See Table 2). An analysis following the results was performed.

USABILITY METRICS

The goals of the test were to assess:

1. Effectiveness of EndoVault EHR by measuring participant success rates and errors
2. Efficiency of EndoVault EHR by measuring the average task time and path deviations
3. Satisfaction with EndoVault EHR by measuring ease of use ratings

DATA SCORING

The following table details how tasks were scored, errors evaluated, and the time data analyzed.

Measures	Rationale and Scoring
Effectiveness: Task Success	A task was counted as a “Success” if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis. The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage.

	<p>Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency.</p> <p>Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target task times used for task times in the Moderator’s Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by 1.5 that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was 13 seconds then allotted task time performance was 20 seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.</p>
<p>Effectiveness: Task Failures</p>	<p>If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, the task was counted as a “Failure.” No task times were taken for errors. The total number of errors, average and standard deviation were calculated for each task. Not all deviations would be counted as errors.</p>
<p>Efficiency: Task Deviations</p>	<p>The participant’s path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.</p>
<p>Efficiency: Task Time</p>	<p>Each task was timed from when the administrator said “Begin” until the participant said, “Done.” If he or she failed to say “Done,” the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation and standard error) were also calculated.</p>

Table 3: Task Measures Scoring

RESULTS

DATA ANALYSIS AND REPORTING

The results of the usability test were calculated according to the methods specified in the Usability Metrics table above (See Table 3). **NONE** of the participants who failed to follow session and task instructions were excluded from the analyses. **No Exclusions to report. There were no irregularities during testing process or interpretation of the data provided by testers.**

Measure Task	N	Task Success (%)	Path Deviation (steps)	Task Time (Seconds)		Errors (%)	Task Ratings (Likert Scale) 5=Easy
	#	Mean (SD)	Deviations (Observed/Optimal)	Mean (SD)	Dev (Obs /Opt)	Mean (SD)	Mean (SD)
CPOE-Write orders for Medication	10	9/10 90% .9 (.3)	4.1/4	16 (17)	16/20	0 (0)	4.6 (.7)
CPOE-Place order for a lab	10	9/10 90% .9 (.3)	4/4	11 (7)	11/20	0 (0)	4.9 (.3)
CPOE- Order and X-Ray	10	9/10 90% .9 (.3)	4/4	11 (9)	11/20	0 (0)	4.9 (.3)
Drug-drug / drug-allergy check	10	9/10 90% .9 (.3)	5/5	27 (10)	27/40	0 (0)	4.4 (1.3)
Find information in Patient Summary screen	10	8/10 (80%) .8 (.4)	3/3	13 (10)	13/20	0 (0)	5 (0)
Review the patient's problem list	10	10/10 100% 1 (0)	2.1/2	9 (5)	9/20	0 (0)	4.9 (.3)
Review the patient's medication list	10	8/10 80% .8 (.4)	2/2	13 (11)	13/20	0 (0)	5 (0)

Review the patient's allergy list	10	10/10 100%	2/2	6 (2)	6/20	0 (0)	5 (0)
Interact with Clinical Decision Support	10	10/10 100%	2/2	4 (2)	4/10	0 (0)	5 (0)
Check the patient's implantable device List	10	8/10 80%	2/2	13 (7)	13/15	0 (0)	4.8 (.6)
Reconcile and incorporate clinical data	10	10/10 100%	3/3	7 (4)	7/25	0 (0)	4.8 (.6)
Send a Prescription	10	9/10 90%	3/3	9 (6)	9/20	0 (0)	4.9 (.3)

Table 4: Performance and Rating Data Summary

DISCUSSION OF THE FINDINGS

EFFECTIVENESS

The results of the testing performed indicated the application was quite effective in providing the medical practices what they need and what the medical professionals require. The task success rate for all participants ranged from 80 to 100 % with each of the mean task times well below the optimum time.

EFFICIENCY

According to the data collected during the usability test it seems that the application was quite efficient overall. Only 1 user had minor deviations from the optimal path, most users navigated through the optimal paths easily and did it within the allotted time for each of the tasks.

SATISFACTION

Based on a mean System Usability Scale of 83 and the mean User Rating of 4.9 out of 5 for each task, overall the satisfaction with the EHR was high.

MAJOR FINDINGS

Overall based on the findings provided by the administrators, the application seemed to be easy to use and simple for the users and non-clinical users. Most of the participants were able to navigate quite efficiently. There were a small minority of users who were not as familiar with some of the tasks and had some difficulties navigating or entering data.

AREAS FOR IMPROVEMENT

A suggestion from a few of the testers was to increase the size of the print in certain sections of the application for quicker navigation and workflow.

Appendices

Appendix 1. EHRUT Usability Test

EHRUT Usability Test **Moderator's Guide**

Administrator _____

Data Logger _____

Date _____

Time _____

Participant # _____

Location _____

Prior to testing

- Confirm schedule with Participants
- Ensure EHRUT lab environment is running properly
- Ensure lab and data equipment is running properly

Prior to each participant:

- Reset application
- Start session with tool

Prior to each task:

- Reset application to starting point for next task

After each participant:

- End session with tool

After all testing

- Back up all video and data files

Orientation (2 minutes)

Thank you for participating in this study. Our session today will last 15-20 minutes. During that time you will take a look at an electronic health record system.

I will ask you to complete a few tasks using this system and answer some questions. We are interested in how easy (or how difficult) this system is to use, what in it would be useful to you, and how we could improve it. You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Do not do anything more than asked. If you get lost or have difficulty, I cannot help you with anything to

do with the system itself. Please save your detailed comments until the end of a task or the end of the session as a whole when we can discuss freely.

I did not have any involvement in its creation, so please be honest with your opinions.
The product you will be using today is a production version.

All of the information that you provide will be kept confidential and your name will not be associated with your comments at any time.

Do you have any questions or concerns?

Preliminary Questions (2 minutes)

Please note gender of participant (M, F, Unknown)

What is your current position and title? (Must be healthcare provider)

- RN: Specialty
- Physician: Specialty
- Resident: Specialty
- Administrative Staff

How long have you been working in this role?

Tell me about your computer experience. . (i.e. # of months/years of experience)

Tell me about your experience with electronic health records. (i.e. # of months/years of experience)

Which of the following best describes your age? [20 to 29; 30 to 39, 40 to 49; 50 to 59, 60 to 69, 70 to 79]

Which of the following describes your highest level of education? [e.g., high school graduate/GED, some college, college graduate (RN, BSN), postgraduate (MD/PhD), other (explain)]

First Impressions (30 Seconds)

This is the application you will be working with. Have you heard of it? If so, tell me what you know about it.
Yes No

- Show test participant the EHRUT.

Notes / Comments:

Task 1: Patient Summary Screen (20 Seconds)

Take the participant to the starting point for the task.

Before going into the exam room, you want to review the *Patient's* information in the patient summary screen and then look at history. Find this information.

Success:

- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: _____Seconds

Optimal Path: *Patient Search* → *Click patient Chart* → *Click Patient Summary(Review Info)* → *Click patient History to review*

- Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:

Show participant written scale: "Very Difficult" (1) to "Very Easy" (5)

Administrator / Notetaker Comments:

Task 2: Review the problem list (20 Seconds)

Take the participant to the starting point for the task.

Check the patient's active problem list.

Success:

- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: Seconds

Optimal Path: *Patient Search* → *Click patient Chart* → *Click Problem List*

- Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:

Show participant written scale: "Very Difficult" (1) to "Very Easy" (5)

Administrator / Notetaker Comments:

Task 3: Review the Medication list (20 Seconds)

Take the participant to the starting point for the task.

Review the patient's medication list

Success:

- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: Seconds

Optimal Path: *Patient Search* → *Click patient Chart* → *Click Medications tab*

- Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:

Show participant written scale: "Very Difficult" (1) to "Very Easy" (5)

Administrator / Notetaker Comments:

Task 4: Review the Patients Allergy list (20 Seconds)

Take the participant to the starting point for the task.

Check the patient's allergy list

Success:

- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: Seconds

Optimal Path: *Patient Search* → *Click patient Chart* → *Click Allergies tab*

- Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:

Show participant written scale: "Very Difficult" (1) to "Very Easy" (5)

Administrator / Notetaker Comments:

Task 5: Interacting with Clinical Decision Support (10 Seconds)

Take the participant to the starting point for the task.

Interact with Clinical Decision Support

Success:

- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: Seconds

Optimal Path: *Patient Search* → *Click patient Chart* →

- Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:

Show participant written scale: "Very Difficult" (1) to "Very Easy" (5)

Administrator / Notetaker Comments:

Task 6: Check the Implantable Device List (15 Seconds)

Take the participant to the starting point for the task.

Check the Patient's implantable device list

.

Success:

- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: Seconds

Optimal Path: *Patient Search* → *Click patient Chart* → *Click patient History(Review past Surgical History*

- Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:

Show participant written scale: "Very Difficult" (1) to "Very Easy" (5)

Administrator / Notetaker Comments:

Task 7: Reconciling and incorporating clinical data (25 Seconds)

Take the participant to the starting point for the task.

Reconcile and incorporate clinical data

Success:

- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: Seconds

Optimal Path: *Patient Search* → *Click patient Chart* → *Tools Menu* → *Reconciliation*

- Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:

Show participant written scale: "Very Difficult" (1) to "Very Easy" (5)

Administrator / Notetaker Comments:

Task 8: Write orders for Medication (20 Seconds)

Take the participant to the starting point for the task.

Write orders for Medication

Success:

- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: Seconds

Optimal Path: *Patient Search* → *Click patient Chart* → *Orders Tab* → *Select “Meds”* → *Click Add New Order*

- Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:

Show participant written scale: “Very Difficult” (1) to “Very Easy” (5)

Administrator / Notetaker Comments:

Task 9: Ordering a lab (20 Seconds)

Take the participant to the starting point for the task.

Order a Lab

Success:

- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: Seconds

Optimal Path: *Patient Search* → *Click patient Chart* → *Click Orders Tab* → *Select “Lab Test”* → *Click Add New Order*

- Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:

Show participant written scale: “Very Difficult” (1) to “Very Easy” (5)

Administrator / Notetaker Comments:

Task 10: Diagnostic Imaging (20 Seconds)

Take the participant to the starting point for the task.

Order an X-Ray

Success:

- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: Seconds

Optimal Path: Patient Search → Click patient Chart → Click Orders Tab → Select “Imaging” → Click Add New Order

- Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:

Show participant written scale: “Very Difficult” (1) to “Very Easy” (5)

Administrator / Notetaker Comments:

Task 11: Drug-drug / drug-allergy check (40 Seconds)

Take the participant to the starting point for the task.

Review Drug-drug, Drug-allergy Interaction Checks for CPOE

Success:

- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: Seconds

Optimal Path: *Patient Search* → *Click patient Chart* → *Click Orders Tab* → *Select "Meds"* → *Click Add New Order* → *Add a medication which has allergy*

- Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:

Show participant written scale: "Very Difficult" (1) to "Very Easy" (5)

Administrator / Notetaker Comments:

Task 12: Electronic Prescribing (*20 Seconds*)

Take the participant to the starting point for the task.

Send a prescription

Success:

- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: Seconds

Optimal Path: *Patient Search* → *Click patient Chart* → *Click Medications Tab* → *Click E-Prescription button*

- Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:

Show participant written scale: "Very Difficult" (1) to "Very Easy" (5)

Administrator / Notetaker Comments:

Final Questions (4 Minutes)

What was your overall impression of this system?

What aspects of the system did you like most?

What aspects of the system did you like least?

Were there any features that you were surprised to see?

What features did you expect to encounter but did not see? That is, is there anything that is missing in this application?

Compare this system to other systems you have used.

Would you recommend this system to your colleagues?

Please Administer the following System Usability Scale Questionnaire to the participant

Appendix 2. Usability Scale Questionnaire

	Strongly Disagree				Strongly Agree
	1	2	3	4	5
1. I think that I would like to use this system frequently					
2. I found the system unnecessarily complex					
3. I thought the system was easy to use					
4. I think that I would need the support of a technical person to be able to use this system					
5. I found the various functions in this system were well integrated					
6. I thought there was too much inconsistency in this system					
7. I would imagine that most people would learn to use this system very quickly					
8. I found the system very cumbersome to use					
9. I felt very confident using the system					
10. I needed to learn a lot of things before I could get going with this system					

Appendix 3. Participant Demographics

	ID	Age	Gender	Education	Profession	Occupational Role	Computer Experience (Mths)	Experience (Mths)	Product Experience (Mths)	Assistive Technology Needs
1	ID01	30-39	Female	Bachelor's degree	Practice Admin	Administrator	180	48	48	None
2	ID02	20-29	Female	Bachelor's degree	Admin Asst	Administrator	24	60	0	None
3	ID03	20-29	Female	Bachelor's degree	Admin Asst	Administrator	120	36	12	None
4	ID04	30-39	Male	Doctorate degree	Physician	Gastroenterologist	120	24	24	None
5	ID05	40-49	Male	Bachelor's degree	Admin Asst	Administrator	36	180	60	None
6	ID06	30-39	Male	Doctorate degree	Physician	Gastroenterologist	36	300	36	None
7	ID07	40-49	Female	Bachelor's degree	RN		72	72	0	None
8	ID08	30-39	Unknown	Bachelor's degree	Pharmacist	Pharmacist	72	180	36	None
9	ID09	30-39	Unknown	Bachelor's degree	Pharmacist	Pharmacist	48	120	60	None
10	ID10	40-49	Female	Doctorate degree	Physician	Gastroenterologist	36	240	24	None

Appendix 4. User Centered Design(UCD) Process and Standards followed for each of the Safety-Enhanced design Criteria.

ISO/TR 16982

ISO/TR 16982:2002 provides information on human-centered usability methods which can be used for design and evaluation. It details the advantages, disadvantages and other factors relevant to using each usability method. It explains the implications of the stage of the life cycle and the individual project characteristics for the selection of usability methods and provides examples of usability methods in context.

<https://www.iso.org/obp/ui/#iso:std:31176:en>

ISO 9241-210 (2010)

ISO 9241-210:2010 provides requirements and recommendations for user-centered design principles and activities throughout the life cycle of computer-based interactive systems. It is intended to be used by those managing design processes and is concerned with ways in which both hardware and software components of interactive systems can enhance human–system interaction.

<https://www.iso.org/obp/ui/#iso:std:iso:9241:-210:ed-1:v1:en>

§ 170.315 (a)(1) Computerized Provider Order Entry (CPOE) – medications - Standards used – **ISO/TR 16982, ISO 9241-210 (2010)**

§ 170.315 (a)(2) CPOE – laboratory - Standards used – **ISO/TR 16982, ISO 9241-210 (2010)**

§ 170.315 (a)(3) CPOE – diagnostic imaging - Standards used – **ISO/TR 16982, ISO 9241-210 (2010)**

§ 170.315 (a)(4) Drug-drug, Drug-allergy Interaction Checks for CPOE - Standards used – **ISO/TR 16982, ISO 9241-210 (2010)**

§ 170.315 (a)(5) Demographics - Standards used – **ISO/TR 16982, ISO 9241-210 (2010)**

§ 170.315 (a)(6) Problem List - Standards used – **ISO/TR 16982, ISO 9241-210 (2010)**

§ 170.315 (a)(7) Medication List - Standards used – **ISO/TR 16982, ISO 9241-210 (2010)**

§ 170.315 (a)(8) Medication Allergy List - Standards used – **ISO/TR 16982, ISO 9241-210 (2010)**

§ 170.315 (a)(9) Clinical Decision Support - Standards used – **ISO/TR 16982, ISO 9241-210 (2010)**

§ 170.315 (a)(14) Implantable Device List - Standards used – **ISO/TR 16982, ISO 9241-210 (2010)**

§ 170.315 (b)(2) Clinical Information Reconciliation and Incorporation - Standards used – **ISO/TR 16982, ISO 9241-210 (2010)**

§ 170.315 (b)(3) Electronic Prescribing - Standards used – **ISO/TR 16982, ISO 9241-210 (2010)**

