



USABILITY TEST REPORT

MEDHOST Enterprise 2017 R1

Report based on ISO/IEC 25062:2006 Common Industry Format for Usability Test Reports

MEDHOST Enterprise 2017 R1

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EXECUTIVE SUMMARY

A usability test of MEDHOST Enterprise 2017R1 was conducted from Dec 12th to Dec 23rd, 2016. 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 matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks.

The criteria tested were:

- §170.315 (a)(1) CPOE – Medications
- §170.315 (a)(2) CPOE – Laboratory
- §170.315 (a)(3) CPOE – Diagnostic Imaging
- §170.315 (a)(4) Drug-drug, Drug-allergy interaction checks
- §170.315 (a)(6) Problem List
- §170.315 (a)(7) Medication List
- §170.315 (a)(8) Medication Allergy List
- §170.315 (a)(9) Clinical Decision Support
- §170.315 (a)(14) Implantable Device List
- §170.315 (b)(2) Clinical Information Reconciliation
- §170.315 (b)(3) ePrescribe

This study collected performance data on 36 tasks typically conducted on an EHR:

1. Navigating to the patient's active medication list
2. Reviewing the patient's medication list
3. Reviewing the medication and allergy alerts
4. Identifying the severity of the alerts
5. Understanding the clinical decision support information
6. Addressing the clinical decision support alert
7. Canceling a pending medication order
8. Modifying a medication order
9. Placing a medication order
10. Canceling a lab order
11. Modifying a lab order
12. Placing a lab order
13. Canceling a diagnostic imaging order
14. Modifying a diagnostic imaging order
15. Placing a diagnostic imaging order
16. Reviewing existing problems
17. Modifying a problem
18. Adding new problems
19. Reviewing the allergy list
20. Modifying an allergy
21. Adding an allergy

22. Reviewing implantable devices
23. Indicating that a device has been removed
24. Adding an implantable device
25. Reconciling allergies
26. Reconciling problems
27. Reconciling medications
28. Adding a home medication as an inpatient medication
29. Suspending a home medication
30. Continuing a home medication without a prescription
31. Continuing a home medication with a prescription
32. Changing a home medication
33. Adding a new electronic prescription
34. Prescribing a controlled substance
35. Discontinuing inpatient medications
36. Completing the prescription process

During the 40-minute, one-on-one usability test, each participant was greeted by the administrator and asked to review and sign an informed consent/release form (included in Appendix 1); they were instructed that they could withdraw at any time. None of the participants had any prior experience with this iteration of the EHR, and each participant was given a 5-minute overview of the system prior to starting the testing. The administrator introduced the test and instructed participants to complete a series of tasks (given one at a time) using the EHRUT. During the testing, the administrator timed the test and recorded user performance data on paper. The administrator did not give the participant assistance in how to complete the task.

The following types of data were collected for each participant:

- Number of tasks successfully completed within the allotted time without assistance
- Time to complete the workflows
- Number of clicks to complete the workflows
- Number and types of errors
- Path deviations
- Participant's verbalizations
- Participant's satisfaction ratings of the system

All participant data was de-identified – no correspondence could be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants were asked to complete a post-test questionnaire. 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.

Table 1: Summary of Task Performance and Rating Data

Task Identifier	Task Success - Mean (%)	Task Success - Std Dev (%)	Task Path Dev - Obs #	Task Errors Mean(%)	Task Errors - Std Dev (%)	Task Rating - Scale Type	Task Rating	Task Rating - Std Dev
1	100	0	0	0	0	Likert	4.9	0.3
2	100	0	0	0	0	Likert	5	0.0
3	100	0	0	0	0	Likert	5	0.0
4	100	0	0	0	0	Likert	4.4	0.7
5	100	0	0	0	0	Likert	4.7	0.5
6	100	0	0	0	0	Likert	4.5	0.7
7	100	0	0	0	0	Likert	4.6	0.7
8	100	0	0	0	0	Likert	4.6	0.7
9	100	0	0	0	0	Likert	4.8	0.6
10	100	0	0	0	0	Likert	5	0.0
11	100	0	0	0	0	Likert	5	0.0
12	100	0	0	0	0	Likert	5	0.0
13	100	0	0	0	0	Likert	5	0.0
14	100	0	0	0	0	Likert	4.9	0.3
15	100	0	0	0	0	Likert	5	0.0
16	100	0	0	0	0	Likert	4.9	0.3
17	100	0	0	0	0	Likert	4.7	0.7
18	100	0	0	0	0	Likert	5	0.0
19	100	0	0	0	0	Likert	4.9	0.3
20	100	0	0	0	0	Likert	4.5	0.8
21	100	0	0	0	0	Likert	4.9	0.3

Task Identifier	Task Success - Mean (%)	Task Success - Std Dev (%)	Task Path Dev - Obs #	Task Errors Mean(%)	Task Errors - Std Dev (%)	Task Rating - Scale Type	Task Rating	Task Rating - Std Dev
22	100	0	0	0	0	Likert	4.6	0.7
23	100	0	0	0	0	Likert	4	1.1
24	100	0	0	0	0	Likert	4.7	0.7
25	100	0	0	0	0	Likert	4.9	0.3
26	100	0	0	0	0	Likert	5	0.0
27	100	0	0	0	0	Likert	5	0.0
28	100	0	0	0	0	Likert	4.5	0.8
29	100	0	0	0	0	Likert	4.9	0.3
30	100	0	0	0	0	Likert	5	0.0
31	100	0	0	0	0	Likert	5	0.0
32	100	0	0	0	0	Likert	4.9	0.3
33	100	0	0	0	0	Likert	5	0.0
34	100	0	0	0	0	Likert	5	0.0
35	100	0	0	0	0	Likert	5	0.0
36	100	0	0	0	0	Likert	5	0.0

Table 2: Summary of Workflow Performance and Rating Data

	Task Success - Mean (%)	Task Success - Std Dev (%)	Task Path Dev - Obs #	Task Time - Mean (sec)	Task Time - Std Dev (sec)	Number of Clicks - Mean	Number of Clicks-Std Dev	Task Errors Mean(%)	Task Errors - Std Dev (%)
§170.315 (a)(1) CPOE – Medications	100	0	0	118.3	32.9	24.1	5.2	0	0
§170.315 (a)(2) CPOE – Laboratory	100	0	0	110	20.8	28.6	6.2	0	0
§170.315 (a)(3) CPOE – Diagnostic Imaging	100	0	0	74.8	19.6	21.1	3.1	0	0
§170.315 (a)(4) Drug-drug, Drug-allergy interaction checks	100	0	0	97.7	16.8	15.3	4.0	0	0
§170.315 (a)(6) Problem List	100	0	0	93.7	32.3	23.7	6.9	0	0
§170.315 (a)(7) Medication List	100	0	0	97.7	16.8	15.3	4.0	0	0
§170.315 (a)(8) Medication Allergy List	100	0	0	60.7	32.8	16	4.0	0	0
§170.315 (a)(9) Clinical Decision Support	100	0	0	97.7	16.8	15.3	4.0	0	0
§170.315 (a)(14) Implantable Device List	100	0	0	85.8	26.2	28.3	9.0	0	0
§170.315 (b)(2) Clinical Information Reconciliation	100	0	0	125.7	34.1	26.5	7.4	0	0
§170.315 (b)(3) ePrescribe	100	0	0	228.3	62.1	55.1	18.0	0	0

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be 92.8 with a standard deviation of 6.6.

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

- Major findings:
 - All of the assigned tasks were completed quickly
 - Each participant was able to successfully complete the designed workflow
 - Verbal and written comments overall were positive
 - Testers indicated that the system would be easy to learn, intuitive, and user friendly
 - Speed at similar tasks and comfort navigating the system increased quickly
- Areas for improvement:
 - Indicating that an implantable device had been removed was not obvious for seven users
 - The workflow to change a documented allergic reaction was not obvious for five users
 - Process to view more information about allergy alerts was not intuitive for three users
 - Selecting/navigating order options was not initially apparent to three users
 - Retracting a problem was not clear for two users

INTRODUCTION

The EHRUT(s) tested for this study was MEDHOST Enterprise 2017 R1, designed to present medical information to healthcare providers in the inpatient setting. 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 provide evidence of usability in the EHR Under Test (EHRUT). To this end, measures of effectiveness, efficiency, and user satisfaction, such as such as the time and number of clicks required to complete a workflow, were captured during the usability testing.

METHOD

Participants

A total of 10 participants were tested on the EHRUT. Participants in the test were Nurse Practitioners and Physician's Assistants and were recruited by Rezult, a contracting firm utilized by MEDHOST. The participants were compensated for their time via a contract through Rezult, not as part of the testing process. In addition, participants had no direct connection to the development of or organization producing the EHRUT and 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.

Participants had a mix of backgrounds and demographic characteristics. The table below depicts participants by characteristics, including demographics, professional experience, computing experience and user needs for assistive technology. Participant names were replaced with Participant IDs so that an individual's data cannot be tied back to individual identities.

Participants were scheduled for 1.5 hour sessions with a minimum of two hours between each session for a debriefing by the administrator and to reset systems to proper test conditions. A spreadsheet was used to keep track of the participant schedule.

Table 3: Participant Characteristics

ID	Gender	Age	Education	Occupation/ Role	Professional Experience	Computer Experience (months)	Product Experience (months)	Assistive Technology
i1	F	30	Master's	Nurse Practitioner	Family NP	240	0	No
i2	F	36	Master's	Physician's Assistant	PA-C	300	0	No
i3	F	31	Master's	Nurse Practitioner	Neonatal ICU NP	312	0	No
i4	F	41	Master's	Nurse Practitioner	NP	144	1	No
i5	F	31	Master's	Nurse Practitioner	Family NP	300	0	No
i6	F	31	Master's	Nurse Practitioner	Family NP	240	0	No
i7	F	32	Master's	Nurse Practitioner	NP	264	3	No
i8	F	28	Master's	Nurse Practitioner	Acute Care NP	240	0	No
i9	F	55	Master's	Nurse Practitioner	Family NP	300	0	No
i10	F	51	Bachelor's	Physician's Assistant	PA-C	264	0	No

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 one EHR. Each participant used the system in the same location, and was 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 within the allotted time without assistance
- Time to complete the registration workflow
- Number of clicks required to complete the registration workflow
- Number and types of errors
- Path deviations
- Participant's verbalizations (comments)
- Participant's 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. The script was divided into sections to reflect the measures being tested, and tasks were assigned to create a workflow representative of each measure:

§170.315 (a)(4) Drug-drug, Drug-allergy interaction checks, §170.315 (a)(7) Medication List, and §170.315 (a)(9) Clinical Decision Support

1. Navigating to the patient's active medication list
2. Reviewing the patient's medication list
3. Reviewing the medication and allergy alerts
4. Identifying the severity of the alerts
5. Understanding the clinical decision support information
6. Addressing the clinical decision support alert

§170.315 (a)(1) CPOE – Medications

7. Canceling a pending medication order
8. Modifying a medication order
9. Placing a medication order

§170.315 (a)(2) CPOE – Laboratory

10. Canceling a lab order
11. Modifying a lab order
12. Placing a lab order

§170.315 (a)(3) CPOE – Diagnostic Imaging

13. Canceling a diagnostic imaging order
14. Modifying a diagnostic imaging order
15. Placing a diagnostic imaging order

§170.315 (a)(6) Problem List

16. Reviewing existing problems
17. Modifying a problem
18. Adding new problems

§170.315 (a)(8) Medication Allergy List

19. Reviewing the allergy list
20. Modifying an allergy
21. Adding an allergy

§170.315 (a)(14) Implantable Device List

22. Reviewing implantable devices
23. Indicating that a device has been removed
24. Adding an implantable device

§170.315 (b)(2) Clinical Information Reconciliation

25. Reconciling allergies
26. Reconciling problems
27. Reconciling medications
28. Adding a home medication as an inpatient medication
29. Suspending a home medication

§170.315 (b)(3) ePrescribe

30. Continuing a home medication without a prescription
31. Continuing a home medication with a prescription
32. Changing a home medication
33. Adding a new electronic prescription
34. Prescribing a controlled substance
35. Discontinuing inpatient medications
36. Completing the prescription process

Because the workflow to access the drug-drug, drug allergy interaction checks and the clinical decision support alerts involves accessing the medication list, the workflows to test these items separately would have been repetitive and were combined so as to only have the user complete the workflow once.

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

Procedures

Upon arrival, participants were greeted; their identity was verified and matched with a name on the participant schedule. Participants were then assigned a participant ID. Each participant reviewed and signed an informed consent and release form (See Appendix 1). A representative from the test team witnessed the participant's signature.

The usability testing administrator conducting the test was an experienced usability practitioner with over 10 years in nursing and medical informatics and a Master's degree in Medical Informatics.

The administrator moderated the session including administering instructions and tasks. The administrator also monitored task times, obtained post-task rating data, and took notes on participant comments. Participants were instructed to perform the tasks:

- As quickly as possible making as few errors and deviations as possible
- Without assistance; administrators were allowed to give immaterial guidance and clarification on tasks, but not instructions on use
- Without using a think aloud technique

None of the participants had any prior experience with this iteration of the EHR, and each participant was given a 5-minute overview of the basic functionality and design of the system prior to starting the testing.

For each task, the participants were given a written copy of the task. Task timing began once the administrator finished reading the question. The task time was stopped once the participant indicated they had successfully completed the task. (Scoring is discussed below.)

Following the session, the administrator gave the participant the post-test questionnaires (see Appendix 2) and thanked each individual for their participation.

Participants' demographic information, task success rate, time on task, errors, deviations, verbal responses, and post-test questionnaire were recorded into a spreadsheet.

Test Locations

The test facility included a waiting area and a quiet testing room with a desk, computer for the participant, and recording computer 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 EHRUT would typically be used in a healthcare facility. In this instance, the testing was conducted in the usability lab at MEDHOST's corporate headquarters. The participants used a mouse, keyboard, and full-sized monitor when interacting with the EHRUT.

The application was set up by the MEDHOST according to the vendor's documentation describing the system setup and preparation. The application was generally 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:

- Informed Consent
- Moderator's Guide

- Post-test Questionnaire
- Click Counter software
- Free Stopwatch timer

Examples of these documents can be found in Appendices 1 and 2. The Moderator's Guide was devised to capture required data.

Participant Instructions

The administrator reads the following instructions aloud to each participant:

Thank you for agreeing to participate in the MEDHOST Enterprise usability testing. During this testing I will read a script with set tasks that you are asked to complete as quickly as possible. At specific points during this process I will be asking you to start and stop a click-counter, and I will be starting and stopping a timer. I will then record the results as part of the study. At the end of the testing you will be asked to provide your feedback on the areas that were covered during testing and your experience with the product overall.

The goal of this session is to obtain information regarding the usability of the system, not to evaluate your skills as a user of the system, as we look for opportunities for improvement. I have not had any involvement with the development of this system, and, therefore, will not be offended by your honest evaluation. Your feedback will be kept confidential, and your name will not be associated with your comments and feedback.

Please note that you are going to be testing in an environment created specifically for this event, not the environment that you use in your facility, so orders, order sets, and options may not match what you are accustomed to.

To start, I will ask that you fill out a brief questionnaire with some basic demographic information, then we will get started with the test script.

Participants were then given 36 tasks to complete. Tasks are listed in the moderator's guide in Appendix 2.

Usability Metrics

According to the NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records, EHRs should support a process that provides a high level of usability for all users. The goal is for users to interact with the system effectively, efficiently, and with an acceptable level of satisfaction. To this end, metrics for effectiveness, efficiency and user satisfaction were captured during the usability testing. The goals of the test were to assess:

- Effectiveness of MEDHOST Enterprise by measuring participant success rates and errors
- Efficiency of MEDHOST Enterprise by measuring the average task time and path deviations
- Satisfaction with MEDHOST Enterprise by measuring ease of use ratings

Data Scoring

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

Table 4: Rationale and Scoring

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 was calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage. Task times were recorded for successes.
Effectiveness: Task Failures	If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as a “failure.” No task times were taken for errors. The total number of errors was calculated for each task and then divided by the total number of times that task was attempted. Not all deviations were counted as errors.
Efficiency: Task Deviations	The participant’s paths through the application were observed. Deviations occurred 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 was divided by the number of optimal steps to provide a ratio of path deviation.
Efficiency: Workflow Time	The workflow 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 tasks. Only times for workflows that were successfully completed were included in the time analysis. Average time was calculated for the workflow. Variance measures (standard deviation and standard error) were also calculated.
Satisfaction: Task Rating	Participant’s subjective impression regarding the ease of use of the application was measured by administering a post-session questionnaire. For each task, the participant was asked to rate each task on a scale of 1 (Difficult) to 5 (Easy). These data are averaged across participants. Common convention is that average ratings for systems judged easy to use should be 3.3 or above. To measure participants’ confidence in and likeability of the MEDHOST Enterprise 2017 R1 system overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included: <ul style="list-style-type: none"> • I think I would like to use this system frequently • I thought the system was easy to use • I would imagine that most people would learn to use this system very quickly See full System Usability Score questionnaire in Appendix 2.

RESULTS

Data Analysis and Reporting

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. The usability testing results for the EHRUT are detailed below (see Tables 5 and 6). The results should be seen in light of the objectives and goals outlined in the Study Design section. The data should yield actionable results that, if corrected, yield material, positive impact on user performance.

Table 5: Summary of Task Performance and Rating Data

Task Identifier	Task Success - Mean (%)	Task Success - Std Dev (%)	Task Path Dev - Obs #	Task Errors Mean(%)	Task Errors - Std Dev (%)	Task Rating - Scale Type	Task Rating	Task Rating - Std Dev
§170.315 (a)(4) Drug-drug, Drug-allergy interaction checks, §170.315 (a)(7) Medication List, and §170.315 (a)(9) Clinical Decision Support								
1	100	0	0	0	0	Likert	4.9	0.3
2	100	0	0	0	0	Likert	5	0.0
3	100	0	0	0	0	Likert	5	0.0
4	100	0	0	0	0	Likert	4.4	0.7
5	100	0	0	0	0	Likert	4.7	0.5
6	100	0	0	0	0	Likert	4.5	0.7
§170.315 (a)(1) CPOE – Medications								
7	100	0	0	0	0	Likert	4.6	0.7
8	100	0	0	0	0	Likert	4.6	0.7
9	100	0	0	0	0	Likert	4.8	0.6
§170.315 (a)(2) CPOE – Laboratory								
10	100	0	0	0	0	Likert	5	0.0
11	100	0	0	0	0	Likert	5	0.0
12	100	0	0	0	0	Likert	5	0.0

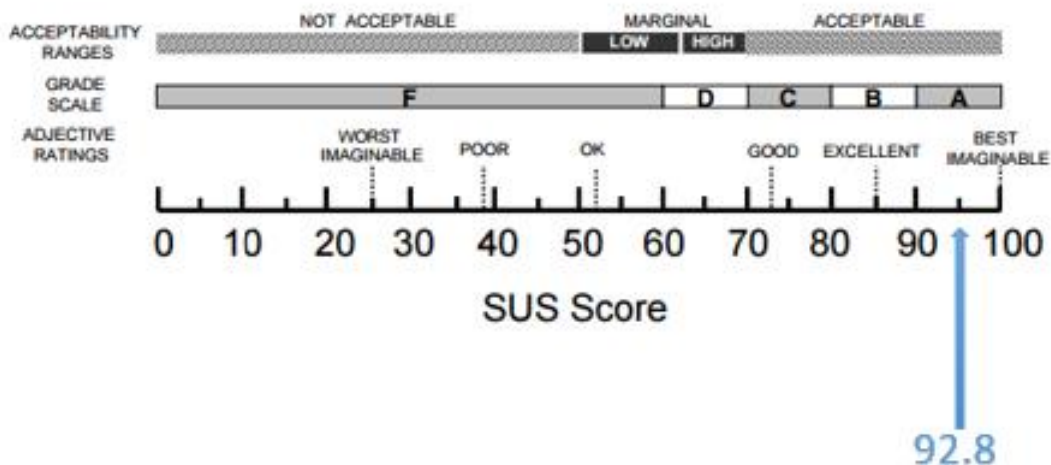
Task Identifier	Task Success - Mean (%)	Task Success - Std Dev (%)	Task Path Dev - Obs #	Task Errors Mean(%)	Task Errors - Std Dev (%)	Task Rating - Scale Type	Task Rating	Task Rating - Std Dev
§170.315 (a)(3) CPOE – Diagnostic Imaging								
13	100	0	0	0	0	Likert	5	0.0
14	100	0	0	0	0	Likert	4.9	0.3
15	100	0	0	0	0	Likert	5	0.0
§170.315 (a)(6) Problem List								
16	100	0	0	0	0	Likert	4.9	0.3
17	100	0	0	0	0	Likert	4.7	0.7
18	100	0	0	0	0	Likert	5	0.0
§170.315 (a)(8) Medication Allergy List								
18	100	0	0	0	0	Likert	4.9	0.3
20	100	0	0	0	0	Likert	4.5	0.8
21	100	0	0	0	0	Likert	4.9	0.3
§170.315 (a)(14) Implantable Device List								
22	100	0	0	0	0	Likert	4.6	0.7
23	100	0	0	0	0	Likert	4	1.1
24	100	0	0	0	0	Likert	4.7	0.7
§170.315 (b)(2) Clinical Information Reconciliation								
25	100	0	0	0	0	Likert	4.9	0.3
26	100	0	0	0	0	Likert	5	0.0
27	100	0	0	0	0	Likert	5	0.0
28	100	0	0	0	0	Likert	4.5	0.8
29	100	0	0	0	0	Likert	4.9	0.3

Task Identifier	Task Success - Mean (%)	Task Success - Std Dev (%)	Task Path Dev - Obs #	Task Errors Mean(%)	Task Errors - Std Dev (%)	Task Rating - Scale Type	Task Rating	Task Rating - Std Dev
§170.315 (b)(3) ePrescribe								
30	100	0	0	0	0	Likert	5	0.0
31	100	0	0	0	0	Likert	5	0.0
32	100	0	0	0	0	Likert	4.9	0.3
33	100	0	0	0	0	Likert	5	0.0
34	100	0	0	0	0	Likert	5	0.0
35	100	0	0	0	0	Likert	5	0.0
36	100	0	0	0	0	Likert	5	0.0

Table 6: Summary of Workflow Performance and Rating Data

	Task Success - Mean (%)	Task Success - Std Dev (%)	Task Path Dev - Obs #	Task Time - Mean (sec)	Task Time - Std Dev (sec)	Number of Clicks - Mean	Number of Clicks-Std	Task Errors Mean(%)	Task Errors - Std Dev (%)
§170.315 (a)(1) CPOE – Medications	100	0	0	118.3	32.9	24.1	5.2	0	0
§170.315 (a)(2) CPOE – Laboratory	100	0	0	110	20.8	28.6	6.2	0	0
§170.315 (a)(3) CPOE – Diagnostic Imaging	100	0	0	74.8	19.6	21.1	3.1	0	0
§170.315 (a)(4) Drug-drug, Drug-allergy interaction checks	100	0	0	97.7	16.8	15.3	4.0	0	0
§170.315 (a)(6) Problem List	100	0	0	93.7	32.3	23.7	6.9	0	0
§170.315 (a)(7) Medication List	100	0	0	97.7	16.8	15.3	4.0	0	0
§170.315 (a)(8) Medication Allergy List	100	0	0	60.7	32.8	16	4.0	0	0
§170.315 (a)(9) Clinical Decision Support	100	0	0	97.7	16.8	15.3	4.0	0	0
§170.315 (a)(14) Implantable Device List	100	0	0	85.8	26.2	28.3	9.0	0	0
§170.315 (b)(2) Clinical Information Reconciliation	100	0	0	125.7	34.1	26.5	7.4	0	0
§170.315 (b)(3) ePrescribe	100	0	0	228.3	62.1	55.1	18.0	0	0

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be: 92.8 with a standard deviation of 6.6. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.



DISCUSSION

Effectiveness

Based on the successes experienced by the test participants, as well as the lack of failures or task deviations, the MEDHOST Enterprise system is an effective way for providers to document patient information and enter orders relevant to an inpatient encounter.

Efficiency

Based on the task time and lack of deviations, the system offers an efficient way for providers to document patient information and enter orders in the inpatient setting.

Satisfaction

The users were very satisfied with the EHRUT, based on the task ratings, SUS survey responses, and the verbal and written comments of the participants. Overall consensus was that this system was very intuitive and would be easy to learn. The SUS Score of 92.8 far surpasses the score of 72.5, which is the benchmark for above average participant satisfaction.

Major Findings

All of the assigned tasks were completed quickly as each participant was able to successfully navigate the tasks and complete the designed workflow. The tasks were designed to mimic the common charting and order entry tasks for the inpatient population. Participants rated the overall experience with an average score of 4.8 on a Likert scale of 1-5. Verbal and written comments overall were positive, including the belief that the system would be easy to learn, intuitive, and user friendly. It was also observed by the test administrator that the testers speed at similar tasks and comfort navigating the system increased quickly after the first few test scenarios.

Areas for Improvement

Participants identified several areas which will be reviewed for potential improvements to the user interface and workflow. These are:

- Indicating that an implantable device had been removed was not obvious for seven users
- The workflow to change a documented allergic reaction was not obvious for five users
- Process to view more information about allergy alerts was not intuitive for three users
- Selecting/navigating order options was not initially apparent to three users
- Retracting a problem was not clear for two users

Despite these challenges all of the testers were able to complete the usability study without issues and expressed satisfaction with the design and functionality of the system.

APPENDICES

Appendix 1: Consent Form

Informed Consent

MEDHOST would like to thank you for participating in this study. The purpose of this study is to evaluate an electronic health records system. If you decide to participate, you will be asked to perform several tasks using the prototype and give your feedback. The study will last about 60 minutes.

Agreement:

I understand and agree that as a voluntary participant in the present study conducted by MEDHOST I am free to withdraw consent or discontinue participation at any time. I understand and agree to participate in the study conducted by MEDHOST.

I understand that the information is for research purposes only and that my name will not be used for any purpose other than research. I understand and agree that the purpose of this study is to make software applications more useful and usable in the future.

I understand and agree that the data collected from this study may be shared outside of MEDHOST and MEDHOST's clients. I understand and agree that data confidentiality is assured, because only de-identified data – i.e., identification numbers not names – will be used in analysis and reporting of the results.

I agree to immediately raise any concerns or areas of discomfort with the study administrator. I understand that I can leave at any time.

Please check one of the following:

- YES, I have read the above statement and agree to be a participant.
- NO, I choose not to participate in this study.

Signature: _____ Date: _____

Printed Name: _____

Appendix 2: Moderators Guide



USABILITY TESTING

Moderator Guide 2017 R1

Enterprise



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OVERVIEW

As part of the CMS EHR Incentive program, the ONC (Office of the National Coordinator) requires that select software functionality certified under the 2015 certification guidelines be subjected to formal usability testing. The following software functions are required to have usability testing and formal results reported to the ONC for certification.

- (a)(1) CPOE – Medications
- (a)(2) CPOE – Laboratory
- (a)(3) CPOE – Diagnostic Imaging
- (a)(4) Drug-drug, Drug-allergy interaction checks
- (a)(6) Problem List
- (a)(7) Medication List
- (a)(8) Medication Allergy List
- (a)(9) Clinical Decision Support
- (a)(14) Implantable Device List
- (b)(2) Clinical Information Reconciliation
- (b)(3) ePrescribe

This guide assists in collecting demographics of the individuals who are participating in the usability testing. The guide also provides simple scripts for the tester to execute. Script execution times and other navigational mouse clicks will be recorded allowing for further analysis of the effectiveness and efficiency of the user software user interface.

USABILITY METRICS

The NIST “Approach for Improving the Usability of Electronic Health Records” guide calls for EHRs to support a high level of usability for all users. Usability is defined as providing a user experience that is effective, efficient and has an acceptable level of user satisfaction. To this end, metrics that measure effectiveness, efficiency and user satisfaction will be captured during the usability test. The metrics are defined as:

1. Effectiveness of MEDHOST Enterprise 2017 R1 by measuring participant success rates and errors
2. Efficiency of MEDHOST Enterprise 2017 R1 by measuring the average task time and path deviations
3. Satisfaction with MEDHOST Enterprise 2017 R1 by measuring ease of use ratings

PREPARATION INSTRUCTIONS

Confirm test patient with the name listed below are available via Patient List: **XXXX**.

Confirm the following information is already entered for the patient **XXXX**:

- Sex: F
- DOB: 3/2/1950
- Marital Status: M
- Race: C
- Primary Language: English
- Insurance: N
- Chief Complaint: Shortness of Breath, Fever
- Height: 5' 3"
- Weight: 145
- Allergies: Penicillin
- Home Medications: Metoprolol Tartrate (Lopressor) 25mg daily
 - Ventolin HFA 108 (90 Base) 2 puffs PRN
 - Metformin (Glucophage) 500 mg TID
- Past Medical History: Type 2 Diabetes Mellitus, Asthma, Anxiety, Hypercholesterolemia
- Past Surgical History: Carpal Tunnel Surgery, bilateral
- Social History: Non-smoker, occasional alcohol use, no drug use, married
- Implanted devices: Tympanostomy tubes, both ears
- Problems: Hypercholesterolemia, Asthma, Type 2 Diabetes Mellitus
- Orders already placed:
 - Acetaminophen 650mg PO Q4H PRN Pain and Fever
 - Normal Saline 1000mL, run at 100ml/hour
 - Lasix 10mg PO BID
 - CBC
 - BMP
 - Lipid Panel
 - Chest x-ray
 - Abdominal CT without contrast
- Pending Orders:
 - Aspirin 325MG Tabs PO Daily
 - Amoxicillin 875 MG Tabs PO BID

Login to MEDHOST Enterprise Patient List as physician **Jane T Banks**. Select the test patient **XXXX**. This physician should already be assigned as the attending.

COMMUNICATION TO PARTICIPANTS

Thank you for agreeing to participate in the MEDHOST Enterprise usability testing. During this testing I will read a script with set tasks that you are asked to complete as quickly as possible. At specific points during this process I will be asking you to start and stop a click-counter, and I will be starting and stopping a timer. I will then record the results as part of the study. At the end of the testing you will be asked to provide your feedback on the areas that were covered during testing and your experience with the product overall.

The goal of this session is to obtain information regarding the usability of the system, not to evaluate your skills as a user of the system, as we look for opportunities for improvement. I have not had any involvement with the development of this system, and, therefore, will not be offended by your honest evaluation. Your feedback will be kept confidential, and your name will not be associated with your comments and feedback.

Please note that you are going to be testing in an environment created specifically for this event, not the environment that you use in your facility, so orders, order sets, and options may not match what you are accustomed to.

To start, I will ask that you fill out a brief questionnaire with some basic demographic information, then we will get started with the test script.

PARTICIPANT INFORMATION

Name: _____

E-mail address: _____

Phone Number: _____

Associated hospital/agency: _____

Gender: Male
 Female

Age: _____

Computer Experience: _____ Years _____ Months

Do you require assistive Yes
technology? No

Highest level of education: No high school degree
 High school graduate, diploma or the equivalent
 Some college credit, no degree
 Trade/technical/vocational training
 Associate degree
 Bachelor's degree
 Master's degree
 Doctorate degree

Current position/title: RN: Specialty _____
 Physician: Specialty _____
 Resident: Specialty _____
 Registrar
 System Analyst
 Other: _____

Experience with MEDHOST: _____ Years _____ Months

TEST SCRIPT

Objective:

To evaluate the user experience while entering orders for medications, labs, and diagnostic imaging, evaluating the patient's problems and allergies, and performing clinical reconciliation and prescribing medications for discharge.

Patient Information:

- The patient is a 66-year-old female hospitalized with shortness of breath and a fever.
- Vital signs on admission:
 - PULSE: 110
 - TEMP: 102.5
 - RR: 20
 - O2SAT: 92
 - SBP: 144
 - DBP: 90
- Labs on admission:
 - BMP results:
 - GLUCOSE: 320
 - BUN: 10
 - CREAT: 1.0
 - CALCIUM: 9.1
 - NA: 136
 - K: 4.0
 - CHLORIDE: 105
 - CO2: 25
 - CBC results:
 - WBC: 19.9
 - RBC: 5.4
 - HGB: 13
 - HCT: 40
 - MCV: 90
 - MCH: 27
 - MCHC: 34
 - RDW: 13
 - PLTCOUNT: 210
 - LYMPH: 40
 - MONO: 10
 - GRAN: 60
 - EOS: 5
 - BASO: 0.3

Criteria:

Drug-Drug/Drug Allergy Interactions, Active Medication List, Clinical Decision Support

We would like your feedback on the presentation of the medication list, screening messages, and clinical decision support that are provided around drug interactions.

Navigate to Orders, confirm that Aspirin and Amoxicillin are pending

START TIMING

START CLICK COUNTER

- Review the patient's active medication list
- Open the verification tray to view the pending orders
- Select Process Order
- Review the medication alerts and the clinical decision support rules
- Acknowledge the clinical decision support rule
- Enter initials HMS
- Click Modify Orders

STOP TIMING

STOP CLICK COUNTER

Time to complete tasks: _____ Number of mouse clicks: _____

Administrator Observations:

CPOE Medications

Script starts on the Medication Orders screen where the last one stopped

START TIMING

START CLICK COUNTER

- Cancel the pending orders for Aspirin and Amoxicillin
- Change Lasix 10MG PO BID to Lasix 20MG PO BID
- Add an order for Ativan 0.5MG Q8H PRN Anxiety
- Process the orders, acknowledging any alerts

STOP TIMING

STOP CLICK COUNTER

Time to complete tasks: _____ Number of mouse clicks: _____

Administrator Observations:

CPOE Lab

START TIMING

START CLICK COUNTER

- Change CBC to daily for 3 days.
- Cancel the order for a Lipid Panel
- Add an order for Hemoglobin A1C, once
- Complete the orders

STOP TIMING

STOP CLICK COUNTER

Time to complete tasks: _____ Number of mouse clicks: _____

Administrator Observations:

CPOE Diagnostic Imaging

START TIMING

START CLICK COUNTER

- Cancel Abdominal CT without contrast
- Change Chest xray from once to daily for 2 days
- Add an order for Chest CT with Contrast with a reason of Shortness of Breath
- Complete the orders

STOP TIMING

STOP CLICK COUNTER

Time to complete tasks: _____ Number of mouse clicks: _____

Administrator Observations:

[Problem List](#)

Start on Chart

START TIMING

START CLICK COUNTER

- Navigate to the problems tile and review the problems
- The patient tells you she doesn't have hypocholesteremia, she has hypertension
- Retract the problem of Hypocholesteremia with a reason of documentation error
- Add a problem of Hypertensive Disorder
- Add a problem of Anxiety, onset 12/2/2016
- Save problems

STOP TIMING

STOP CLICK COUNTER

Time to complete tasks: _____ Number of mouse clicks: _____

Administrator Observations:

[Medication Allergy List](#)

Start on Chart

START TIMING

START CLICK COUNTER

- Navigate to the allergies section
- The patient states that she gets a really bad rash from penicillin and is allergic to morphine, which makes her nauseous.
- Change the reaction to Penicillin to Severe Rash with a reason of documentation error
- Add an allergy of Morphine with a severe reaction of nausea
- Save allergies

STOP TIMING

STOP CLICK COUNTER

Time to complete tasks: _____ Number of mouse clicks: _____

Administrator Observations:

Clinical Medication Reconciliation

Start on Orders tile

START TIMING

START CLICK COUNTER

- Navigate to Admission Reconciliation
- Review Allergies list and verify
- Review Problem list and verify
- Review Medication list
- Verify Medication list
- Add Metformin 500MG TID to inpatient meds
- Add Metoprolol (Lopressor) to inpatient meds but change to twice a day
- Ventolin will not be ordered for the inpatient stay
- Confirm the medication orders and complete the reconciliation – override any alerts.

STOP TIMING

STOP CLICK COUNTER

Time to complete tasks: _____ Number of mouse clicks: _____

Administrator Observations:

Implantable Device List

Start on Chart

START TIMING

START CLICK COUNTER

- Navigate to the Implantable Device List
- Note that the Tympanostomy tubes were removed and discarded February 17 of 2016
- Add Saline Breast Implants, implanted January 8th of 2010
- Save changes

STOP TIMING

STOP CLICK COUNTER

Time to complete tasks: _____ Number of mouse clicks: _____

Administrator Observations:

Electronic Prescribing

Start on Orders tile

START TIMING

START CLICK COUNTER

- Navigate to discharge reconciliation
- Change Metoprolol (Lopressor) to 25MG twice a day, patient says she needs a new prescription, prescribe 60 tabs
- Continue Metformin, no prescription necessary
- Prescribe Ativan (Lorazepam) 0.5mg PRN Anxiety, 10 tabs
- Prescribe Furosemide 20MG Daily, 30 tabs
- Have patient continue taking Ventolin same as at home
- Discontinue Normal Saline and Tylenol
- Complete the prescription process, reviewing the scripts

STOP TIMING

STOP CLICK COUNTER

Time to complete tasks: _____ Number of mouse clicks: _____

Administrator Observations:

FEEDBACK

Experience:

Rate your experience: 1 = Difficult 3 = Neutral 5 = Easy	1	2	3	4	5
1. Navigating to the patient's active medication list					
2. Reviewing the patient's medication list					
3. Reviewing the medication and allergy alerts					
4. Identifying the severity of the alerts					
5. Understanding the clinical decision support information					
6. Addressing the clinical decision support alert					
7. Canceling a pending medication order					
8. Modifying a medication order					
9. Placing a medication order					
10. Canceling a lab order					
11. Modifying a lab order					
12. Placing a lab order					
13. Canceling a diagnostic imaging order					
14. Modifying a diagnostic imaging order					
15. Placing a diagnostic imaging order					
16. Reviewing existing problems					
17. Modifying a problem					
18. Adding new problems					

Rate your experience: 1 = Difficult 3 = Neutral 5 = Easy	1	2	3	4	5
19. Reviewing the allergy list					
20. Modifying an allergy					
21. Adding an allergy					
22. Reviewing implantable devices					
23. Indicating that a device has been removed					
24. Adding an implantable device					
25. Reconciling allergies					
26. Reconciling problems					
27. Reconciling medications					
28. Adding a home medication as an inpatient medication					
29. Suspending a home medication					
30. Continuing a home medication without a prescription					
31. Continuing a home medication with a prescription					
32. Changing a home medication					
33. Adding a new electronic prescription					
34. Prescribing a controlled substance					
35. Discontinuing inpatient medications					
36. Completing the prescription process					
Comments (likes, dislikes, surprises, suggestions) – continue on back if necessary					

Usability Testing Survey:

The following industry standard questionnaire uses the System Usability Scale to evaluate the user experience with the EHR technology.

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