MedOne Systems, LLC

EHR Usability Test Report of BOLT version 3.5

Prepared by:

Ezra Ward and Enke-Mari Marx

MedOne Systems, LLC
BRILLIANTLY SIMPLE SOFTWARE
http://www.medonesystems.com/

401 Matthews Street
Marietta, OH 45750

5 JUNE 2019

EHR Usability Test Report of BOLT Version 3.5

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

BOLT Version 3.5

Date of Usability Test: May 1, 2 and 3, 2019

Date of Report: 5 June 2019

Report Prepared By: MedOne Systems, LLC
Ezra Ward and Enke-Mari Marx
401 Matthews Street, Marietta, OH 45750
(740) 568-4817
info@medoneSystems.com

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1. Executive Summary

Usability tests of BOLT version 3.5 was conducted on May 1, 2 and 3, 2019 in Marietta, Ohio by MedOne Systems, LLC. The purpose of these tests was to validate the usability of the current user interface and provide evidence of usability in the EHR Under Test (EHRUT).

During the usability tests, ten healthcare professionals matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks. This study collected performance data on seven routines typically conducted on an EHR, split into various tasks for the inpatient and ambulatory settings:

- 170.315 (a)(1) Computerized Provider Order Entry – Medications
- 170.315 (a)(2) Computerized Provider Order Entry – Laboratory
- 170.315 (a)(3) Computerized Provider Order Entry – Diagnostic Imaging
- 170.315 (a)(6) Problem list
- 170.315 (a)(7) Medication list
- 170.315 (a)(8) Medication allergy list
- 170.315 (b)(2) Clinical information reconciliation and incorporation

A similar study was done in September 2017 of BOLT version 3. The purpose of the tests in that study, was to validate the usability of that version of the user interface. That study collected performance data on ten routines typically conducted on an EHR for the inpatient setting only, which included six of the seven listed above – (a)(1), (a)(2), (a)(3), (a)(6), (a)(7) and (a)(8), and also the following four:

- 170.315 (a)(4) Drug-drug, drug-allergy interaction checks
- 170.315 (a)(5) Demographics
- 170.315 (a)(9) Clinical decision support
- 170.315 (a)(14) Implantable device list

The user interface for the four measures listed above, has not changed in any way in BOLT version 3.5 despite now also being used in the Ambulatory setting. Therefore, this study of BOLT version 3.5 does not include tests for (a)(4), (a)(5), (a)(9) and (a)(14).

For the ambulatory setting, the user interface for (a)(1), (a)(2), (a)(3), (a)(6), (a)(7) and (a)(8), is different in BOLT version 3.5. Therefore, this study of BOLT version 3.5 includes tests for (a)(1), (a)(2), (a)(3), (a)(6), (a)(7) and (a)(8) for both the inpatient and ambulatory settings. This study also includes a test for (b)(2) which has not been tested yet.

During the 30-minute one-on-one usability tests, each participant was greeted by the administrator and asked to review and sign a Non-Disclosure and Informed Consent form (Appendix 3: Non-Disclosure Agreement and Informed Consent Form). Participants were

instructed that they could withdraw at any time. Most participants had prior experience with the EHRUT to some extent. The administrator introduced the usability 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 and electronically. The administrator did not give the participants assistance in how to complete the tasks. 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 tasks
- Number and types of errors
- Path deviations
- Participant's verbalizations
- Participant's satisfaction ratings of the system

All participant data was de-identified so that no correspondence could be made between the identity of the participant and 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 Table 1 - Usability Testing Results, a summary of the performance and rating data collected on the EHRUT.

Measure / Task	N	Task Success	Path Deviation	Task Time in seconds (Mean)	Errors	Task Ratings 5 = Easy 1 = Hard	Risk Analysis
(Task A.6.1) Record 4 problems	10	100%	0	34	0	5	Low
(Task A.6.2) Change Problem list	10	100%	0	34	0	5	Low
(Task A.6.3) Verify changed problems on Problem list	10	100%	0	9	0	5	Low
(Task A.6.4) View historical problem list	10	100%	0	14	0	5	Low
(Task A.8.1) Record 3 patient allergies	10	100%	0	31	0	5	Low
(Task A.8.2) Change 2 allergies	10	100%	0	20	0	5	Low
(Task A.8.3) Verify allergy list contains	10	100%	0	8	0	5	Low

changes made to allergies						
(Task A.8.4) Verify historical allergy list	10	100%	0	10	0	5	Low
(Task B.2.1) Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record	10	100%	0	102	0	5	Low
(Task B.2.2) Generate a new CCDA with reconciled data	10	100%	0	11	0	5	Low
(Task A.1.1.imp) Record orders for 3 medications	10	100%	0	30	0	5	Low
(Task A.1.2.imp) Change orders for 3 medications	10	100%	0	39	0	5	Low
(Task A.1.3.imp) Verify medications changes	10	100%	0	7	0	5	Low
(Task A.2.1.imp) Record 3 laboratory orders	10	100%	0	30	0	5	Low
(Task A.2.2.imp) Change 3 laboratory orders	10	100%	0	44	0	5	Low
(Task A.2.3.amb) Verify laboratory order changes	10	100%	0	6	0	5	Low
(Task A.3.1.imp) Record 3 Radiology / imaging orders	10	100%	0	38	0	5	Low
(Task A.3.2.imp) Change Radiology / imaging orders	10	100%	0	46	0	5	Low
(Task A.3.3.imp) Verify imaging order changes	10	100%	0	9	0	5	Low

(Task A.7.1.imp) Record orders for 3 medications	10	100%	0	30	0	5	Low
(Task A.7.2.imp) Change orders for 3 medications	10	100%	0	36	0	5	Low
(Task A.7.3.imp) Verify medications changes	10	100%	0	14	0	5	Low
(Task A.7.4.imp) View historical medication list	10	100%	0	9	0	5	Low
(Task A.1.1.amb) Record orders for 3 medications	10	100%	0	36	0	5	Low
(Task A.1.2.amb) Change orders for 3 medications	10	100%	0	44	0	5	Low
(Task A.1.3.amb) Verify medications changes	10	100%	0	7	0	5	Low
(Task A.2.1.amb) Record 3 laboratory orders	10	100%	0	56	0	5	Low
(Task A.2.2.amb) Change 3 laboratory orders	10	100%	0	43	0	5	Low
(Task A.2.3.amb) Verify laboratory order changes	10	100%	0	7	0	5	Low
(Task A.3.1.amb) Record 3 Radiology / imaging orders	10	100%	0	37	0	5	Low
(Task A.3.2.amb) Change Radiology / imaging orders	10	100%	0	35	0	5	Low
(Task A.3.3.amb) Verify imaging order changes	10	100%	0	12	0	5	Low
(Task A.7.1.amb) Record 3 home medications	10	100%	0	27	0	5	Low
(Task A.7.2.amb) Change orders for 3 medications	10	100%	0	40	0	5	Low
(Task A.7.3.amb) Verify medication changes	10	100%	0	11	0	5	Low

(Task A.7.4.amb) Verify medication history	10	100%	0	16	0	5	Low

Table 1 - Usability Testing Results

The results from the System Usability Scale (SUS) scored the subjective satisfaction with the system based on performance with these tasks to be 97.

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

MAJOR FINDINGS

Participants made special note of the following features of the EHRUT:

- At a glance, it's clear that the system prioritizes the most important patient identifiers and clinical information currently required and displays that information concisely.
- From the first screen, and the main work area for most clinical users, the "big picture" is clear to see – clinical work to be done, important patient references and status, and discharge preparation which is a collective effort by all teams who work on the patient, and are use this system. There is also a Timeline showing the patient's clinical history which is accessible to the user at any time and that was mentioned to be very useful.
- The system is very user friendly, intuitive, easy to navigate, and has a smooth flow through the application. It makes sense in the clinical world too.
- It is a modern touch application which makes it not only easy to use, but also enjoyable.
- The system takes less time to add problems, order medications and labs than other systems the users were familiar with, and it's also easier and quicker to make changes to those things added.

AREAS FOR IMPROVEMENT

The participants were asked to describe areas they felt the application could improve or add functionality. They provided the following feedback:

- Participants who use the system daily, mentioned that the system tends to be slower during certain parts of the day and that they feel in general, the system is taking some strain since more teams were added to the system.
- Users would like to have the ability to see if lab reports are pending, but currently only the results are shown within BOLT.
- It was stated that testing / study results from other facilities / health systems would be very beneficial to have in BOLT.

2. Introduction

The EHRUT tested for this study was BOLT version 3.5. Designed to present medical information to healthcare providers, the EHRUT consists of an application used to capture patient medical records, exchange health information between stakeholders and suggest quality improvement based on patient specific information. 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 EHRUT. To this end, measures of effectiveness, efficiency and user satisfaction, such as time on task, ability to locate information, and ease of executing the task were captured during the usability testing.

3. Method

3.1. Participants

A total of ten participants were tested on the EHRUT. Participants were physicians, physician assistants, nurse practitioners and registered nurses. Participants were recruited by MedOne Systems. In addition, participants had no direct connection to the development of or organization producing the EHRUT. Participants were not from the supplier organization. Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received.

For the test purposes, end-user characteristics were identified and translated into a recruitment screener used to solicit potential participants. The recruiting screener (Appendix 1: Recruiting Screener) is provided.

Recruited participants had a mix of backgrounds and demographic characteristics conforming to the recruitment screener. Participant's Demographics (Appendix 2: Participant Demographics) were used to show the demographics breakdown of the participants. Table 2 - Participant Demographics, lists participants by characteristics, including demographics, professional experience, computing experience and user needs for assistive technology. The participants' names were replaced with Participant IDs so that an individual's data cannot be tied back to individual identities.

Participant ID	Gender	Age Range	Occupation / role	Years EHRUT Experience	Place of Business	Test Date	Test Time	Assistive Technology Needs
PID01	M	40-49	Physician	5	Inpatient Facility	5/1/2019	10:00	*None*
PID02	F	40-49	Family Nurse Practitioner	5	Inpatient Facility	5/1/2019	13:00	*None*
PID03	M	30-39	Physician	4	Inpatient Facility	5/1/2019	14:30	*None*
PID04	M	40-49	Physician	5	Inpatient Facility	5/1/2019	16:00	*None*
PID05	F	40-49	Physician	5	Inpatient Facility	5/1/2019	16:30	*None*
PID06	F	40-49	Family Nurse Practitioner	5	Inpatient Facility	5/2/2019	15:30	*None*

PID07	F	20-29	Physician's Assistant	2	Inpatient / Ambulatory Facility	5/2/2019	16:30	*None*
PID08	F	40-49	Registered Nurse (RN, BSN)	1.5	Inpatient Facility	5/3/2019	10:30	*None*
PID09	F	30-39	Physician	2	Inpatient Facility	5/3/2019	14:00	*None*
PID10	M	30-39	Registered Nurse (RN, BSN)	0	Inpatient Facility	5/3/2019	16:30	*None*

Table 2 - Participant Demographics

Ten participants were recruited and all ten participated in the usability test. Zero participants failed to show for the study. Participants were scheduled for 30 minutes sessions with 5 minutes in between each session for debrief by the administrator / data logger, and to reset systems to proper test conditions. A spreadsheet was used to keep track of the participant schedule and included each participant's demographic characteristics.

3.2. 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 can 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 tasks
- Number and types of errors
- Path deviations
- Participant's verbalizations (comments)
- Participant's satisfaction ratings of the system

Additional information about the various measures can be found in the section on Usability Metrics.

3.3. Tasks

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

- **Task 2:** 170.315 (a)(6) Problem list *(inpatient/ambulatory)*
- **Task 3:** 170.315 (a)(8) Medication allergy list *(inpatient/ambulatory)*
- **Task 4:** 170.315 (b)(2) Clinical information reconciliation and incorporation *(inpatient/ambulatory)*
- **Task 5:** 170.315 (a)(1) Computerized Provider Order Entry – Medications, (a)(2) – Laboratory, (a)(3) – Diagnostic Imaging *(Inpatient)*
- **Task 6:** 170.315 (a)(7) Medication list *(inpatient)*
- **Task 7:** 170.315 (a)(1) Computerized Provider Order Entry – Medications, (a)(2) – Laboratory, (a)(3) – Diagnostic Imaging *(ambulatory)*
- **Task 8:** 170.315 (a)(7) Medication list *(ambulatory)*

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users. Tasks should always be constructed considering the study objectives.

3.4. Procedures

Upon arrival, participants were greeted; their identity was verified and matched with a name on the participant schedule. The participants were assigned a participant ID. Each participant reviewed and signed a non-disclosure agreement and an informed consent form (Appendix 3: Non-Disclosure Agreement and Informed Consent Form). A representative from the test team witnessed the participant's signature.

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 (see specific instructions below):

- As quickly as possible making as few errors and deviations as possible.
- 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 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 that they had successfully completed the task. Scoring is discussed below in the

Data Scoring section.

Following the session, the administrator gave the participant the post-test questionnaire (Appendix 5: System Usability Scale Questionnaire), and thanked each individual for their participation.

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

3.5.   Test Location

The test facility had a testing room with a table, computer for the participant, and recording computer for the administrator. 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 the safety instruction and evacuation procedures were valid, in place, and visible to the participants.

3.6.   Test Environment

The EHRUT would be typically used in a healthcare facility or office. In this instance, the testing was conducted in a conference room. For testing, the computer used was a laptop running Windows 10. The participants used touchscreen, touchpad and keyboard when interacting with the EHRUT.

The EHRUT used the touch enabled 13.3" LED display on 1920 x 1080 screen resolution in full color. The application was set up by the vendor according to the vendor's documentation describing the system set-up and preparation. The application itself runs on Microsoft Windows 10 as a Universal Windows Platform (UWP) application using a training database over a WLAN 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).

3.7.   Test Forms and Tools

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

- Non-Disclosure Agreement (Appendix 3: Non-Disclosure Agreement and Informed Consent Form)
- Informed Consent (Appendix 3: Non-Disclosure Agreement and Informed Consent Form)

- Moderator's Guide (Appendix 4: Moderator's Guide)
- Post-test Questionnaire (Appendix 5: System Usability Scale Questionnaire)

Appendix 4: Moderator's Guide was designed to provide step-by-step instructions to the participant from the time the participant arrived until the testing is completed.

3.8.   Participant Instructions

The administrator reads the following instructions aloud to each participant (also see the full moderator's guide in Appendix 4: Moderator's Guide):

Thank you for participating in this study. Your input is very important.

Our session today will take less than 30 minutes. During this 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 challenging) 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. All the information that you provide will be kept confidential and your name will not be associated with your comments at any time.

Should you feel it necessary, you are able to withdraw at any time during the testing.

Following the procedural instructions, participants were shown the EHR and as their first task, were given a few minutes to explore the system and make comments. Once this task was complete, the administrator gave the following instructions:

For each task, I will read the description to you and say "Begin." At that point, please perform the task and say "Done" once you believe you have successfully completed the task.

I will ask you your impressions about the task once you are done.

Participants were then given 5 tasks to complete. Tasks are listed in the moderator's guide in Appendix 4: Moderator's Guide.

3.9.   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 EHRUT by measuring participant success rates and errors.
- Efficiency of EHRUT by measuring the average task time and path deviations.
- Satisfaction with EHRUT by measuring ease of use ratings.

4. Data Scoring

Table 3 - Details of how observed data was scored, 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. Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency. 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 some factor [e.g., 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 [x] seconds then allotted task time performance was [x * 1.5] seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.
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 would be counted as errors. This should also be expressed as the mean number of failed tasks per participant. On a qualitative level, an enumeration of errors and error types should be collected.
Efficiency: **Task Deviations**	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. It is strongly recommended that task deviations be reported. Optimal paths (i.e., procedural steps) should be recorded when constructing tasks.
Efficiency: **Task Time**	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.
Satisfaction: **Task Rating**	Participant's subjective impression of the ease of use of the application was measured by administering both a simple post-task question as well as a post-session questionnaire. After each task, the participant was asked to rate "Overall, this task was:" on a scale of 1 (Very Difficult) to 5 (Very Easy). This data is 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 BOLT overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, "I think I would like to use this system frequently," "I thought the system was easy to use," and "I would imagine that most people would learn to use this system very quickly." See full System Usability Score questionnaire in Appendix 5.

Table 3 - Details of how observed data was scored

Task	Risk
(Task A.6.1) Record 4 problems	Low
(Task A.6.2) Change Problem list	Low
(Task A.6.3) Verify changed problems on Problem list	Low
(Task A.6.4) View historical problem list	Low
(Task A.8.1) Record 3 patient allergies	Low
(Task A.8.2) Change 2 allergies	Low
(Task A.8.3) Verify allergy list contains changes made to allergies	Low
(Task A.8.4) Verify historical allergy list	Low
(Task B.2.1) Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record	Low
(Task B.2.2) Generate a new CCDA with reconciled data	Low
(Task A.1.1.imp) Record orders for 3 medications	Low
(Task A.1.2.imp) Change orders for 3 medications	Low
(Task A.1.3.imp) Verify medications changes	Low
(Task A.2.1.imp) Record 3 laboratory orders	Low
(Task A.2.2.imp) Change 3 laboratory orders	Low
(Task A.2.3.amb) Verify laboratory order changes	Low
(Task A.3.1.imp) Record 3 Radiology / imaging orders	Low
(Task A.3.2.imp) Change Radiology / imaging orders	Low
(Task A.3.3.imp) Verify imaging order changes	Low
(Task A.7.1.imp) Record orders for 3 medications	Low
(Task A.7.2.imp) Change orders for 3 medications	Low
(Task A.7.3.imp) Verify medications changes	Low
(Task A.7.4.imp) View historical medication list	Low
(Task A.1.1.amb) Record orders for 3 medications	Low
(Task A.1.2.amb) Change orders for 3 medications	Low
(Task A.1.3.amb) Verify medications changes	Low
(Task A.2.1.amb) Record 3 laboratory orders	Low
(Task A.2.2.amb) Change 3 laboratory orders	Low
(Task A.2.3.amb) Verify laboratory order changes	Low
(Task A.3.1.amb) Record 3 Radiology / imaging orders	Low
(Task A.3.2.amb) Change Radiology / imaging orders	Low
(Task A.3.3.amb) Verify imaging order changes	Low
(Task A.7.1.amb) Record 3 home medications	Low
(Task A.7.2.amb) Change orders for 3 medications	Low
(Task A.7.3.amb) Verify medication changes	Low
(Task A.7.4.amb) Verify medication history	Low

Table 4 - Task Risk Analysis

5. Results

5.1. Data Analysis and Reporting

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. If participants failed to follow session and task instructions, their data was excluded from the analyses. However, all participants followed task instructions and no data was excluded.

The usability testing results for the EHRUT are detailed in Table 5 - Usability Testing Results. The results should be seen considering 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.

Furthermore, the data should be presented in forms such as the table below so that the tasks can be easily identified, and their performance results examined and compared.

Measure / Task	N	Task Success	Path Deviation	Task Time in seconds (Mean)	Errors	Task Ratings 5 = Easy 1 = Hard	Risk Analysis
(Task A.6.1) Record 4 problems	10	100%	0	34	0	5	Low
(Task A.6.2) Change Problem list	10	100%	0	34	0	5	Low
(Task A.6.3) Verify changed problems on Problem list	10	100%	0	9	0	5	Low
(Task A.6.4) View historical problem list	10	100%	0	14	0	5	Low
(Task A.8.1) Record 3 patient allergies	10	100%	0	31	0	5	Low
(Task A.8.2) Change 2 allergies	10	100%	0	20	0	5	Low
(Task A.8.3) Verify allergy list contains changes made to allergies	10	100%	0	8	0	5	Low
(Task A.8.4) Verify historical allergy list	10	100%	0	10	0	5	Low
(Task B.2.1) Incorporate a CCDA and conduct	10	100%	0	102	0	5	Low

reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record						
(Task B.2.2) Generate a new CCDA with reconciled data	10	100%	0	11	0	5	Low
(Task A.1.1.imp) Record orders for 3 medications	10	100%	0	30	0	5	Low
(Task A.1.2.imp) Change orders for 3 medications	10	100%	0	39	0	5	Low
(Task A.1.3.imp) Verify medications changes	10	100%	0	7	0	5	Low
(Task A.2.1.imp) Record 3 laboratory orders	10	100%	0	30	0	5	Low
(Task A.2.2.imp) Change 3 laboratory orders	10	100%	0	44	0	5	Low
(Task A.2.3.amb) Verify laboratory order changes	10	100%	0	6	0	5	Low
(Task A.3.1.imp) Record 3 Radiology / imaging orders	10	100%	0	38	0	5	Low
(Task A.3.2.imp) Change Radiology / imaging orders	10	100%	0	46	0	5	Low
(Task A.3.3.imp) Verify imaging order changes	10	100%	0	9	0	5	Low
(Task A.7.1.imp) Record orders for 3 medications	10	100%	0	30	0	5	Low
(Task A.7.2.imp) Change orders for 3 medications	10	100%	0	36	0	5	Low
(Task A.7.3.imp) Verify medications changes	10	100%	0	14	0	5	Low

(Task A.7.4.imp) **View historical medication list**	10	100%	0	9	0	5	Low
(Task A.1.1.amb) **Record orders for 3 medications**	10	100%	0	36	0	5	Low
(Task A.1.2.amb) **Change orders for 3 medications**	10	100%	0	44	0	5	Low
(Task A.1.3.amb) **Verify medications changes**	10	100%	0	7	0	5	Low
(Task A.2.1.amb) **Record 3 laboratory orders**	10	100%	0	56	0	5	Low
(Task A.2.2.amb) **Change 3 laboratory orders**	10	100%	0	43	0	5	Low
(Task A.2.3.amb) **Verify laboratory order changes**	10	100%	0	7	0	5	Low
(Task A.3.1.amb) **Record 3 Radiology / imaging orders**	10	100%	0	37	0	5	Low
(Task A.3.2.amb) **Change Radiology / imaging orders**	10	100%	0	35	0	5	Low
(Task A.3.3.amb) **Verify imaging order changes**	10	100%	0	12	0	5	Low
(Task A.7.1.amb) **Record 3 home medications**	10	100%	0	27	0	5	Low
(Task A.7.2.amb) **Change orders for 3 medications**	10	100%	0	40	0	5	Low
(Task A.7.3.amb) **Verify medication changes**	10	100%	0	11	0	5	Low
(Task A.7.4.amb) **Verify medication history**	10	100%	0	16	0	5	Low

Table 5 - Usability Testing Results

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be: 97. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.

5.2. Discussion of the Findings

The participants have prior experience with the EHRUT. Some participants have not yet been using the latest version of the EHRUT and were therefore not accustomed to a couple of differences in gestures or button icons. However, the functions were the same and therefore, they were able to quickly adjust to anything they were not used to yet.

Major Findings

Participants made special note of the following features of the EHRUT:

- At a glance, it's clear that the system prioritizes the most important patient identifiers and clinical information currently required and displays that information concisely.
- From the first screen, and the main work area for most clinical users, the "big picture" is clear to see – clinical work to be done, important patient references and status, and discharge preparation which is a collective effort by all teams who work on the patient, and are use this system. There is also a Timeline showing the patient's clinical history which is accessible to the user at any time and that was mentioned to be very useful.
- The system is very user friendly, intuitive, easy to navigate, and has a smooth flow through the application. It makes sense in the clinical world too.
- It is a modern touch application which makes it not only easy to use, but also enjoyable.
- The system takes less time to add problems, order medications and labs than other systems the users were familiar with, and it's also easier and quicker to make changes to those things added.

Areas for Improvement

The participants were asked to describe areas they felt the application could improve or add functionality. They provided the following feedback:

- Participants who use the system daily, mentioned that the system tends to be slower during certain parts of the day and that they feel in general, the system is taking some strain since more teams were added to the system.
- Users would like to have the ability to see if lab reports are pending, but currently only the results are shown within BOLT.

It was stated that testing / study results from other facilities / health systems would be very beneficial to have in BOLT(the incorporation of CCDAs, etc).

Effectiveness

All participants completed each task.

Participants who completed the usability study do not complete medication allergies or incorporate a CCDA on a regular basis.

With that in mind, each participant completed the medication allergies quickly and without error. Even with minimal training on the CCDA incorporation feature, users were able to intuitively know what to do in order to complete the task successfully and in an acceptable time.

Efficiency

All participants completed all tasks in a timely manner as noted in Table 6 - Task Times.

Some participants were observed to be faster using their thumbs to tap interactive areas in the application. The application allows users to use their fingers, a laptop's trackpad and/or a plugged-in mouse and/or keyboard. However, the user interface was designed with the use of thumbs in mind and therefore, it is the fastest way to interact with the system.

The administrator documented that some users utilized the ability to tap / click the [+] button to add an additional medication, laboratory or radiology order from within the add order page after completing the current order. Participants that did not tap / click this [+] button, tapped / clicked the [Save] button, returned to the medication or laboratory / radiology order list and tapped / clicked the initial [+] button again to add another order. This added only a couple seconds to their task time.

Some users recorded medication, laboratory or radiology orders through the Care Pathway feature in BOLT rather than directly accessing the individual order entry screen. This is considered even more efficient than the individual order entry screen. All users utilized the optimal path to complete the assigned task.

When tasks required participants to make changes to items e.g. (Task A.1.2.imp) Change orders for 3 medications, some participants chose to delete the item to be changed and enter a new item instead of tapping / clicking on the item to be changed, and simply making the required change to the item and tapping / clicking on the [Save] button to store the change. This added only a few seconds to the total seconds those participants spent on tasks in such a manner.

Task	Optimal (sec)	Targeted Time (x1.5)	Optimal Efficiency	Average	Median	STDEV
(Task A.6.1) Record 4 problems	30	45	1.13	34	32	9.03
(Task A.6.2) Change Problem list	30	45	1.13	34	31.5	10.21
(Task A.6.3) Verify changed problems on Problem list	10	15	0.90	9	9	1.49

(Task A.6.4) View historical problem list	15	22.5	0.93	14	14	14.52
(Task A.8.1) Record 3 patient allergies	30	45	1.03	31	27	34.05
(Task A.8.2) Change 2 allergies	20	30	1.00	20	19	20.56
(Task A.8.3) Verify allergy list contains changes made to allergies	10	15	0.80	8	7	8.85
(Task A.8.4) Verify historical allergy list	10	15	1.00	10	9.5	10.20
(Task B.2.1) Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record	120	180	0.85	102	80	111.12
(Task B.2.2) Generate a new CCDA with reconciled data	10	15	1.10	11	10	11.06
(Task A.1.1.imp) Record orders for 3 medications	30	45	1.00	30	25.5	32.63
(Task A.1.2.imp) Change orders for 3 medications	45	67.5	0.87	39	34	40.49
(Task A.1.3.imp) Verify medications changes	10	15	0.70	7	7	7.52
(Task A.2.1.imp) Record 3 laboratory orders	45	67.5	0.67	30	30	30.44
(Task A.2.2.imp) Change 3 laboratory orders	45	67.5	0.98	44	42	44.86
(Task A.2.3.amb) Verify laboratory order changes	10	15	0.60	6	7	6.51
(Task A.3.1.imp) Record 3 Radiology / imaging orders	30	45	1.27	38	37	38.89
(Task A.3.2.imp) Change Radiology / imaging orders	45	67.5	1.02	46	41	48.07
(Task A.3.3.imp) Verify imaging order changes	10	15	0.90	9	8.5	9.27
(Task A.7.1.imp) Record orders for 3 medications	30	45	1.00	30	28	34.00
(Task A.7.2.imp) Change orders for 3 medications	30	45	1.20	36	32.5	38.17

(Task A.7.3.imp) Verify medications changes	15	22.5	0.93	14	7	20.80
(Task A.7.4.imp) View historical medication list	10	15	0.90	9	9	8.96
(Task A.1.1.amb) Record orders for 3 medications	30	45	1.20	36	34	36.68
(Task A.1.2.amb) Change orders for 3 medications	45	67.5	0.98	44	44.5	44.80
(Task A.1.3.amb) Verify medications changes	10	15	0.70	7	6.5	7.82
(Task A.2.1.amb) Record 3 laboratory orders	45	67.5	1.24	56	55	56.83
(Task A.2.2.amb) Change 3 laboratory orders	45	67.5	0.96	43	40	43.62
(Task A.2.3.amb) Verify laboratory order changes	10	15	0.70	7	7.5	7.55
(Task A.3.1.amb) Record 3 Radiology / imaging orders	45	67.5	0.82	37	33.5	40.10
(Task A.3.2.amb) Change Radiology / imaging orders	45	67.5	0.78	35	34.5	35.76
(Task A.3.3.amb) Verify imaging order changes	10	15	1.20	12	12.5	12.76
(Task A.7.1.amb) Record 3 home medications	30	45	0.90	27	26	27.51
(Task A.7.2.amb) Change orders for 3 medications	30	45	1.33	40	35	42.77
(Task A.7.3.amb) Verify medication changes	15	22.5	0.73	11	8.5	15.41
(Task A.7.4.amb) Verify medication history	10	15	1.60	16	15.5	16.42

Table 6 - Task Times

Analysis of the Use, Tested Performance, and Error Rates

Even though an optimal path to successful completion of each task is provided for each task, for some tasks, the EHRUT allows the user to complete the task in a different way. This is not considered path deviation, rather it is considered an optimal use of the EHR by the user.

For example, instead of tapping / clicking the [Save] button after adding a medication, and then tapping / clicking on the [+] button on the Medications column on the Treatment tab to add another medication (i.e. two clicks to be able to add another medication), they can tap / click the [+] button on the form where they add a medication which will save the medication they have

added and present them with an empty form to add another medication (i.e. one click to add another medication).

It was found that some users completed some tasks in ways different from the described optimal path, and in some cases completed those tasks faster or slower because of that.

All participants rated the all the tasks as easy to complete, and therefore the tasks are not prone to error. It is, therefore, very unlikely that errors would occur. However, there were tasks, for example (a)(1) CPOE – Medications, that could have a high impact on the patient in the unlikely event that an error is made while completing the task.

Satisfaction

All 10 participants rated the tasks with a "5" as the task was very easy. All responded that they would recommend the EHRUT to their colleagues. Most noted the clean uncluttered appearance that fully supports touch screen technology as factors that aided in making the system very user friendly. Several noted the intuitiveness of the application. They enjoyed the flow of the system which makes sense in the clinical world.

Appendices

The following appendices include supplemental data for this usability test report. Following is a list of the appendices provided:

Appendix 1: Recruiting Screener

Appendix 2: Participant Demographics

Appendix 3: Non-Disclosure Agreement and Informed Consent Form

Appendix 4: Moderator's Guide

Appendix 5: System Usability Scale Questionnaire

Appendix 6: Letter to Verify Authenticity of The Usability Report

Appendix 1: Recruiting Screener

The purpose of a screener is to ensure that the participants selected represent the target user population as closely as possible. (Portions of this sample screener are taken from www.usability.gov/templates/index.html#Usability and adapted for use.)

Recruiting Script

Hello, my name is _____, calling from MedOne Systems. We are recruiting individuals to participate in a usability study for an electronic health record. We would like to ask you a few questions to see if you qualify and if would like to participate. This should only take a few minutes of your time. This is strictly for research purposes.

May I ask you a few questions?

1. [IF NOT OBVIOUS] Are you male or female? [RECRUIT A MIX OF PARTICIPANTS]

   ☐ Male   ☐ Female

2. Have you participated in a focus group or usability test in the past 12 months? [IF YES, TERMINATE]

3. Do you, or does anyone in your home, work in marketing research, usability research, web design [...ETC.]? [IF YES, TERMINATE]

4. Do you, or does anyone in your home, have a commercial or research interest in an electronic health record software or consulting company? [IF YES, TERMINATE]

5. Which of the following best describes your age? [RECRUIT MIX]

   ☐ 23 to 39   ☐ 40 to 59   ☐ 60 - to 74   ☐ 75 and older

6. Which of the following best describes your race or ethnic group?

   ☐ Caucasian   ☐ Asian   ☐ Black/African-American   ☐ Latino/a or Hispanic

7. Do you require any assistive technologies to use a computer? [IF SO, PLEASE DESCRIBE _____]

Professional Demographics

8. What is your current position and title? [MUST BE HEALTHCARE PROVIDER]

	Specialty
Registered Nurse (RN)	
Physician	
Resident	

9. How long have you held this position? _____

10. Describe your work location (or affiliation) and environment? _____
    [e.g., private practice, health system, government clinic, etc.]

Computer Expertise

11. About how many hours per week do you spend on the computer? _____
    [RECRUIT ACCORDING TO THE DEMOGRAPHICS OF THE INTENDED USERS, E.G., 0 TO 10, 11 TO 25, 26+ HOURS PER WEEK]
12. What computer platform do you usually use? _____ [E.G., MAC, WINDOWS, ETC.]
13. In the last month, how often have you used an electronic health record? _____
14. How many years have you used an electronic health record? _____
15. How many EHRs do you use or are you familiar with? _____
16. How does your work environment maintain patient records? [Recruit according to the demographics of the intended users]

    ☐ On paper   ☐ Some paper, some electronic   ☐ All electronic

Contact Information

IF THE PERSON MATCHES YOUR QUALIFICATIONS, ASK THE FOLLOWING:

Those are all the questions I have for you. Your background matches the people we're looking for.

Would you be able to participate on [date, time]? [IF SO, COLLECT CONTACT INFORMATION]

May I get your contact information?

Name of participant	
Address	
City, State, Zip	
Daytime phone number	
Evening phone number	
Alternate [cell] phone number	
Email address	

This study will take place on the 3rd floor at Marietta Memorial Hospital. I will confirm your appointment a couple of days before your session and provide you with directions to our office. What time is the best time to reach you?

Appendix 2: Participant Demographics

Following is a high-level overview of the participants in this study.

Gender	Count
Men	4
Women	6
Total (participants)	**10**

Occupation/Role	Count
Physician	5
Physician Assistant	1
Nurse Practitioners	2

Miscellaneous	Count
Average Years of Experience	41
Facility Use of EHR	5
All paper EHR	0
Some paper, some electronic EHR	8
All electronic EHR	2

Appendix 3: Non-Disclosure Agreement and Informed Consent Form

Non-Disclosure Agreement

THIS AGREEMENT is entered into as of _____, 2019, between

_____ ("the Participant") and MedOne Systems located at

address 401 Matthew Street, Marietta, Ohio 45750.

The Participant acknowledges his or her voluntary participation in today's usability study may bring the Participant into possession of Confidential Information. The term "Confidential Information" means all technical and commercial information of a proprietary or confidential nature which is disclosed by MedOne Systems, or otherwise acquired by the Participant, in the course of today's study.

By way of illustration, but not limitation, Confidential Information includes trade secrets, processes, formulae, data, know-how, products, designs, drawings, computer aided design files and other computer files, computer software, ideas, improvements, inventions, training methods and materials, marketing techniques, plans, strategies, budgets, financial information, or forecasts.

Any information the Participant acquires relating to this product during this study is confidential and proprietary to MedOne Systems and is being disclosed solely for the purposes of the Participant's participation in today's usability study. By signing this form, the Participant acknowledges that s/he will provide feedback and will not disclose this confidential information obtained today to anyone else or any other organizations.

Participant's printed name: _____

Signature: _____   Date: ___/___/___

Informed Consent

MedOne Systems 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 30 minutes.

Agreement

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

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 with outside of MedOne Systems. 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: ___/___/___

Appendix 4: Moderator's Guide

EHRUT Usability Test
Moderator's Guide

Name of Administrator		
Date and Time		
Number of Participants		
Location Address	401 Matthews Street, Marietta, Ohio 45750	

Orientation (5 MINUTES)

Thank you for participating in this study. Our session today will take less than 30 minutes. During that time, you will 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 answer or 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 when we can discuss freely.

Please be honest with your opinions.

The product you will be using today is BOLT application version 3.5. Some of the data may not make sense as it is placeholder data.

All 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?

Task 1: First Impressions (5 MINUTES)

This is BOLT version 3.5 that you will be working with during this usability study. Have you heard of it?

☐ YES   ☐ NO

If yes, please describe what you know about it.

```



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[SHOW TEST PARTICIPANT THE EHRUT]

Please don't click on anything just yet. What do you notice? What are you able to do here? Please be specific.

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Notes / Comments

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Task 2: 170.315 (a)(6) Problem list (inpatient/ambulatory)

[TAKE THE PARTICIPANT TO THE PATIENT RECORD BEFORE STARTING THE TASK]

1. (Task A.6.1) Access the patient's Problem list and record 4 problems:
   a. **COPD (Chronic obstructive lung disease) – Chronic**
   b. **Dementia - Chronic**
   c. **CHF (Congestive heart failure) – Acute – diagnosed today**
   d. **Anemia - Acute**
   e. Save
2. (Task A.6.2) Change Problem list:
   a. **COPD – Chronic** to **COPD – Acute**
   b. **Dementia – Chronic** to **Alzheimer's disease – Chronic**
   c. **Anemia – Acute** to **Inactive**
   d. Save
3. (Task A.6.3) Verify changed problems on Problem list.
   a. Is the Problem list correct?
4. (Task A.6.4) Tap the filter icon on the Timeline on the right side of the screen.
   a. Hide all but "Problem List Changes".
   b. Are you presented with the history of the Problem list?

   ☐ Success

   ☐ Easily completed

   ☐ Completed with difficulty or help - Describe below

   ☐ Not completed

Task ID	Task description	Time to complete (sec)
Step 1 (Task A.6.1)	Access the patient's Problem list and record 4 problems	
Step 2 (Task A.6.2)	Change Problem list	
Step 3 (Task A.6.3)	Verify changed problems on Problem list	
Step 4 (Task A.6.4)	Tap the filter icon on the Timeline on the right side of the screen	

Comments

[ ]

Optimal Path

Whether the user is in the ambulatory or inpatient setting, the Problem list is available via the Patient tab at the top of the screen. Tap / Click the [+] in the Problems header to add a problem. Provide the name of the problem and select an option between Chronic / Acute / Inactive. Tap / Click the [+] key to instantly save the current Problem and add another problem, or tap / click the [Save] button in the upper left corner of the screen. To change a problem, tap / click the problem tile that you wish to change. Tap / Click the problem name to change the problem. Tap / Click on the appropriate option between Chronic / Acute / Inactive. Tap / Click the [Save] button in the upper left corner to save the change(s). The Problem list is immediately available to review. Tap / Click the filter icon on the right side of the screen and uncheck all items except "Hide Problem List Changes". You will be presented with the historical Problem list.

☐ Correct

☐ Minor Deviations / Cycles: Describe below

☐ Major Deviations: Describe below

☐ Observed Errors and Verbalizations

[ ]

Rating

Overall, this task was: _____ "Very Easy" (1) to "Very Difficult" (5)

Administrator / Note Taker Comments

[ ]

Task 3: 170.315 (a)(8) Medication allergy list (inpatient/ambulatory)

[TAKE THE PARTICIPANT TO THE PATIENT RECORD BEFORE STARTING THE TASK]

1. (Task A.8.1) Access patient's medication Allergies and record 3 patient allergies:
   a. **Penicillin G**, with **Anaphylaxis** as the reaction.
   b. **Ibuprofen**, with **Macular eruption** as the reaction.
   c. **Latex,** with **Unknown** as a reaction.
   d. Save
2. (Task A.8.2) Change 2 allergies:
   a. Change **Ibuprofen** with **Macular Eruption** to **Ibuprofen** with **Anaphylaxis** as a reaction.
   b. Change **Latex** with **Unknown** to **Latex** with **Anaphylaxis** as a reaction.
   c. Save
3. (Task A.8.3) Verify allergy list contains changes made to allergies.
   a. Is the medication allergy list correct?
4. (Task A.8.4) Tap the allergy history button.
   a. Are you presented with a list of historical allergies and changes?

☐ Success

   ☐ Easily completed

   ☐ Completed with difficulty or help - Describe below

☐ Not completed

Task ID	Task description	Time to complete (sec)
Step 1 (Task A.8.1)	Access patient's medication Allergies and record 3 patient allergies	
Step 2 (Task A.8.2)	Change 2 allergies	
Step 3 (Task A.8.3)	Verify allergy list contains changes made to allergies	
Step 4 (Task A.8.4)	Tap the allergy history button	

Comments

> (blank box)

Optimal Path

Whether the user is in the ambulatory or inpatient setting, patient allergies are modified from the Allergies tile on the Patient tab at the top of the screen. Tap / Click the Allergies tile to review patient allergies. Tap / Click the [+] button to add an allergy. Tap / Click an existing allergy tile to make changes to its Reaction and the severity thereof. Tap and hold / [right click] on an allergy and select the [Delete Selected] option from the bottom, to delete it. Click the "Save" button in the upper left corner of the screen to save.

☐ Correct

☐ Minor Deviations / Cycles: Describe below

☐ Major Deviations: Describe below

☐ Observed Errors and Verbalizations

> (blank box)

Rating

Overall, this task was: _____ "Very Easy" (1) to "Very Difficult" (5)

Administrator / Note Taker Comments

> (blank box)

Task 4: 170.315 (b)(2) Clinical information reconciliation and incorporation (inpatient/ambulatory)

[TAKE THE PARTICIPANT TO THE PATIENT RECORD BEFORE STARTING THE TASK]

1. (Task B.2.1) Access Items. Resolve the item to review CCDA information about the patient. Import the information into the patient's medical record. Reconcile the patient's Allergies. Reconcile the patient's Home Medications. Reconcile the patient's Problems.
2. (Task B.2.2) Generate CCDA with updated information.

☐ Success

　　☐ Easily completed

　　☐ Completed with difficulty or help - Describe below

☐ Not completed

Task ID	Task description	Time to complete (sec)
Step 1 (Task B.2.1)	Access Items. Resolve the item to review CCDA information about the patient. Import the information into the patient's medical record. Reconcile the patient's Allergies. Reconcile the patient's Home Medications. Reconcile the patient's Problems.	
Step 2 (Task B.2.2)	Generate CCDA with updated information.	

Comments

Optimal Path

Whether the user is in the ambulatory or inpatient setting, Clinical Information Reconciliation and Incorporation are performed from an item in the Items tab at the top of the screen. Tap / Click on the Items tab. Tap / Click on the Resolve button of the item indicating that there is CCDA information that can be reconciled into the patient's medical record. To discard the information, check the second box in the column on the right. To import the data from the CCDA into the patient's medical record, check the first box in the column to the right. Tap / Click on the Patient tab. Tap / Click the Allergies tile. Tap / Click on the Reconcile button. Reconcile

allergies by tapping / clicking Add / Discard and/or Keep / Discard buttons appropriately. Tap / Click the [Save] button in the top left corner to save the reconciled Allergies to the patient's medical record. Tap / Click the Home Medications tile. Tap / Click on the Reconcile button. Reconcile Home Medications by tapping / clicking Add / Discard and/or Keep / Discard buttons appropriately. Tap / Click the [Save] button in the top left corner to save the reconciled Home Medications to the patient's medical record. In the Problems column, tap / click the Reconcile button. Reconcile Problems by tapping / clicking Add / Discard and/or Keep / Discard buttons appropriately. Tap / Click the [Save] button in the top left corner to save the reconciled Problems to the patient's medical record.

Open BOLT Tools, search for 'CCDA', select Generate CCDA(s). Search and choose for the patient to generate the CCDA for. Tap / Click Proceed.

☐ Correct

☐ Minor Deviations / Cycles: Describe below

☐ Major Deviations: Describe below

☐ Observed Errors and Verbalizations

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Rating

Overall, this task was: _____ "Very Easy" (1) to "Very Difficult" (5)

Administrator / Note Taker Comments

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Task 5: 170.315 (a)(1) Computerized Provider Order Entry – Medications, (a)(2) – Laboratory, (a)(3) – Diagnostic Imaging (Inpatient)

[TAKE THE PARTICIPANT TO THE PATIENT RECORD BEFORE STARTING THE TASK]

Medications

1. (Task A.1.1.imp) Access the patient's Medication list and record orders for 3 medications:
   a. **Plavix Oral 75 mg every day**
   b. **Aspirin Oral 325 mg every day**
   c. **Crestor Oral 10 mg every day**
   d. Save
2. (Task A.1.2.imp) Change orders for 3 medications:
   a. **Plavix Oral 75 mg every day** to **Diabeta Oral 1.25 mg 2 times per day**
   b. **Aspirin Oral 325 mg every day** to **Aspirin Oral 81 mg every day**
   c. **Crestor Oral 10 mg every day** to **Crestor Oral 20 mg every day**
   d. Save
3. (Task A.1.3.imp) Verify medications changes.
   a. Is the medication list accurate?

Laboratory

4. (Task A.2.1.imp) Access the order list and record 3 laboratory orders:
   a. **CBC (complete blood count)** for **Today**
   b. **TSH (Thyroid stim hormone)** for **Today**
   c. **INR (Protime with inr)** for **Today**
   d. Save
5. (Task A.2.2.imp) Change 3 laboratory orders:
   a. Change **CBC (complete blood count)** time to **AM Tomorrow**
   b. Change **TSH (Thyroid stim hormone)**
      i. Delete **TSH**
      ii. Add **Complete Metabolic Panel** for **Today**
   c. Change **INR (Protime with INR)** time to **AM Tomorrow**
   d. Save
6. (Task A.2.3.imp) Verify laboratory order changes.
   e. Is the order list accurate?

Diagnostic Imaging

7. (Task A.3.1.imp) Access Radiology/imaging orders and record 3 Radiology / imaging orders:
    a. **CXR (2 views),** reason: **chest pain,** when: **Today**
    b. **CTA CHEST W PE STUDY,** reason: **chest pain,** when: **Today**
    c. **CT Head, W/O Contrast,** reason: **headache,** when: **Today**
    d. Save
8. (Task A.3.2.imp) Change Radiology / imaging orders:
    a. Change **CXR (2 views)** time to **In AM Tomorrow**
    b. Add **CTA CHEST W PE STUDY** time to **In AM Tomorrow**
    c. Cancel 1 radiology/imaging orders: **CT Head, W/O Contrast**
        i. **CTA of the abdomen** reason: **AAA,** when: **Today**
    d. Save
9. (Task A.3.3.imp) Verify imaging order changes.
    e. Is the order list accurate?

☐ Success

    ☐ Easily completed

    ☐ Completed with difficulty or help - Describe below

☐ Not completed

Task ID	Task description	Time to complete (sec)
Medications		
Step 1 (Task A.1.1.imp)	Access the patient's Medication list and record orders for 3 medications	
Step 2 (Task A.1.2.imp)	Change orders for 3 medications	
Step 3 (Task A.1.3.imp)	Verify medications changes	
Laboratory		
Step 4 (Task A.2.1.imp)	Access the order list and record 3 laboratory orders	
Step 5 (Task A.2.2.imp)	Change 3 laboratory orders	
Step 6 (Task A.2.3.imp)	Verify laboratory order changes	

Diagnostic Imaging		
Step 7 (Task A.3.1.imp)	Access Radiology/imaging orders and record 3 Radiology / imaging orders	
Step 8 (Task A.3.2.imp)	Change 3 Radiology/imaging orders	
Step 9 (Task A.3.3.imp)	Verify imaging order changes	

Comments

Optimal Path

In the Inpatient setting, a patient's Medication list is accessed on the Treatment tab. Tap / Click the [+] button on the Medications column to new record medication orders. Tap / Click a medication tile in the Medications column to change that medication. Drug-allergy & drug-drug warning(s) will be displayed in Drug Warnings section on the right side of the screen. Save new medication by clicking the [Save] button in the upper left corner of the screen. The medication list will immediately come into view to review changes.

Laboratory and radiology / imaging orders are accessed on the Treatment tab in the Orders column. Add orders by tapping / clicking the [+] key on the Orders column. Tap / Click the [Save] button in the upper left corner of the screen to save. The laboratory order list / radiology order list will immediately come into view to review changes. Tap and hold / [right click] an order then tap / click [Cancel selected items] at the bottom of the screen. The laboratory order list / radiology order list will immediately come into view to review changes. Submit the order by clicking [Send Pending Orders] in the bottom right corner of the screen. User will be forced to acknowledge alerts before submitting the order.

☐ Correct

☐ Minor Deviations / Cycles: Describe below

☐ Major Deviations: Describe below

☐ Observed Errors and Verbalizations

Rating

Overall, this task was: _____ "Very Easy" (1) to "Very Difficult" (5)

Administrator / Note Taker Comments

Task 6: 170.315 (a)(7) Medication list (inpatient)

[TAKE THE PARTICIPANT TO THE PATIENT RECORD BEFORE STARTING THE TASK]

1. (Task A.7.1.imp) Access the patient's Medications list and record orders for 3 medications:
   a. **Plavix Oral 75 mg every day**
   b. **Aspirin Oral 325 mg every day**
   c. **Crestor Oral 10 mg every day**
   d. Save
2. (Task A.7.2.imp) Change orders for 3 medications:
   a. **Plavix Oral 75 mg every day** to **Diabeta Oral 1.25 mg 2 times per day**
   b. **Aspirin Oral 325 mg every day** to **Aspirin Oral 81 mg every day**
   c. **Crestor Oral 10 mg every day** to **Crestor Oral 20 mg every day**
   d. Save
3. (Task A.7.3.imp) Verify medications changes.
   a. Is the medication list accurate?
4. (Task A.7.4.imp) Tap / Click on the [History] button on the Medications column.
   a. Are you presented with the history of the Medications list?

☐ Success

   ☐ Easily completed

   ☐ Completed with difficulty or help - Describe below

☐ Not completed

Task ID	Task description	Time to complete (sec)
Step 1 (Task A.7.1.imp)	Access the patient's Medications list and record orders for 3 medications	
Step 2 (Task A.7.2.imp)	Change orders for 3 medications	
Step 3 (Task A.7.3.imp)	Verify medications changes	
Step 4 (Task A.7.4.imp)	Tap the Hx icon on the Medications column	

Comments

[ ]

Optimal Path

A patient's Medications are accessed through the Patient Treatment page. Tap / Click the [+] button on the Medications column to new record medication orders. Tap / Click the medication tile in the Medications column, to change a medication. Drug-allergy & drug-drug warning(s) will be displayed in Drug Warnings section on the right side of the screen. Save by clicking the [Save] button in the upper left corner of the screen. The medication list will immediately come into view to review changes. Tap / Click the [History] button on the Medications column to review a history of the Medications list.

☐ Correct

☐ Minor Deviations / Cycles: Describe below

☐ Major Deviations: Describe below

☐ Observed Errors and Verbalizations

[ ]

Rating

Overall, this task was: _____ "Very Easy" (1) to "Very Difficult" (5)

Administrator / Note Taker Comments

[ ]

Task 7: 170.315 (a)(1) Computerized Provider Order Entry – Medications, (a)(2) – Laboratory, (a)(3) – Diagnostic Imaging (ambulatory)

[TAKE THE PARTICIPANT TO THE PATIENT RECORD BEFORE STARTING THE TASK]

Medications

1. (Task A.1.1.amb) Access the Ambulatory Discharge and record orders for 3 medications:
   a. **Ibuprofen Oral 200 mg 3 times per day**
   b. **Coumadin Oral 1 mg every day**
   c. **Plavix Oral 600 mg once**
   d. Save
2. (Task A.1.2.amb) Change orders for 3 medications:
   a. **Ibuprofen Oral 200 mg 3 times per day** to **Acetaminophen Oral 500 mg every 4 hours**
   b. **Coumadin Oral 1 mg every day** to **Eliquis Oral 2.5 mg 2 times per day**
   c. **Plavix Oral 600 mg once** to **Plavix Oral 75 mg every day**
   d. Save
3. (Task A.1.3.amb) Verify medications changes.
   a. Is the medication list accurate?

Laboratory

10. (Task A.2.1.amb) Access the Ambulatory Discharge and record 3 laboratory orders:
    f. **Urinalysis** for **Dysuria** for **Today**
    g. **TSH (Thyroid stim hormone)** for **Other specified disorders of kidney and ureter** for **Today**
    h. **PVR (Post-void residual)** for **Drug induced retention of urine** for **Tomorrow**
    i. Save
11. (Task A.2.2.amb) Change 3 laboratory orders:
    j. Change **Urinalysis** time to **Tomorrow**
    k. Change **TSH (Thyroid stim hormone)**
       i. Delete **TSH**
       ii. Add **Complete Metabolic Panel** for **Today**
    l. Change **PVR (Post-void residual)** time to **in 1 month**
    m. Save
12. (Task A.2.3.amb) Verify laboratory order changes.
    n. Is the order list accurate?

Diagnostic Imaging

13. (Task A.3.1.amb) Access the Ambulatory Discharge and record 3 Radiology / imaging orders:
    f. **CXR (2 views),** reason: **chest pain,** when: **Today**
    g. **CTA CHEST W PE STUDY,** reason: **chest pain,** when: **Tomorrow**
    h. **CT Head, W/O Contrast,** reason: **headache,** when: **in 1 month**
    i. Send pending orders

14. (Task A.3.2.amb) Change Radiology / imaging orders:
    j. Change **CXR (2 views)** time to **Tomorrow**
    k. Add **CTA CHEST W PE STUDY** time to **Today**
    l. Cancel 1 radiology/imaging orders: **CT Head, W/O Contrast**
        i. **CTA of the abdomen** reason: **AAA,** when: **in 1 month**
    m. Save

15. (Task A.3.3.amb) Verify imaging order changes.
    n. Is the order list accurate?

☐ Success

  ☐ Easily completed

  ☐ Completed with difficulty or help - Describe below

☐ Not completed

Task ID	Task description	Time to complete (sec)
Medications		
Step 1 (Task A.1.1.amb)	Access the Ambulatory Discharge and record orders for 3 medications	
Step 2 (Task A.1.2.amb)	Change orders for 3 medications	
Step 3 (Task A.1.3.amb)	Verify medications changes	
Laboratory		
Step 4 (Task A.2.1.amb)	Access the Ambulatory Discharge and record 3 laboratory orders	
Step 5 (Task A.2.2.amb)	Change 3 laboratory orders	
Step 6 (Task A.2.3.amb)	Verify laboratory order changes	

Diagnostic Imaging		
Step 7 (Task A.3.1.amb)	Access the Ambulatory Discharge and record 3 Radiology / imaging orders	
Step 8 (Task A.3.2.amb)	Change 3 Radiology/imaging orders	
Step 9 (Task A.3.3.amb)	Verify imaging order changes	

Comments

Optimal Path

Ambulatory medication orders are accessed through the Work tab. Tap / Click the Discharge tile in the Tools column. Tap / Click the [+] button on the Medications section to record new medication orders. Tap / Click the medication tile in the Medications section to change a medication. Drug-allergy & drug-drug warning(s) will be displayed in Drug Warnings section on the right side of the screen. Save new medication by clicking the [Save] button in the upper left corner of the screen. To remove a medication, tap and hold / [right click] a medication tile in the Medications section, then click [cancel] at the bottom of the screen. The medication list will immediately come into view to review changes.

Laboratory and radiology / imaging orders are accessed through Orders section on the Work tab. Tap / Click the Discharge tile in the Tools column. Add orders by tapping / clicking the [+] key on the Orders section. To remove an order, tap and hold / [right click] an order tile in the Orders section, then click [cancel] at the bottom of the screen. The laboratory order list / radiology order list will immediately come into view to review changes.

Submit the discharge orders by clicking [Done] in the bottom right corner of the screen. User will be forced to acknowledge alerts before submitting the orders.

☐ Correct

☐ Minor Deviations / Cycles: Describe below

☐ Major Deviations: Describe below

☐ Observed Errors and Verbalizations

Rating

Overall, this task was: _____ "Very Easy" (1) to "Very Difficult" (5)

Administrator / Note Taker Comments

Task 8: 170.315 (a)(7) Medication list (ambulatory)

[TAKE THE PARTICIPANT TO THE PATIENT RECORD BEFORE STARTING THE TASK]

1. (Task A.7.1.amb) Access the patient Home Medications list and record 3 home medications:
   a. **Lisinopril Oral 10 mg every day**
   b. **Aspirin Oral 325 mg every day**
   c. **Norvask Oral 5 mg every day**
   d. Save
2. (Task A.7.2.amb) Change orders for 3 medications:
   a. **Lisinopril Oral 10 mg every day** to **Diabeta Oral 1.25 mg 2 times per day**
   b. **Aspirin Oral 325 mg every day** to **Aspirin Oral 81 mg every day**
   c. **Norvask Oral 5 mg every day** to **Norvask Oral 10 mg every day**
   d. Save
3. (Task A.7.3.amb) Verify medication changes.
   a. Is the medication list accurate?
4. (Task A.7.4.amb) Verify medication history.
   a. Are you presented with the history of the home medication list?

☐ Success

    ☐ Easily completed

    ☐ Completed with difficulty or help - Describe below

☐ Not completed

Task ID	Task description	Time to complete (sec)
Step 1 (Task A.7.1.amb)	Access the patient Home Medications list and record 3 home medications	
Step 2 (Task A.7.2.amb)	Change orders for 3 medications	
Step 3 (Task A.7.3.amb)	Verify medications changes	
Step 4 (Task A.7.4.amb)	Verify medication history	

Comments

Optimal Path

A patient's Home Medications are accessed through the Patient tab. Tap / Click on the Home Medications tile. Tap / Click the [+] button on the Home Medications bar to record patient medications. Tap / Click the specific home medication tile to change a home medication. Save new medication by clicking the [Save] button in the upper left corner of the screen. The medication list will immediately come into view to review changes. To the right of the current home medication list, the medication history list is visible.

☐ Correct

☐ Minor Deviations / Cycles: Describe below

☐ Major Deviations: Describe below

☐ Observed Errors and Verbalizations

Rating

Overall, this task was: _____ "Very Easy" (1) to "Very Difficult" (5)

Administrator / Note Taker Comments

Task 10: Final Questions (5 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?

Appendix 5: System Usability Scale Questionnaire

In 1996, Brooke published a "low-cost usability scale that can be used for global assessments of systems usability" known as the System Usability Scale or SUS.16 Lewis and Sauro (2009) and others have elaborated on the SUS over the years. Computation of the SUS score can be found in Tullis and Albert (2008) and Brooke wrote a retrospective about it in 2013 which can be found at https://dl.acm.org/citation.cfm?id=2817913.

	Circle the number for your response	Strongly Disagree		Impartial		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

# Appendix 6: Letter to Verify Authenticity of The Usability Report

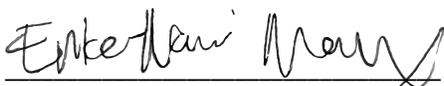May 7, 2019

To whom it may concern,

By this letter, MedOne Systems confirms the following information is true in relations to the attached report for Safety-Enhanced Design and User Center Design.

The BOLT 3.5 usability report is being submitted as part of the EHR certification requirements outlined in 170.315(g)(3) – Safety Enhanced Design.

Sincerely

_____
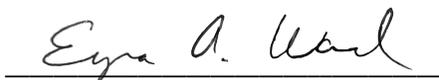
Ezra A. Ward

_____

Enke-Mari Marx

MedOne Systems, LLC
http://www.medonesystems.com/
401 Matthews Street
Marietta, OH 45750