EHR Usability Test Report of PracticeTracker™ v10.0

Report based on NISTIR 7742 Customized Common Industry Format Template for Electronic Health Record Usability Testing

Product Name:	PracticeTracker™ v10.0
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Report Prepared By:	Tranquilmoney Inc.,
	461 Vose Avenue, 2nd Floor South Orange,
	New Jersey, 07079

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EXECUTIVE SUMMARY

A usability test of PracticeTracker™ v10.0 was conducted on 04/30/2018 at client location in New York and Chennai (India) through web conference. 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, one healthcare provider and none other intended users matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks.
This study collected performance data on ten tasks typically conducted on an EHR:

1. CPOE Medication
2. CPOE Laboratory
3. CPOE Radiology
4. Drug-drug, Drug-allergy Interaction Checks
5. Demographics
6. Problem List
7. Medication List
8. Medication Allergy List
9. Clinical Decision Support
10. Clinical Information Reconciliation and Incorporation

During one hour, one-on-one usability test, Administrator greeted each participant and instructed that they could withdraw at any time. Some Participants had prior experience with the EHR. 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, along with the data logger(s) recorded user performance data on paper and electronically. The administrator assisted the participant on how to complete the task when they were unable to proceed further and recorded the same in the report.

Participant screens, head shots and audio were recorded for subsequent analysis.

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 – 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 and were compensated with $100 for their participation. 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.

Task Identifier	Tasks	Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Ratings 5=Easy
			#	Mean (SD) %	Deviations (Observed / Optimal)	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD) %	Mean (SD)
170.315.a.1 (1)	Record Medication via CPOE		10	100 (0)	7.7/7	91.4 (6.83)	91.4/80	70.00 (82.33)	3.6 (0.52)
170.315.a.1 (2)	Change Medication via CPOE		10	100 (0)	7.3/7	63 (6)	63/50	30.00 (48.30)	3.6 (0.52)
170.315.a.1 (3)	Display CPOE Medication List		10	100 (0)	4/4	21.9 (2.42)	21.9/20	0.00 (0)	4.3 (0.48)
170.315.a.2 (1)	Record Laboratory Order		10	100 (0)	5.4/5	85 (9.07)	85/70	40.00 (69.92)	3.5 (0.53)
170.315.a.2 (2)	Change Laboratory Order		10	100 (0)	5.1/5	52 (6.55)	52/40	10.00 (31.62)	3.5 (0.53)
170.315.a.2 (3)	Display Laboratory Order		10	100 (0)	4/4	12.5 (1.58)	12.5/10	0.00 (0)	4.4 (0.52)
170.315.a.3 (1)	Record Radiology/Imaging Order		10	100 (0)	6.2/6	85.4 (7.11)	85.4/70	20.00 (42.16)	3.8 (0.42)
170.315.a.3 (2)	Change Radiology/Imaging Order		10	100 (0)	6/6	51.6 (7.04)	51.6/40	0.00 (0)	3.8 (0.42)
170.315.a.3 (3)	Display Radiology/Imaging Order		10	100 (0)	4/4	12.7 (1.70)	12.7/10	0.00 (0)	4.3 (0.48)
170.315.a.4 (1)	Create drug-drug interaction / Adjust the severity level		10	100 (0)	7.6/7	100.1 (5.82)	100.1/80	60.00 (69.92)	3.7 (0.67)
170.315.a.4 (2)	Create drug-allergy interaction / Adjust the severity level		10	100 (0)	7.4/7	99.2 (5.05)	99.2/80	40.00 (51.64)	3.7 (0.67)
170.315.a.5 (1)	Record Patient Demographic		10	100 (0)	4.2/4	88.5 (7.71)	88.5/80	20.00 (42.16)	3.8 (0.63)
170.315.a.5 (2)	Change Patient Demographic		10	100 (0)	5/5	61.8 (5.03)	61.8/45	0.00 (0)	3.7 (0.48)
170.315.a.5 (3)	Display Patient Demographic		10	100 (0)	3/3	23.9 (4.31)	23.9/20	0.00 (0)	4.5 (0.53)
170.315.a.6 (1)	Record Problem List		10	100 (0)	6.2/6	58 (6.51)	58/45	20.00 (42.16)	3.2 (0.42)
	Change Problem List		10		6.1/6		39.2/30		

170.315.a.6 (2)			100 (0)		39.2 (6.37)		10.00 (31.62)	3.2 (0.42)
170.315.a.6 (3)	Display Active / Historical Problem List	10	100 (0)	5/5	12.9 (1.66)	12.9/10	0.00 (0)	4.3 (0.48)
170.315.a.7 (1)	Record Medication	10	100 (0)	7.4/7	90.2 (4.80)	90.2/80	40.00 (51.64)	3.6 (0.52)
170.315.a.7 (2)	Change Medication	10	100 (0)	7.2/7	61.4 (4.84)	61.4/50	20.00 (42.16)	3.6 (0.52)
170.315.a.7 (3)	Display Active / Historical Medication List	10	100 (0)	4/4	21.8 (1.81)	21.8/20	0.00 (0)	4.3 (0.48)
170.315.a.8 (1)	Record Medication Allergy	10	100 (0)	7.6/7	91.7 (5.85)	91.7/80	60.00 (51.64)	3.4 (0.52)
170.315.a.8 (2)	Change Medication Allergy	10	100 (0)	7.7/7	61.9 (6.06)	61.9/50	70.00 (82.33)	3.4 (0.52)
170.315.a.8 (3)	Display Active / Historical Medication Allergy List	10	100 (0)	4/4	21.7 (1.25)	21.7/20	0.00 (0)	4.4 (0.52)
170.315.a.9 (1)	Add a CDS problem list intervention	10	100 (0)	9.4/9	61 (6.27)	61/45	40.00 (69.92)	3.1 (0.57)
170.315.a.9 (2)	Add a CDS medication list intervention	10	100 (0)	9.1/9	60.3 (6.29)	60.3/45	10.00 (31.62)	3.1 (0.57)
170.315.a.9 (3)	Add a CDS medication allergy list intervention	10	100 (0)	9.1/9	60.1 (7.23)	60.1/45	10.00 (31.62)	3.1 (0.57)
170.315.a.9 (4)	Add a CDS demographics intervention	10	100 (0)	9/9	59 (4.64)	59/45	0.00 (0)	3.1 (0.57)
170.315.a.9 (5)	Add a CDS lab tests and results intervention	10	100 (0)	9/9	59.8 (4.36)	59.8/45	0.00 (0)	3.1 (0.57)
170.315.a.9 (6)	Add a CDS vital signs intervention	10	100 (0)	9/9	58.2 (3.94)	58.2/45	0.00 (0)	3.1 (0.57)
170.315.a.9 (7)	Trigger the CDS interventions added using the applicable data elements from each of the required elements	10	100 (0)	3.2/3	20.9 (1.97)	20.9/20	20.00 (42.16)	3.6 (0.52)
170.315.a.9 (8)	View the intervention information using the Info button standard for data elements	10	100 (0)	3.2/3	20.7 (1.16)	20.7/20	20.00 (42.16)	3.7 (0.48)
170.315.a.9 (9)	Identify User Diagnostic and Therapeutic Reference Information (bibliographic citation, developer, funding source, release/revision date)	10	100 (0)	5.4/5	27.2 (2.39)	27.2/25	40.00 (69.92)	3.6 (0.52)

170.315.a.9 (10)	Trigger the CDS interventions based on data elements by incorporating patient information from a transition of care/referral summary	10	100 (0)	13.3/13	128.6 (9.66)	128.6/110	30.00 (48.30)	3.3 (0.48)
170.315.b.2 (1)	Incorporate CCDA and reconcile the data	10	100 (0)	10.4/10	132.5 (15.20)	132.5/100	40.00 (69.92)	3.2 (0.42)
170.315.b.2 (2)	Generate a new CCDA with the reconciled data	10	100 (0)	5.2/5	48.4 (6.87)	48.4/40	20.00 (42.16)	3.5 (0.53)

MAJOR FINDINGS

During the testing process, it was observed that the participants performed the majority of tasks within expected number of steps. However, it was revealed that all the participants exceeded the optimal range of time while performing the tasks.

Participants found that adding a new CDS intervention was slightly difficult as they struggled while giving access to the CDS interventions and bibliographical citations. The clinical information reconciliation and incorporation interface proved to be the higher risk area, since the some of the users taken more time to reconcile the data before importing to EHRUT. The participants were not familiar with its functionality.

Overall, the testing process evidenced that the participants were exceeding the optimal time and there is presence of path deviations. However, the participants were able to perform all the tasks without any error. The performance of the participants during the testing process depicts zero error; which describes the usability of the software.

AREAS FOR IMPROVEMENT

The first area of improvement belongs to clinical information reconciliation and incorporation. Participants spent extra time to reconcile the data. The second area of improvement identified was the CDS, since most of the participants faced difficulty while configuring the interventions. There was also some confusion as to where the alert would be shown while interacting with the product. These needs to be addressed to improve the user experience.

INTRODUCTION

The PracticeTracker EHR tested for this study was PracticeTracker™ v10.0. Designed to present medical information to healthcare providers in ambulatory outpatient practices, the PracticeTracker consists of complete patient charting, medications, laboratory tests, and radiology tests. This System allows them to maintain medication lists, immunizations and allergies. 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 were captured during the usability testing.

METHOD

PARTICIPANTS

A total of ten participants were tested on the EHRUT. Participants in the test were Physician, office manager and analysts of medical groups. Participants were compensated with $100 for their participation. In addition, participants had no direct connection to the development of organization producing the EHRUT(s). Participants were not from the testing or supplier organization. Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received.

For the test purposes, end-user characteristics were identified and translated into a recruitment screener used to solicit potential participants; an example of a screener is provided in Appendix [1].

Recruited participants had a mix of backgrounds and demographic characteristics conforming to the recruitment screener. The following is a table of 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.

Sl. No	Part ID	Gender	Age	Education	Occupation /Role	Professional Experience	Computer Experience	Product Experience	Assistive Tech needs
1	P1	Male	60-69	Doctorate Degree	Physician	408	324	60	No
2	P2	Female	60-69	Master's Degree	Office Manager	120	120	0	No
3	P3	Male	30-39	Bachelor's Degree	Analyst	84	84	0	Yes
4	P4	Male	20-29	Bachelor's Degree	Analyst	48	48	48	Yes
5	P5	Male	30-39	Bachelor's Degree	Analyst	144	144	12	Yes
6	P6	Male	30-39	Bachelor's Degree	Analyst	72	72	24	Yes
7	P7	Male	30-39	Bachelor's Degree	Analyst	144	144	0	Yes
8	P8	Male	30-39	Bachelor's Degree	Analyst	156	156	144	Yes
9	P9	Male	40-49	Bachelor's Degree	Analyst	264	264	156	Yes
10	P10	Male	40-49	Bachelor's Degree	Analyst	204	204	120	Yes

Ten participants (matching the demographics in the section on Participants) were recruited and participated in the usability test.

Participants were scheduled for one hour sessions with 10 minutes in between each session for debrief by the administrator(s) and data logger(s), 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.

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 a means for both to record or benchmark current usability, but also to identify areas where improvements must be made.

During the usability test, participants interacted with the 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:

1. Number of tasks successfully completed within the allotted time without assistance
2. Time to complete the tasks
3. Number and types of errors
4. Path deviations
5. Participant's verbalizations (comments)
6. Participant's satisfaction ratings of the system

Additional information about the various measures can be found in Section 3.9 on Usability Metrics.

TASKS

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

1. CPOE Medication
2. CPOE Laboratory
3. CPOE Radiology
4. Drug-drug, Drug-allergy Interaction Checks
5. Demographics
6. Problem List
7. Medication List
8. Medication Allergy List
9. Clinical Decision Support
10. Clinical Information Reconciliation and Incorporation

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 in light of the study objectives.

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. A representative from the test team witnessed the participant's signature.

To ensure that the test ran smoothly, two staff members participated in this test, the usability administrator and the data logger. The usability testing staffs have adequate knowledge on this testing process.

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. A second person served as the data logger and took notes on task success, path deviations, number and type of errors, and comments.

Participants were instructed to perform the tasks (see specific instructions below):

➔ 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.

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 in Section 3.9.

Following the session, the administrator gave the participant the post-test questionnaire (e.g., the System Usability Scale, see Appendix 5), compensated them for their participation, 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.

Participants were thanked for their time and compensated. Participants signed a receipt and acknowledgement form (See Appendix 6) indicating that they had received the compensation.

TEST LOCATION

The test facility included a waiting area and a quiet 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 of the safety instruction and evacuation procedures were valid, in place, and visible to the participants.

TEST ENVIRONMENT

The EHRUT would be typically be used in a healthcare office or facility. For testing, the computers ran Windows 7 as an operating system. The participants used the same computer, a mouse when using the EHR and were seated properly in a room where outside noise is controlled and kept to a minimum.

The application itself was running on chrome using a test database on a LAN connection. Technically, the system performance 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.

TEST FORMS AND TOOLS

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

1. Informed Consent
2. Moderator's Guide
3. Post-test Questionnaire
4. Incentive Receipt and Acknowledgment Form

Examples of these documents can be found in Appendices 3-6 respectively. The Moderator's Guide was devised so as to be able to capture required data. Also prior to the test, participants were given the rating metrics, so they would have them available during testing for reference. Rating metrics sent were:

1. Very Difficult
2. Difficult
3. Neither Difficult nor Easy
4. Easy
5. Very Easy

The participant's interaction with the EHRUT was captured and recorded digitally with screen capture software running on the test machine and verbal comments were recorded with a microphone. The test session were electronically transmitted to a nearby observation room where the data logger observed the test session.

PARTICIPANT INSTRUCTIONS

The administrator reads the following instructions aloud to the each participant

Thank you for participating in this study. Your input is very important. Our session today will last about one hour. During that time you will use an instance of an electronic health record. I will ask you to complete a few tasks using this system and answer some questions. You should complete the tasks as quickly as possible making as few errors as possible. Please try to complete the tasks on your own following the instructions very closely. Please note that we are not testing you we are testing the system, therefore if you have difficulty all this means is that something needs to be improved in the system. I will be here in case you need specific help, but I am not able to instruct you or provide help in how to use the application

Overall, we are interested in how easy (or how difficult) this system is to use, what in it would be useful to you, and how we could improve it. I did not have any involvement in its creation, so please be honest with your opinions. All of 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 time (30 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 would like to request that you not *talk aloud or verbalize while you are doing the tasks. I will ask you your impressions about the task once you are done.*

Participants were then given ten tasks to complete. Tasks are listed in the moderator's guide in Appendix [B4].

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:

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

DATA SCORING

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

Measures	Rationale and Scoring
Effectiveness: Task Success	A task was counted as a "Success" if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis. The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage. 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., 1.25] 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 * 1.25] 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 an "Failures." 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). 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 PracticeTracker 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: Details of how observed data were scored

RESULTS

DATA ANALYSIS AND REPORTING

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. Participants who failed to follow session and task instructions had their data excluded from the analyses.

The usability testing results for the EHRUT are detailed below. The results should be seen in light of the objectives and goals outlined in Section 3.2 Study Design. The data should yield actionable results that, if corrected, yield material, positive impact on user performance.

Task Identifier	Tasks	Measure / N	Task Success Mean (SD) %	Path Deviation Deviations (Observed / Optimal)	Task Time Mean (SD)	Task Time Deviations (Observed / Optimal)	Errors Mean (SD) %	Task Ratings 5=Easy Mean (SD)
170.315.a.1 (1)	Record Medication via CPOE	10	100 (0)	7.7/7	91.4 (6.83)	91.4/80	70.00 (82.33)	3.6 (0.52)
170.315.a.1 (2)	Change Medication via CPOE	10	100 (0)	7.3/7	63 (6)	63/50	30.00 (48.30)	3.6 (0.52)
170.315.a.1 (3)	Display CPOE Medication List	10	100 (0)	4/4	21.9 (2.42)	21.9/20	0.00 (0)	4.3 (0.48)
170.315.a.2 (1)	Record Laboratory Order	10	100 (0)	5.4/5	85 (9.07)	85/70	40.00 (69.92)	3.5 (0.53)
170.315.a.2 (2)	Change Laboratory Order	10	100 (0)	5.1/5	52 (6.55)	52/40	10.00 (31.62)	3.5 (0.53)
170.315.a.2 (3)	Display Laboratory Order	10	100 (0)	4/4	12.5 (1.58)	12.5/10	0.00 (0)	4.4 (0.52)
170.315.a.3 (1)	Record Radiology/Imaging Order	10	100 (0)	6.2/6	85.4 (7.11)	85.4/70	20.00 (42.16)	3.8 (0.42)
170.315.a.3 (2)	Change Radiology/Imaging Order	10	100 (0)	6/6	51.6 (7.04)	51.6/40	0.00 (0)	3.8 (0.42)
170.315.a.3 (3)	Display Radiology/Imaging Order	10	100 (0)	4/4	12.7 (1.70)	12.7/10	0.00 (0)	4.3 (0.48)
170.315.a.4 (1)	Create drug-drug interaction / Adjust the severity level	10	100 (0)	7.6/7	100.1 (5.82)	100.1/80	60.00 (69.92)	3.7 (0.67)
170.315.a.4 (2)	Create drug-allergy interaction / Adjust the severity level	10	100 (0)	7.4/7	99.2 (5.05)	99.2/80	40.00 (51.64)	3.7 (0.67)
170.315.a.5 (1)	Record Patient Demographic	10	100 (0)	4.2/4	88.5 (7.71)	88.5/80	20.00 (42.16)	3.8 (0.63)
170.315.a.5 (2)	Change Patient Demographic	10	100 (0)	5/5	61.8 (5.03)	61.8/45	0.00 (0)	3.7 (0.48)
170.315.a.5 (3)	Display Patient Demographic	10	100 (0)	3/3	23.9 (4.31)	23.9/20	0.00 (0)	4.5 (0.53)
170.315.a.6 (1)	Record Problem List	10	100 (0)	6.2/6	58 (6.51)	58/45	20.00 (42.16)	3.2 (0.42)

170.315.a.6 (2)	Change Problem List	10	100 (0)	6.1/6	39.2 (6.37)	39.2/30	10.00 (31.62)	3.2 (0.42)
170.315.a.6 (3)	Display Active / Historical Problem List	10	100 (0)	5/5	12.9 (1.66)	12.9/10	0.00 (0)	4.3 (0.48)
170.315.a.7 (1)	Record Medication	10	100 (0)	7.4/7	90.2 (4.80)	90.2/80	40.00 (51.64)	3.6 (0.52)
170.315.a.7 (2)	Change Medication	10	100 (0)	7.2/7	61.4 (4.84)	61.4/50	20.00 (42.16)	3.6 (0.52)
170.315.a.7 (3)	Display Active / Historical Medication List	10	100 (0)	4/4	21.8 (1.81)	21.8/20	0.00 (0)	4.3 (0.48)
170.315.a.8 (1)	Record Medication Allergy	10	100 (0)	7.6/7	91.7 (5.85)	91.7/80	60.00 (51.64)	3.4 (0.52)
170.315.a.8 (2)	Change Medication Allergy	10	100 (0)	7.7/7	61.9 (6.06)	61.9/50	70.00 (82.33)	3.4 (0.52)
170.315.a.8 (3)	Display Active / Historical Medication Allergy List	10	100 (0)	4/4	21.7 (1.25)	21.7/20	0.00 (0)	4.4 (0.52)
170.315.a.9 (1)	Add a CDS problem list intervention	10	100 (0)	9.4/9	61 (6.27)	61/45	40.00 (69.92)	3.1 (0.57)
170.315.a.9 (2)	Add a CDS medication list intervention	10	100 (0)	9.1/9	60.3 (6.29)	60.3/45	10.00 (31.62)	3.1 (0.57)
170.315.a.9 (3)	Add a CDS medication allergy list intervention	10	100 (0)	9.1/9	60.1 (7.23)	60.1/45	10.00 (31.62)	3.1 (0.57)
170.315.a.9 (4)	Add a CDS demographics intervention	10	100 (0)	9/9	59 (4.64)	59/45	0.00 (0)	3.1 (0.57)
170.315.a.9 (5)	Add a CDS lab tests and results intervention	10	100 (0)	9/9	59.8 (4.36)	59.8/45	0.00 (0)	3.1 (0.57)
170.315.a.9 (6)	Add a CDS vital signs intervention	10	100 (0)	9/9	58.2 (3.94)	58.2/45	0.00 (0)	3.1 (0.57)
170.315.a.9 (7)	Trigger the CDS interventions added using the applicable data elements from each of the required elements	10	100 (0)	3.2/3	20.9 (1.97)	20.9/20	20.00 (42.16)	3.6 (0.52)
170.315.a.9 (8)	View the intervention information using the Info button standard for data elements	10	100 (0)	3.2/3	20.7 (1.16)	20.7/20	20.00 (42.16)	3.7 (0.48)

170.315.a. 9 (9)	Identify User Diagnostic and Therapeutic Reference Information (bibliographic citation, developer, funding source, release/revision date)	10	100 (0)	5.4/5	27.2 (2.39)	27.2/25	40.00 (69.92)	3.6 (0.52)
170.315.a. 9 (10)	Trigger the CDS interventions based on data elements by incorporating patient information from a transition of care/referral summary	10	100 (0)	13.3/13	128.6 (9.66)	128.6/1 10	30.00 (48.30)	3.3 (0.48)
170.315.b. 2 (1)	Incorporate CCDA and reconcile the data	10	100 (0)	10.4/10	132.5 (15.20)	132.5/1 00	40.00 (69.92)	3.2 (0.42)
170.315.b. 2 (2)	Generate a new CCDA with the reconciled data	10	100 (0)	5.2/5	48.4 (6.87)	48.4/40	20.00 (42.16)	3.5 (0.53)

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be: 87. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.

MAJOR DISCUSSION FROM FINDINGS

The test findings are discussed below:

(a.1) CPOE MEDICATION

Discussion of the Findings

Performance data:

- 100% of participants successfully completed the task (1.1) of recording new medication. (Pass)
- 100% of participants successfully completed the task (1.2) of changing medication orders. (Pass)
- 100% of participants successfully completed the task (1.3) of accessing medication orders. (Pass)

The following sections discuss the results organized around an error analysis, test performance and error rates. The error analysis includes identification of use errors and user interface design issues as well as classification of severity based on the consequence of the error. Use errors and user interface design issues that resulted in subtask failures, errors and issues related to aspects of the user interface that are considered more severe compared to noncritical system usability issues related to efficiency. Based on the errors and issues in the Error Analysis section and the associated strategy, the Areas for Improvement section is defined.

Effectiveness was measured with task success and failure.

Noncritical system usability issues are discussed in the Efficiency section.

Recommendations associated with effectiveness and efficiency are provided in the Areas for Improvement section.

Satisfaction was assessed at the Task scenario level and at the system level.

Usage and Error Analysis: No critical or noncritical use errors were identified or observed as part of this usability task. Most of the participants found difficulty in using the third party software as it is new for them.

Recording and changing medication was displayed in a popup window. The Users find it difficult to key in the

medications as it involves more number of steps. User expectations was to complete it in a single view.

Effectiveness: The success score for each of the tasks under CPOE Medication was observed to be 100%. All the participants completed the tasks successfully.

Efficiency: Most of the participants exceeded the optimal time for each task. EHRUT uses third party software for medications which is new to the participants that causes more time and some path deviations to select the appropriate values.

Satisfaction: The participants gave an average satisfaction rating of 3.8 out of 5 points on a Likert scale.

Areas of Improvement: Not much improvements suggested here as everything is handled in 3rd party software.

(a.2) CPOE LABORATORY

Discussion of the Findings

Performance data:

- 100% of participants successfully completed the task (2.1) of recording new lab orders. (Pass)
- 100% of participants successfully completed the task (2.2) of changing lab orders. (Pass)
- 100% of participants successfully completed the task (2.3) of accessing lab orders. (Pass)

Error Rates:

- 4 participants incorrectly choose the lab codes rather than the one which they are intended to do. Later, the moderator shows the right LOINC value for the orders to complete successfully.

The following sections discuss the results organized around an error analysis, test performance and error rates. The error analysis includes identification of use errors and user interface design issues as well as classification of severity based on the consequence of the error. Use errors and user interface design issues that resulted in subtask failures, errors and issues related to aspects of the user interface that are considered more severe compared to noncritical system usability issues related to efficiency. Based on the errors and issues in the Error Analysis section and the associated strategy, the Areas for Improvement section is defined.

Effectiveness was measured with task success and failure.

Noncritical system usability issues are discussed in the Efficiency section.

Recommendations associated with effectiveness and efficiency are provided in the Areas for Improvement section.

Satisfaction was assessed at the Task scenario level and at the system level.

Usage and Error Analysis: Non-critical use errors were identified as part of the CPOE Laboratory tasks. Most of the participants were able to complete the tasks without errors. Some participants finds difficulty in choosing the correct LOINC code. It was instructed later to use the description to find the lab test names incase if they are unsure about the codes.

Effectiveness: The success score for each of the tasks under CPOE Laboratory was observed to be 100%. All the participants completed the tasks successfully.

Efficiency: Most of the participants completed within the optimal time for each task. Participants were not familiar with LOINC codes. However participants found some difficulty, they were able to complete the tasks without any errors except some path deviations.

Satisfaction: The participants gave an average satisfaction rating of 3.8 out of 5 points on a Likert scale

Areas of Improvement: EHRUT should be modified as to keep the LOINC description by default in the selection combo box, so that the user can easily search the lab test with description.

(a.3) CPOE RADIOLOGY

Discussion of the Findings

Performance data:

- 100% of participants successfully completed the task (3.1) of recording new radiology orders. (Pass)
- 100% of participants successfully completed the task (3.2) of changing radiology orders. (Pass)
- 100% of participants successfully completed the task (3.3) of accessing radiology orders. (Pass)

Error Rates:

- 3 participants incorrectly choose the radiology codes rather than the one which they are intended to do. Later, the moderator shows the right LOINC value for the orders to complete successfully.

The following sections discuss the results organized around an error analysis, test performance and error rates. The error analysis includes identification of use errors and user interface design issues as well as classification of severity based on the consequence of the error. Use errors and user interface design issues that resulted in subtask failures, errors and issues related to aspects of the user interface that are considered more severe compared to noncritical system usability issues related to efficiency. Based on the errors and issues in the Error Analysis section and the associated strategy, the Areas for Improvement section is defined.

Effectiveness was measured with task success and failure.

Noncritical system usability issues are discussed in the Efficiency section.

Recommendations associated with effectiveness and efficiency are provided in the Areas for Improvement section.

Satisfaction was assessed at the Task scenario level and at the system level.

Usage and Error Analysis: Non-Critical use errors were identified as part of the CPOE Radiology tasks. Two participants missed to select the radiology order before saving the radiology order. After alert displayed in the application, participants selected the LOINC code.

One participant choose the clear button instead of updating the orders.

Effectiveness: The success score for each of the tasks under CPOE Radiology was observed to be 100%. All the participants completed the tasks successfully.

Efficiency: Most of the participants completed within the optimal time for each task. Participants were not familiar with LOINC codes. However participants found some difficulty, they were able to complete the tasks without any errors except some path deviations.

Satisfaction: The participants gave an average satisfaction rating of 4 out of 5 points on a Likert scale

Areas of Improvement: EHRUT should be modified as to keep the LOINC description by default in the selection combo box, so that the user can easily search the lab test with description. Instead of having alert while saving the EHRUT will provide a text notifying the selection of LOINC codes before saving orders.

(a.4) DRUG-DRUG, DRUG-ALLERGY INTERACTION CHECKS

Discussion of the Findings

Performance data:

- 100% of participants successfully completed the task (4.1) of creating drug-drug interaction and adjusting the severity level. (Pass)

• 100% of participants successfully completed the task (4.2) of creating drug-allergy interaction and adjusting the severity level. (Pass)

Error Rates:

• 3 participants incorrectly choose the drugs for making the drug-drug interaction
• 2 participants incorrectly choose the drugs for making the drug-allergy interaction

Later, it was explained that the unavailability of history of allergy/drug while adding medication results in the inconvenience for the user to produce interaction. Then, the participants can able to complete the tasks successfully.

The Adjusting of severity level were found to be more difficult for most of the users as they were not known about this feature earlier.

The following sections discuss the results organized around an error analysis, test performance and error rates. The error analysis includes identification of use errors and user interface design issues as well as classification of severity based on the consequence of the error. Use errors and user interface design issues that resulted in subtask failures, errors and issues related to aspects of the user interface that are considered more severe compared to noncritical system usability issues related to efficiency. Based on the errors and issues in the Error Analysis section and the associated strategy, the Areas for Improvement section is defined.

Effectiveness was measured with task success and failure.

Noncritical system usability issues are discussed in the Efficiency section.

Recommendations associated with effectiveness and efficiency are provided in the Areas for Improvement section.

Satisfaction was assessed at the Task scenario level and at the system level.

Usage and Error Analysis: No Critical or critical use errors were identified as part of these tasks. Most of the participants found difficulty in using the third party software as they are using for the first time. The Users were not shown history of allergy/drugs anywhere while adding drugs, so the user could able to find the contraindication only while saving the medication. The Participants feels that the window could be closed once after adding medications. They also find it difficult in setting the alert preferences as it involves role change and some extra steps for configuration.

Effectiveness: The success score for each of the tasks under Drug-drug, Drug-allergy Interaction Checks was observed to be 100%. All the participants completed the tasks successfully.

Efficiency: Most of the participants exceeded the optimal time for each task. EHRUT uses third party software for medications which is new to the participants that causes more time and some path deviations to select the appropriate values.

Satisfaction: The participants gave an average satisfaction rating of 3.7 out of 5 points on a Likert scale

Areas of Improvement: Not much improvements suggested here as everything is handled in 3rd party software.

(a.5) DEMOGRAPHICS

Discussion of the Findings

Performance data:

• 100% of participants successfully completed the task (5.1) of recording new patient demographics includes sexual orientation, gender identity, race and ethnicity. (Pass)
• 100% of participants successfully completed the task (5.2) of changing patient demographic includes sexual orientation, gender identity, race and ethnicity. (Pass)
• 100% of participants successfully completed the task (5.3) of accessing patient demographic includes sexual orientation, gender identity, race and ethnicity. (Pass)

Error Rates:

• 2 participants incorrectly cancelled modifying the demographic details considering it as save option.
• 3 participants find difficulty in choosing the multiple race/ethnicity details from the lookup
• 1 participant misinterpreted the information given to choose gender identity and choose incorrectly. Later, as per the instruction from moderator, it was done successfully

The following sections discuss the results organized around an error analysis, test performance and error rates. The error analysis includes identification of use errors and user interface design issues as well as classification of severity based on the consequence of the error. Use errors and user interface design issues that resulted in subtask failures, errors and issues related to aspects of the user interface that are considered more severe compared to noncritical system usability issues related to efficiency. Based on the errors and issues in the Error Analysis section and the associated strategy, the Areas for Improvement section is defined.

Effectiveness was measured with task success and failure.

Noncritical system usability issues are discussed in the Efficiency section.

Recommendations associated with effectiveness and efficiency are provided in the Areas for Improvement section.

Satisfaction was assessed at the Task scenario level and at the system level.

Usage and Error Analysis: No critical or non-critical use errors were identified as part of these tasks. Some of the participants taken time to complete the tasks but overall most of the participants were found the interface was user friendly and impressive. The User was impressed with the way the large number of race and ethnicity were given in the look up control. In Gender Identity field, the user has to keep Ctrl button pressed, to select more than one item, which is instructed to user separately, but it doesn't affect the flow much.

Effectiveness: The success score for each of the tasks under Demographics was observed to be 100%. All the participants completed the tasks successfully.

Efficiency: Participants took time to record/change demographic information. However most of the users were familiar with recording demographic information. Participants were able to complete the tasks without any errors with few path deviations.

Satisfaction: The participants gave an average satisfaction rating of 4 out of 5 points on a Likert scale. Participants were impressive with interface.

Areas of Improvement: Not much improvements suggested here as everything can be handled by the user as instructed.

(a.6) Problem List

Discussion of the Findings

Performance data:

• 100% of participants successfully completed the task (6.1) of recording diagnostic problem list. (Pass)
• 100% of participants successfully completed the task (6.2) of changing diagnostic problem list. (Pass)
• 100% of participants successfully completed the task (6.3) of accessing patient active (or) historical diagnostic problem list. (Pass)

Error Rates:

• 3 participants incorrectly chose the diagnostic coding option, and later modified as per instruction.
• 2 participants find difficulty in displaying description from the keyed codes, due to optimization factor which is discussed in the Error Analysis section

The following sections discuss the results organized around an error analysis, test performance and error rates. The error analysis includes identification of use errors and user interface design issues as well as classification of severity based on the consequence of the error. Use errors and user interface design issues that resulted in subtask failures, errors and issues related to aspects of the user interface that are considered more severe compared to noncritical system usability issues related to efficiency. Based on the errors and issues in the Error Analysis section and the associated strategy, the Areas for Improvement section is defined.

Effectiveness was measured with task success and failure.

Noncritical system usability issues are discussed in the Efficiency section.

Recommendations associated with effectiveness and efficiency are provided in the Areas for Improvement section.

Satisfaction was assessed at the Task scenario level and at the system level.

Usage and Error Analysis: Critical use errors were identified as part of the problem list tasks. All the participants were instructed to select the corresponding code option to add the respective codes. By default ICD10 code option was selected in interface. While asked to record the problem with SNOMED codes, three participants were missed to change the SNOMED code option, which doesn't reflects the expected codes. The Other problem noticed was when the code is keyed directly in the field, the description will be populated in the description field when they move out of code field. It takes some time to load as there are large number of codes available in both the ICD and SNOMED.

Effectiveness: The success score for each of the tasks under Problem List was observed to be 100%. All the participants completed the tasks successfully.

Efficiency: Most of the participants exceeded the optimal time and some participants had path deviations. Some of the participants found some difficulty in choosing SNOMED and ICD codes, which needs lot of mouse use. But participants were impressive with all options provided with-in single interface.

Satisfaction: The participants gave an average satisfaction rating of 3.6 out of 5 points on a Likert scale.

Areas of Improvement: The EHRUT will be optimized to pull out the descriptions fast when the diagnosis code is keyed.

(a.7) MEDICATION LIST

Discussion of the Findings

Performance data:

- 100% of participants successfully completed the task (7.1) of recording new medication. (Pass)
- 100% of participants successfully completed the task (7.2) of changing medication orders. (Pass)
- 100% of participants successfully completed the task (7.3) of display active/historical medication orders. (Pass)

The following sections discuss the results organized around an error analysis, test performance and error rates. The error analysis includes identification of use errors and user interface design issues as well as classification of severity based on the consequence of the error. Use errors and user interface design issues that resulted in subtask failures, errors and issues related to aspects of the user interface that are considered more severe compared to noncritical system usability issues related to efficiency. Based on the errors and issues in the Error Analysis section and the associated strategy, the Areas for Improvement section is defined.

Effectiveness was measured with task success and failure.

Noncritical system usability issues are discussed in the Efficiency section.

Recommendations associated with effectiveness and efficiency are provided in the Areas for Improvement

section.

Satisfaction was assessed at the Task scenario level and at the system level.

Usage and Error Analysis: Non-Critical use errors were identified as part of the medication list tasks. Most of the participants found difficulty in using the third party software as they are seeing for the first time. The Users were instructed to choose the right medication from the list displayed.

Recording and changing medication was displayed in a popup window. So the users have to record or change the medication and instructed to close the popup window. But two participant closed the popup window before recording the medication and then again started to record the medication which caused more time and steps for the participant.

Effectiveness: The success score for each of the tasks under Medication List was observed to be 100%. All the participants completed the tasks successfully.

Efficiency: Most of the participants exceeded the optimal time for each task. EHRUT uses third party software for medications which is new to the participants that causes more time and some path deviations to select the appropriate values.

Satisfaction: The participants gave an average satisfaction rating of 3.8 out of 5 points on a Likert scale

Areas of Improvement: Not much improvements suggested here as everything is handled in 3rd party software.

(a.8) MEDICATION ALLERGY LIST

Discussion of the Findings

Performance data:

• 100% of participants successfully completed the task (8.1) of recording new medication allergies. (Pass)
• 100% of participants successfully completed the task (8.2) of changing medication allergies. (Pass)
• 100% of participants successfully completed the task (8.3) of display active/historical medication allergies. (Pass)

The following sections discuss the results organized around an error analysis, test performance and error rates. The error analysis includes identification of use errors and user interface design issues as well as classification of severity based on the consequence of the error. Use errors and user interface design issues that resulted in subtask failures, errors and issues related to aspects of the user interface that are considered more severe compared to noncritical system usability issues related to efficiency. Based on the errors and issues in the Error Analysis section and the associated strategy, the Areas for Improvement section is defined.

Effectiveness was measured with task success and failure.

Noncritical system usability issues are discussed in the Efficiency section.

Recommendations associated with effectiveness and efficiency are provided in the Areas for Improvement section.

Satisfaction was assessed at the Task scenario level and at the system level.

Usage and Error Analysis: Non-Critical use errors were identified as part of the Medication Allergy list tasks. Most of the participants found difficulty in using the third party software as they are seeing for the first time. Recording and changing medication was displayed in a popup window. So the users have to record or change the medication and instructed to close the popup window.
Some users couldn't find the allergy reaction which they were intended to key in. So instructions were provided to key the reaction in the free text given below.

Effectiveness: The success score for each of the tasks under Medication Allergy List was observed to be 100%. All the participants completed the tasks successfully.

Efficiency: Most of the participants exceeded the optimal time for each task. EHRUT uses third party software for medications which is new to the participants that causes more time and some path deviations to select the appropriate values.

Satisfaction: The participants gave an average satisfaction rating of 3.7 out of 5 points on a Likert scale

Areas of Improvement: Not much improvements suggested here as everything is handled in 3rd party software.

(a.9) CLINICAL DECISION SUPPORT

Discussion of the Findings

Performance data:

• 100% of participants successfully completed the task (9.1) of adding new CDS problem list intervention. (Pass)
• 100% of participants successfully completed the task (9.2) of adding new CDS medication list intervention. (Pass)
• 100% of participants successfully completed the task (9.3) of adding new CDS medication allergy list intervention. (Pass)
• 100% of participants successfully completed the task (9.4) of adding new CDS demographics intervention.
• 100% of participants successfully completed the task (9.5) of adding new CDS lab tests and results intervention. (Pass)
• 100% of participants successfully completed the task (9.6) of adding new CDS vital signs intervention. (Pass)
• 100% of participants successfully completed the task (9.7) of triggering the CDS intervention added using the applicable data elements from each of the required elements. (Pass)
• 100% of participants successfully completed the task (9.8) of viewing the intervention information using the Info button standard for elements. (Pass)
• 100% of participants successfully completed the task (9.9) of identifying user diagnostic and therapeutic reference information. (Pass)
• 100% of participants successfully completed the task (9.10) of triggering the intervention based on data elements by incorporating patient information from the transition of care/referral summary. (Pass)

Error Rates:

• 3 participants while configuring the problem list intervention show the diagnostic option incorrectly, so the alert not displayed. Later on instruction, the diagnostic option chosen was changed.
• 2 participants incorrectly added the medication information, they themselves corrected later on.
• 3 participants found difficulty in identifying the intervention of the alerts once the data is entered. Based on moderator instruction, they found the right place
• 4 participants were given their feedback of reference information as to have some better references which they were needed. Post testing process, this was explained to them as they themselves can provide the citation whichever needed for them
• 5 participants found difficulty in accessing the reconciliation screen and then incorporating it into the CDS interventions. They couldn't understand the flow of how the both can be combined to see the results. Providing hash values for the files imported seems to be the difficult process for the users.
• 3 participants missed to provide access for their user role, so the intervention will not be shown to the user, later on instruction the access were given.

The following sections discuss the results organized around an error analysis, test performance and error rates. The error analysis includes identification of use errors and user interface design issues as well as classification of severity based on the consequence of the error. Use errors and user interface design issues that resulted in subtask failures, errors and issues related to aspects of the user interface that are considered more severe compared to noncritical system usability issues related to efficiency. Based on the errors and issues in the Error Analysis section and the associated strategy, the Areas for Improvement section is defined.

Effectiveness was measured with task success and failure.

Noncritical system usability issues are discussed in the Efficiency section.

Recommendations associated with effectiveness and efficiency are provided in the Areas for Improvement section.

Satisfaction was assessed at the Task scenario level and at the system level.

Usage and Error Analysis: Critical use errors were identified as part of these tasks. All the participants were instructed to configure the interventions. Three participants missed to change the ICD option before entering the ICD code while configuring the alerts. The participants were unfamiliar with the alert icon and after moderator instructed the CDS icon to the participants, each participant successfully completed the task with intended path. Some participants took more time to provide user access to the CDS configuration.

Most of the participants found difficulty in providing hash value for the CCDA file while incorporating into the application. The participants were unfamiliar with the reconciliation task and time taken to understand the process.

Most of the participant finds it difficult to provide the bibliographic citation for the alerts.

Effectiveness: The success score for each of the tasks under Clinical Decision Support was observed to be 100%. All the participants completed the tasks successfully.

Efficiency: Most of the participants exceeded the optimal time and few participants had path deviations. Participants found some difficulty in configuring interventions and bibliographic citations. All the participants completed the tasks without errors.

Satisfaction: The participants gave an average satisfaction rating of 3.5 out of 5 points on a Likert scale

Areas of Improvement: EHRUT will be improved to handle the generating hash values and validating it on its own without user intervention. User suggested to have alerts on entering details other than having it separately in patient account. We will try to fulfil the needs in better ways.

(b.2) CLINICAL INFORMATION RECONCILIATION AND INCORPORATION

Discussion of the Findings

Performance data:

• 100% of participants successfully completed the task b(2.1) of incorporating the CCDA and reconciling the data. (Pass)
• 100% of participants successfully completed the task b(2.2) of generating new CCDA with the reconciled data. (Pass)

Error Rates:

• 5 participants were confused with the technology used, as it is not known to them already and they feels it as more technical.
• 4 participants need the help to successfully complete the task as providing hash values for the files to be imported seems to be very tough for them, even though the hash values were given along with the files to be imported.
• 2 participants incorrectly do the reconciliation process, instead of selecting 'Do not import' for the data, they have reconciled as such which results in the duplicate import of data.
• 1 participant doesn't show interest in the reconciliation process and feels it is highly technical for them to use it in their process. Later, it was discussed and explained about the process involved in incorporating the data into the system they use. Then the process was taken over and completed successfully
• 5 participant missed to created new CCDA document using the reconciled data. After the instruction, new CCDA was created for the data.

The following sections discuss the results organized around an error analysis, test performance and error

rates. The error analysis includes identification of use errors and user interface design issues as well as classification of severity based on the consequence of the error. Use errors and user interface design issues that resulted in subtask failures, errors and issues related to aspects of the user interface that are considered more severe compared to noncritical system usability issues related to efficiency. Based on the errors and issues in the Error Analysis section and the associated strategy, the Areas for Improvement section is defined.

Effectiveness was measured with task success and failure.

Noncritical system usability issues are discussed in the Efficiency section.

Recommendations associated with effectiveness and efficiency are provided in the Areas for Improvement section.

Satisfaction was assessed at the Task scenario level and at the system level.

Usage and Error Analysis: Critical and Non-Critical use errors were identified as part of Clinical Information Reconciliation and Incorporation tasks. All the participants were instructed to incorporate and reconcile the CCDA to EHRUT. Most of the participants found difficulty in providing hash value for the CCDA file while incorporating into the application. Four participants were chose the move button instead of reconcile. So the user alert was displayed in the application.

Some participants were unclear to reconcile the data. With moderator instruction, the participant completed the task.

Though the users found incorporating data into EHRUT is useful, they feel the steps involved as more technical and requires more user friendliness.

No system failure error(s) pops up to result in the system failure, the risk prone is defined by the technical use involved in the reconciliation process. This is been derived based on the difficulties / comments based on the user involved in the usability testing.

During the post task discussion, all the clarifications and suggestions were noted by the moderator for further enhancements.

Effectiveness: The success score for each of the tasks under clinical Information Reconciliation and Incorporation was observed to be 100%. All the participants completed the tasks successfully.

Efficiency: All the participants exceeded the optimal number of steps and time while incorporating a CCDA. Providing hash values to CCDA files were difficult as it is technical but the participants were able to complete the tasks successfully without any errors.

Satisfaction: The participants gave an average satisfaction rating of 3.4 out of 5 points on a Likert scale

Areas of Improvement: EHRUT will be improved to handle the generating hash values and validating it on its own without user intervention. And the reconciliation will be done taking the less user interaction into account.

MAJOR FINDINGS

During the testing process, it was observed that the participants performed the majority of tasks within expected number of steps. However, it was revealed that all the participants exceeded the optimal range of time while performing the tasks.

Participants found that adding a new CDS intervention was slightly difficult as they struggled while giving access to the CDS interventions and bibliographical citations. The clinical information reconciliation and incorporation interface proved to be the higher risk area, since the some of the users taken more time to reconcile the data before importing to EHRUT. The participants were not familiar with its functionality.

Overall, the testing process evidenced that the participants were exceeding the optimal time and there is presence of path deviations. However, the participants were able to perform all the tasks without any error. The performance of the participants during the testing process depicts zero error; which describes the usability of the software.

The subtask failure was related to lack of exposure to the CDS/Reconciliation Console.

AREAS FOR IMPROVEMENT

The first area of improvement belongs to clinical information reconciliation and incorporation. Participants spent extra time to reconcile the data. The second area of improvement identified was the CDS, since most of the participants faced difficulty while configuring the interventions. There was also some confusion as to where the alert would be shown while interacting with the product. These needs to be addressed to improve the user experience.

To this end, measures of effectiveness, efficiency and user satisfaction, such as the 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, and participant's satisfaction ratings of the system were captured during the usability testing.

POTENTIAL ADVERSE CONSEQUENCES:

Potential Consequences included:
- Care activity recorded under different patient.
- Selecting incorrect files for reconciliation
- Missed (or) omitted the needed medication of patient to be imported into the system
- When the access for CDS alerts not given to the required user, the chance of showing correct alerts to the required patient is limited
- Providing inappropriate codes (diagnosis/loinc) results in incorrect data for the patient

Though the system doesn't produce any harmful effect in technical aspects, the missing of right information will produce potential problem for the patient.

Throughout the testing, Most of the participants can able to complete all the tasks along with the subset tasks. But few consequences were recorded based on the data recorded by the participant's test results from the analysis of the use, tested performance and error rates in order to identify risk prone errors.

When the participants works with multiple patients, the chance the selecting incorrect patient (or) keying the information under different patient happens. When the incorrect files were chosen for reconciliation, the system imports duplicate information of the same patient under different entries. On import, if the needed medication was left out, the patient doesn't have the correct history. When the CDS alert is produced and if it is not shown to the intended user, then the purpose of alert goes vain. If the correct codes are not given from the code set, it leads to the inappropriate entry of data for the patient.

APPENDICES

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

1. Sample Recruiting screener
2. Participant demographics
3. Non-Disclosure Agreement (NDA) and Informed Consent Form
4. Example Moderator's Guide
5. System Usability Scale Questionnaire
6. Incentive receipt and acknowledgment form

Appendix 1: SAMPLE RECRUITING SCREENER

The purpose of a screener 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 for Recruiting Firm

Hello, my name is _____, calling from *[Insert name of recruiting firm]*. 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. If you are interested and qualify for the study, you will be paid to participate. Can I ask you a few questions?

Customize this by dropping or adding questions so that it reflects your EHR's primary audience

1. [If not obvious] Are you male or female? [Recruit a mix of participants]

2. Have you participated in a focus group or usability test in the past *xx* 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? [23 to 39; 40 to 59; 60 - to 74; 75 and older] [Recruit Mix]

6. Which of the following best describes your race or ethnic group? [e.g., Caucasian, Asian, Black/African-American, Latino/a or Hispanic, etc.]

7. Do you require any assistive technologies to use a computer? [if so, please describe]

Professional Demographics *Customize this to reflect your EHR's primary audience*
8. What is your current position and title? (Must be healthcare provider)
   - RN: Specialty _____
   - Physician: Specialty _____
   - Resident: Specialty _____
   - Administrative Staff
   - Other [Terminate]

9. How long have you held this position?

10. Describe your work location (or affiliation) and environment? (Recruit according to the intended users of the application) [e.g., private practice, health system, government clinic, etc.]

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

Computer Expertise *Customize this to reflect what you know about your EHR's audience*
12. Besides reading email, what professional activities do you do on the computer? [e.g., access EHR, research; reading news; shopping/banking; digital pictures; programming/word processing, etc.] [If no computer use at all, Terminate]

13. 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]

14. What computer platform do you usually use? [e.g., Mac, Windows, etc.]

15. What Internet browser(s) do you usually use? [e.g., Firefox, IE, AOL, etc.]

16. In the last month, how often have you used an electronic health record?

17. How many years have you used an electronic health record?

18. How many EHRs do you use or are you familiar with?

19. How does your work environment 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*

Those are all the questions I have for you. Your background matches the people we're looking for. [If you are paying participants or offering some form of compensation, mention] For your participation, you will be paid [amount].

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:

Before your session starts, we will ask you to sign a release form allowing us to videotape your session. The videotape will only be used internally for further study if needed. Will you consent to be videotaped?

This study will take place remotely using WebEx meeting Remote session from our location. I will confirm your appointment a couple of days before your session and provide you with session meeting details. 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

Men	[9]
Women	[1]
Total (participants)	[10]

Occupation/Role

Physician	[1]

Office Manager   [1]
Analyst   [8]
Total (participants)   [10]

Appendix 3: NON-DISCLOSURE AGREEMENT AND INFORMED CONSENT FORM

Non-Disclosure Agreement

THIS AGREEMENT is entered into as of _____ *2017*, between _____ **("the Participant")** and the testing organization ***Tranquilmoney, Inc.*** located at ***481 Vose Avenue, 2nd Floor Orange, New Jersey, 07079***.

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 *Tranquilmoney*, 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 *Tranquilmoney* 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 receive monetary compensation for 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

Tranquilmoney 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. At the conclusion of the test, you will be compensated for your time.

Agreement

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

I understand and consent to the use and release of the videotape by Tranquilmoney. I understand that the information and videotape is for research purposes only and that my name and image will not be used for any purpose other than research. I relinquish any rights to the videotape and understand the videotape may be copied and used by Tranquilmoney without further permission.

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 Tranquilmoney and Tranquil money's client. 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

Administrator _____

Data Logger _____

Date _____   **Time** _____

Participant # _____

Location _____

Orientation (10 minutes)

Thank you for participating in this study. Our session today will last 60 minutes. During that time you will take a look at an electronic health record system.

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

I did not have any involvement in its creation, so please be honest with your opinions.

The product you will be using today is *PracticeTracker v10.0*. We are recording the audio and screenshots of our session today. All of the information that you provide will be kept confidential and your name will not be associated with your comments at any time.

Do you have any questions or concerns?

Preliminary Questions (5 minutes)

What is your job title / appointment?

How long have you been working in this role?

 What are some of your main responsibilities?

Tell me about your experience with electronic health records.

First Impressions (15 *Seconds*)

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

- *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.

Test Scenarios Based On Risk Factor

The tasks are prioritized in accordance with the risks associated with user errors.

(b.2) Clinical Information Reconciliation and Incorporation

User Interaction – Moderate

Risk Involved – High

Tasks:

1. Incorporate a CCDA and conduct reconciliation of the medications, problems and medication allergies in the CCDA with another source.

Optimal Path: Reports (1) – EHR Reports (2) - Receive Referral (3) - Browse and upload the referral file (4) – Provide the Hash value (5) – Move the Patient Demographic (6) - Reconciliation (7) - Confirm button (8) - Import button (9) - Close Window (10)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

2. Generate new CCDA with the reconciled data

Optimal Path: After Reconciliation, Go to Patients (1) - Search and select the patient (2) – Add Progress Notes for the patient (3) – Click Patient Summary in the Action button (4) – Click 'Export Summary' (5)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

(a.9) Clinical Decision Support

> User Interaction – Moderate

> Risk Involved – Moderate

Tasks:

1. Add a CDS problem list intervention

Optimal Path: Tools (1) - CDS Configuration (2) - Configure and save button (3) - User list (4) - Select the user(s)/role and save button (5) - Close window (6) - Charts (7) - Search and select the patient (8) - CDS Alert will display in top right corner (9)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

2. Add a CDS medication list intervention

Optimal Path: Tools (1) - CDS Configuration (2) - Configure and save button (3) - User list (4) - Select the user(s)/role and save button (5) - Close window (6) - Charts (7) - Search and select the patient (8) - CDS Alert will display in top right corner (9)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

3. Add a CDS medication allergy list intervention

Optimal Path: Tools (1) - CDS Configuration (2) - Configure and save button (3) - User list (4) - Select the user(s)/role and save button (5) - Close window (6) - Charts (7) - Search and select the patient (8) - CDS Alert will display in top right corner (9)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

4. Add a CDS demographics intervention

Optimal Path: Tools (1) - CDS Configuration (2) - Configure and save button (3) - User list (4) - Select the user(s)/role and save button (5) - Close window (6) - Charts (7) - Search and select the patient (8) - CDS Alert will display in top right corner (9)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

5. Add a CDS lab tests and results intervention

Optimal Path: Tools (1) - CDS Configuration (2) - Configure and save button (3) - User list (4) - Select the user(s)/role and save button (5) - Close window (6) - Charts (7) - Search and select the patient (8) - CDS Alert will display in top right corner (9)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

□1   □2   □3   □4   □5

Time taken to complete the task (in secs):

<u>Comments:</u>

<u>Task Errors:</u>

<u>Observed Errors and Verbalizations:</u>

<u>Administrator Comments:</u>

6.   Add a CDS vital signs intervention

<u>Optimal Path:</u> Tools (1) - CDS Configuration (2) - Configure and save button (3) - User list (4) - Select the user(s)/role and save button (5) - Close window (6) - Charts (7) - Search and select the patient (8) - CDS Alert will display in top right corner (9)

□ Correct

□Minor Deviation, Describe below:

□Major Deviation, Describe below:

<u>Success Rate:</u>

□Easily Completed

□Completed with Difficulty or help, Describe below:

□Not Completed

<u>Ratings:</u>

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

□1   □2   □3   □4   □5

Time taken to complete the task (in secs):

<u>Comments:</u>

<u>Task Errors:</u>

<u>Observed Errors and Verbalizations:</u>

<u>Administrator Comments:</u>

7.   Trigger the CDS interventions added using the applicable data elements from each of the required elements

<u>Optimal Path:</u> Patients (1) – Search and select Patient (2) – Click Alerts icon in the top right (3)

□ Correct

□Minor Deviation, Describe below:

□Major Deviation, Describe below:

<u>Success Rate:</u>

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1　☐2　☐3　☐4　☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

8.　View the intervention information using the Info button standard for data elements in the problem list, medication list, and demographics

Optimal Path:　Patients (1) – Search and select Patient (2) – Click Alerts icon in the top right (3) – Click Help link in the CDS alert

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1　☐2　☐3　☐4　☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

9.　Identify User Diagnostic and Therapeutic Reference Information (bibliographic citation, developer, funding source, release/revision date)

Optimal Path:　Patients (1) – Search and select Patient (2) – Click Action button in the top right (3) – Click the Help link in the alert (4) – The Information can be identified from the page (5)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

10. Trigger the CDS interventions based on data elements in the problem list, medication list, and medication allergy list by incorporating patient information from a transition of care/referral summary

Optimal Path: Reports (1) – EHR Reports (2) - Receive Referral (3) - Browse and upload the referral file (4) – Provide the Hash value (5) – Move the Patient Demographic (6) - Reconciliation (7) - Confirm button (8) - Import button (9) - Close Window (10) - Patients (11) - Search and select the patient (12) - CDS Alert will display in top right corner (13)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

(a.7) Medication List

        User Interaction – Moderate

        Risk Involved – Moderate

Tasks:

1.   Record medication

Optimal Path: Patients (1) – Search and select the patient (2) - Charts (3) - Medication List (4) - Add/Edit Medication button (5) - Find and add the medication (6) - Close Window (7)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

2.   Change medication

Optimal Path: Patients (1) – Search and select the patient (2) - Charts (3) - Medication List (4) - Add/Edit Medication button (5) - Modify the medication (6) - Close Window (7)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

□1   □2   □3   □4   □5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

3. Display active / historical medication list

Optimal Path: Patients (1) – Search and select the patient (2) - Charts (3) - Medication List (4)

□ Correct

□Minor Deviation, Describe below:

□Major Deviation, Describe below:

Success Rate:

□Easily Completed

□Completed with Difficulty or help, Describe below:

□Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

□1   □2   □3   □4   □5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

(a.8) Medication Allergy List

>   User Interaction – Moderate

>   Risk Involved – Moderate

Tasks:

1. Record medication allergy

Optimal Path: Patients (1) – Search and select the patient (2) - Charts (3) - Allergy List (4) - Add/Edit Allergies button (5) - Find and add the Allergies (6) - Close Window (7)

□ Correct

□Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1 ☐2 ☐3 ☐4 ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

2. Change medication allergy

Optimal Path: Patients (1) – Search and select the patient (2) - Charts (3) - Allergy List (4) - Add/Edit Allergies button (5) - Modify the Allergies (6) - Close Window (7)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1 ☐2 ☐3 ☐4 ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

3. Display active / historical medication allergy list

Optimal Path: Patients (1) – Search and select the patient (2) - Charts (3) - Allergy List (4)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

(a.1) CPOE Medication

User Interaction – Moderate

Risk Involved – Moderate

Tasks:

1. Record medication via CPOE

Optimal Path: Patients (1) – Search and select the patient (2) - Charts (3) - Medication List (4) - Add/Edit Medication button (5) - Find and add the medication (6) - Close Window (7)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

2. Change medication via CPOE

Optimal Path: Patients (1) – Search and select the patient (2) - Charts (3) - Medication List (4) - Add/Edit Medication button (5) - Modify the medication (6) - Close Window (7)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

3. Display active / historical CPOE medication

Optimal Path: Patients (1) – Search and select the patient (2) - Charts (3) - Medication List (4)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

(a.4) Drug-drug, Drug-allergy Interaction Checks

User Interaction – Moderate

Risk Involved – Moderate

Tasks:

1. Create drug-drug interaction / Adjust the severity level of displayed drug-drug interaction

Optimal Path: Patients (1) – Search and select the patient (2) - Charts (3) - E-Prescription (4) - Add/Edit Prescription button (5) - Options (6) - Preferences (7) - location (8) - Find and add the medication for prescription (9) - Sign the prescription (10) - Close Window (11)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:
(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

2. Create drug-allergy interaction / Adjust the severity level of displayed drug-allergy interaction

Optimal Path: Patients (1) – Search and select the patient (2) - Charts (3) - E-Prescription (4) - Add/Edit Prescription button (5) - Options (6) - Preferences (7) - location (8) - Find and add the medication for prescription (9) - Sign the prescription (10) - Close Window (11)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

(a.2) CPOE Laboratory

> User Interaction – Moderate

> Risk Involved – Moderate

Tasks:

1. Record laboratory order

Optimal Path: Patients (1) – Search and select the patient (2) - Orders (3) – Key and select the laboratory order details (4) - Save button (5)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

2. Change laboratory order

Optimal Path: Patients (1) – Search and select the patient (2) - Orders (3) – Edit the laboratory order details (4) - Update button (5)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

3.   Display laboratory order

Optimal Path: Patients (1) – Search and select the patient (2) - Orders (3) - Check in the bottom of screen (4)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

(a.3) CPOE Radiology

   User Interaction – Moderate

   Risk Involved – Moderate

Tasks:

1. Record radiology / imaging order

Optimal Path: Patients (1) – Search and select the patient (2) - Orders (3) - Radiology Order (4) – Key and select the radiology/imaging order details (5) - Save button (6)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

2. Change radiology / imaging order

Optimal Path: Patients (1) – Search and select the patient (2) - Orders (3) - Radiology Order (4) - Edit the radiology/imaging order details (5) - Update button (6)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

□1   □2   □3   □4   □5

Time taken to complete the task (in secs):

<u>Comments:</u>

<u>Task Errors:</u>

<u>Observed Errors and Verbalizations:</u>

<u>Administrator Comments:</u>

3.   Display radiology / imaging order

<u>Optimal Path:</u> Patients (1) – Search and select the patient (2) - Orders (3) – Check in the bottom of 'Radiology' screen (4)

□ Correct

□Minor Deviation, Describe below:

□Major Deviation, Describe below:

<u>Success Rate:</u>

□Easily Completed

□Completed with Difficulty or help, Describe below:

□Not Completed

<u>Ratings:</u>

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

□1   □2   □3   □4   □5

Time taken to complete the task (in secs):

<u>Comments:</u>

<u>Task Errors:</u>

<u>Observed Errors and Verbalizations:</u>

<u>Administrator Comments:</u>

(a.6) Problem List

> User Interaction – high
>
> Risk Involved – Moderate

Tasks:

1.   Record problem list

<u>Optimal Path:</u> Patients (1) – Search and select the patient (2) – Left panel of the screen (3) – Problem List (4) – Add the Patient's diagnosed details (5) - Save button (6)

□ Correct

□Minor Deviation, Describe below:

□Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

2.   Change problem list

Optimal Path: Patients (1) – Search and select the patient (2) – Left panel of the screen (3) – Problem List (4) – Edit/Change the Patient's diagnosed details (5) - Save button (6)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

3.   Display active / historical problem list

Optimal Path: Patients (1) – Search and select the patient (2) – Left panel of the screen (3) – Problem List (4) – Check in the bottom of the screen (5)

☐ Correct

☐Minor Deviation, Describe below:

□Major Deviation, Describe below:

Success Rate:

□Easily Completed

□Completed with Difficulty or help, Describe below:

□Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

□1   □2   □3   □4   □5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

(a.5) Demographics

       User Interaction – high

       Risk Involved – Low

Tasks:

1. Record patient demographic data according to applicable specified standards that includes - Race and Ethnicity, Sexual Orientation, Preferred Language, Gender Identity, Sex, Date of Birth

Optimal Path: Click add patient icon in the top right corner of the screen (1) – Add the demographic details (2) – Click 'Add' (3) - Close Window (4)

□ Correct

□Minor Deviation, Describe below:

□Major Deviation, Describe below:

Success Rate:

□Easily Completed

□Completed with Difficulty or help, Describe below:

□Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

□1   □2   □3   □4   □5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

2. Change patient demographic data according to applicable specified standards that includes - Race and Ethnicity, Sexual Orientation, Preferred Language, Gender Identity, Sex, Date of Birth

Optimal Path: Patients (1) – Search and select the patient (2) – Modify the patient demographic details (3) – Save the patient details (4) - Close Window (5)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

3. Display patient demographic data

Optimal Path: Patients (1) – Search and select the patient (2) – Added details displayed in Info (3)

☐ Correct

☐Minor Deviation, Describe below:

☐Major Deviation, Describe below:

Success Rate:

☐Easily Completed

☐Completed with Difficulty or help, Describe below:

☐Not Completed

Ratings:

(Scale – 'Very Easy – 5', 'Very Difficult – 1')

☐1   ☐2   ☐3   ☐4   ☐5

Time taken to complete the task (in secs):

Comments:

Task Errors:

Observed Errors and Verbalizations:

Administrator Comments:

Final Questions (10 *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?

Administer the SUS

Appendix 5: SYSTEM USABILITY SCALE QUESTIONNAIRE

Sl. No	Description	Strongly Disagree				Strongly Agree
1	I think that I would like to use this system frequently					
2	I found the system unnecessarily complex					
3	I thought the system was easy to use					
4	I think that I would need the support of a technical person to be able to use this system					
5	I found the various functions in this system were well integrated					
6	I thought there was too much inconsistency in this system					
7	I would imagine that most people would learn to use this system very quickly					
8	I found the system very cumbersome to use					
9	I felt very confident using the system					
10	I needed to learn a lot of things before I could get going with this system					

Appendix 6: INCENTIVE RECEIPT AND ACKNOWLEDGMENT FORM

ACKNOWLEDGMENT FORM

I hereby acknowledge receipt of $_____ for my participation in a research study run by **Tranquilmoney Inc.**

Printed Name: _____

Address: _____

_____

Signature: _____   Date: _____

Usability Researcher: _____

Signature of Usability Researcher: _____

Date: _____

Witness: _____

Witness Signature: _____

Date: _____