

Safety-Enhanced Design Usability Test Report

Report based on NISTIR 7742

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1. Executive Summary

A usability test of MDLand International Corporation's iClinic 12.3 was conducted from 8/10/18 through 9/7/18 at various provider locations by MDLand. The purpose of this test was to test and validate the usability of the current user interface and provide evidence of usability of iClinic in the EHR Under Test (EHRUT). This study collected performance data on tasks outlined in the ONC-ATL EHR Safety – Enhanced Design Checklist 2015 Edition following usability test procedures from the NISTIR 7741 and the NISTIR 7742 sources. During the usability test, 14 participants matching the target demographic criteria served as participants and used iClinic in simulated, but representative tasks.

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

- Find information in Patient Summary screen
- Add, Remove, and Edit the Problem List
- Record, Change and Display Lab Order and Diagnostic Imaging
- Add, Remove, and Edit the Medication Allergy List
- Add, Remove, and Edit the Medication List
- Reconcile outside records with the Patient's chart
- Review and Edit the Patient's implantable device list
- Add, Remove and Edit Physician/Prescription Order

During the 60-minute one-on-one usability test, each participant was greeted by the administrator and asked to review and sign an informed consent/release form (included in Appendix 2); they were instructed that they could withdraw at any time. 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 recorded user performance data on paper and electronically. The administrator did not give the participant assistance in how to complete the task.

The following types of data were collected for each participant:

- Number of tasks successfully completed within the allotted time without assistance
- Time to complete the 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.

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 iClinic. The following is a summary of the performance and rating data collected on iClinic.

Task ID	Task Success - Mean (%)	Task Success - SD%	Task Path Deviation - Observed #	Task Path Deviation - Optimal #	Task Time - Mean (seconds)	Task Time - SD (seconds)	Task Time Deviation - Mean Observed Seconds	Task Time Deviation - Mean Optimal Seconds	Task Errors Mean(%)	Task Errors - SD%	Task Rating 5=Easy	Task Rating - SD%
a.1	99.86	0.53	7	7	86.37	47.66	74.03	38	0.07	0.27	4.79	0.43
a.2	98.93	4.01	9	8	61.02	62.09	56.66	20	0	0	4.71	0.47
a.3	98.64	2.68	8	8	41.29	22.79	38.34	10	0	0	4.79	0.43
a.4	96	6.87	10	8	55.42	39.23	51.16	0	0.15	0.55	4.85	0.38
a.5	98.85	3	7	7	44.18	26.42	40.78	0	0	0	4.92	0.28
a.6	94.64	8.15	11	9	66.15	44.36	61.42	45	0.14	0.36	4.71	0.47
a.7	95.71	9.38	9	8	82	47.19	76.15	40	0.21	0.58	4.79	0.43
a.8	96.07	5.62	9	8	67.8	31.51	62.96	60	0.07	0.27	4.79	0.58
a.9	83.29	12.03	32	15	269.76	173.35	250.49	120	0.79	0.8	3.93	1.14
a.14	92.86	6.42	14	8	80.05	51.54	74.33	50	0.29	0.61	4.21	1.19
b.2	80.77	10	14	10	231.19	104.34	213.41	100	0.85	0.99	3.31	1.49
b.3	83.07	6.14	8	7	87.27	62.76	81.04	70	0.21	0.43	4.58	0.51

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be 84.82 for all participants.

2. Introduction

The purpose of this document is to report on summative testing performed by MDLand International Corporation to evaluate the usability of its iClinic, electronic health record (EHR) software within the intended use of the product for specified workflows. The usability testing attempted to represent realistic exercises and conditions. To evaluate and provide evidence of the usability of this system, the effectiveness, efficiency and user satisfaction were measured by collecting success rates, error and deviation rates, time on task and user satisfaction ratings as reported in this document. The areas of improvement provide detailed information about the test results and recommendations for resolving problems. All testing artifacts used to perform the usability evaluations are included in the appendices.

3. Method

3.1 Participants

Recruited participants had a mix of backgrounds and demographic characteristics conforming to the solution and role tested. The following is a table of participants by characteristics, including demographics, professional experience, and computing experience. Participant names were replaced with User IDs so that an individual's data cannot be tied back to the individual identities.

A total of 14 participants were tested on iClinic software over the course of four weeks, from 8/10/18 to 9/7/18. Participants in the test were clinical staff representing physician and nursing roles, medical assistant or office manager. Participants had no direct connection to the development of our organization producing the EHRUT(s). Participants were not from the testing or supplier organization.

See Table 1 for the detailed participant information.

Part ID	Gender	Age	Education	Occupation/Role	Professional Experience (months)	Computer Experience (months)	Product Experience (months)	Computer Proficiency	Assistive Technology
A01	Male	50-59	Doctorate Degree (e.g. MD, DNP, DMD, PhD)	MD	363	363	87	5	No
A02	Female	20-29	Bachelor's Degree	Medical Assistant	96	120	58	5	No
A03	Female	20-29	Bachelor's Degree	Front Desk	8	120	8	5	No
A04	Female	20-29	Some college credit, no degree	Front Desk	12	12	12	4	No
B01	Female	50-59	Bachelor's Degree	Phlebotomist	132	168	3	4	No
B02	Male	40-49	Doctorate Degree (e.g. MD, DNP, DMD, PhD)	MD	264	432	12	5	No
C01	Female	50-59	Master's Degree	Office Manager	228	180	168	5	No
C02	Male	50-59	Doctorate Degree (e.g. MD, DNP, DMD, PhD)	MD	360	360	168	5	No
C03	Female	30-39	Bachelor's Degree	Medical Assistant	120	180	72	4	No
C04	Female	20-29	High school graduate, diploma or equivalent (GED)	Medical Assistant	0	120	60	4	No
D01	Female	50-59	Doctorate Degree (e.g. MD, DNP, DMD, PhD)	MD	300	120	120	3	No
D02	Male	40-49	Master's Degree	Office Manager	156	240	156	5	No
D03	Female	40-49	High school graduate, diploma or equivalent (GED)	Medical Assistant	240	72	120	3	No
D04	Female	40-49	Some college credit, no degree	Medical Assistant	228	180	120	3	No

3.2 Study Design

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

During the usability test, participants interacted with 1 EHR. Each participant used the system in the participant-defined location, and was provided with the same instructions. The system was evaluated for effectiveness, efficiency and satisfaction as defined by measures collected and analyzed for each participant:

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

The results of this test will be used to provide MDLand International Corporation product management staff with data to drive future requirements.

3.3 Tasks

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users and were designed to be realistic and representatives of the kinds of activities a user might do with the EHR in an acute care setting. Tasks were constructed in light of the study objectives.

The tasks themselves were written to cover both the safety-enhanced design workflows required for system certification by the Office of the National Coordinator for Health Information Technology. A number of 12 tasks were constructed in this usability test, including:

- Medication
- Drug-drug and Drug-allergy Interaction
- e-Prescription
- Medication list
- Medication allergy list
- Problem list
- Lab Order
- Imaging Order
- Implantable Device List
- Patient's Demographics

- Clinical Decision Support
- 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.

The following information is captured from each participant’s recording.

Task #	Task Name	Task Description	Task Optimal Path
1	CPOE-Medications	7 steps: Record medication via CPOE, Change medication via CPOE, and Display changed CPOE medication order.	Patient Home→Search/Select test patient # → go to medical history tab → click active medication list → add new medication order for Ampicillin → change prescription’s day supply→ save
2	CPOE-Laboratory	8 steps: Record Lab order via CPOE, Change Lab order via CPOE, Display changed CPOE Lab order.	Patient Home→ Search/Select test patient # → go to medical history tab→ click on lab/imaging/letter order history→ click on new lab order → enter lab order → add a note for this lab order → save
3	CPOE-Imaging Order	8 steps: Record Imaging order via CPOE, Change Imaging order via CPOE, and Display changed CPOE Imaging order.	Patient Home→ Search/Select test patient # → go to medical history tab→ click on lab/imaging/letter order history→ click on new imaging order → enter imaging order → change office location for this order → save
4	Drug-drug, Drug-allergy Interaction	8 steps: Preconfigured by Administrator: using CPOE, trigger a drug-drug interaction by entering a new medication order, using CPOE, trigger a drug-allergy interaction by entering a new medication order. Adjust the severity level of a displayed drug-drug interaction.	Patient Home→ Search/Select patient # → go to medical history tab → click on active medication list → view triggered drug allergy and drug interaction → click check interaction → change severity level in drug interaction → save
5	Demographics	7 steps: Record a patient’s preferred language, date of birth, birth sex, race, ethnicity, sexual orientation, gender identity. Change the	Login Screen→ Patient Home→Search/Select test patient #--> Edit patient demographics→ enter set orientation→ change preferred language→ save

		patient's preferred language, date of birth, birth sex, race, ethnicity, sexual orientation, gender identity. Display the patient's changed preferred language, date of birth, birth sex, race, ethnicity, sexual orientation, gender identity.	
6	Problem List	9 steps: Record a problem to the problem list. Change a problem on the problem list. Display the active problem list. Display the historical problem list.	Patient Home → Search/Select test patient # → click on medical history tab → problem list → add new problem from ICD list, hypertension → save → change existing problem on problem list to resolved → save → change problem list status to display all
7	Medication List	8 steps: Record a medication to the medication list. Change a medication on the medication list. Display the active medication list. Display the historical medication list.	Patient Home → Search/Select test patient # → click on medical history tab → active medication list → click new and add new medication, Claritin → Change medication frequency to every 12 hours → save → select to display active and historical medical list (all)
8	Medication Allergy List	8 steps: Record a medication allergy. Change a medication allergy. Display the active medication allergy list. Display the historical medication allergy list.	Patient Home → Search/Select test patient # → click on medical history tab → allergy, click edit → add new allergy, 'Blue Dyes' from list → Save → Change the allergy record date → select to display active and historical medication allergy list (all)
9	Clinical Decision Support	15 steps: Preconfigured by Administrator. Enter the vital signs, demographic, ICD code and result. See the alerts based from the CDS rules setup.	Health Registry → New Decision Support → Save → Add Operator → Enter ICD code for hypertension → Save → Add Operator → Enter demographic (both gender, age 18-80) → Save → Add Operator → Enter Vital Sign (BP(sys) 130-160; BP(dia) 85-100) → Save → Add Operator → Enter Lab Result (LOINC code and value) → Save → Save Action → Click on Health Registry → Select Registry type as decision support to view CDS alert

10	Implantable Device List	8 steps: Preconfigured Implantable Device Identifier by Administrator. Record UDI. Change UDI Status. Access UDI, device description, identifiers, and attributes.	Patient Home → Search/Select test patient # → medical history → implantable device tab, edit → click into displayed device → click find device from GUDID → change UDI status → save
11	Clinical Information, Reconciliation and Incorporation	10 steps: Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record. Generate a new CCDA with reconciled data.	Inbox/Outbox → Adjust date to 90 dates → find a Transition of Care (CCDA Attachment), match with current test patient # → Go to Patient Home → Search/Select test patient # → Select One Office Visit → Click into Reconciliation Panel → Set all items status to be reconciled → Select and conduct the reconciliation of the medications, medication allergies, and problems in the CCDA you want → Save status
12	Electronic prescribing	7 steps: Create new prescription. Change prescription (dosage or duration). Cancel prescription. Refill prescription. Receive fill status notification. Request and receive medication history information.	Patient Home → Search/Select test patient # → Medical History Tab → Active Medication List → Select Medication from list to refill/renew → Scroll down and click into retrieve medication history → Click Retrieve Now → Save

3.4 Procedures

Each participant was assigned a user id to identify results while detaching the identity of the individual from the responses and observations. Each participant reviewed and signed an informed consent and release form (See Appendix 3). A representative from the test team witnessed the participant's signature.

An 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, which were recorded into a spreadsheet.

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. Each session was recorded, and the administrator took notes on the participant's interaction with the system. During the session, the test questionnaire was administered, and participants' demographic information, task success rate, time on task, deviations, and errors were recorded into an excel form. Upon completing all the tasks, the administrator gave the participant the post-test questionnaire (e.g., the System Usability Scale). Participants were thanked for their time.

3.5 Test Location and Environment

The test facility varied by participant, since the testing was conducted in our user's office. The iClinic application would be typically be used in a healthcare office or facility. Thus, in this instance, the testing was conducted in doctor offices. The doctor offices were already currently running the application with the computer and browser set at default 100%. The participants used a mouse and keyboard when interacting with the EHR. iClinic used a monitor with a graphics adapter capable of 1440 x 900. The chrome browser settings were set at the default 100%

A computer and a computer mouse were used by the participant. While an iPhone timer for the administrator to record and a notebook was used to log the recorded information. Only the participant(s), data logger and test administrator were in the room.

3.6 Test Forms and Tools

During the usability test, various documents and instruments were used, including a administrator's guide and a participant's guide. Documents also consisted of a User Sheet/Demographics Questionnaire (See Appendix 1), Informed Consent (Appendix 2), Task Sheet (Appendix 3) and Post-test Questionnaire (Appendix 4). The participant's interaction with the iClinic application was monitored by our data logger. A cell phone was used to time tasks, and collect data from the subjective survey. The data collected was later transcribed to an Excel spreadsheet for analysis and reporting.

3.7 Participant Instructions

The administrator reads the following instructions aloud to each participant:

Thank you for participating in this study. Your input is very important. During the time of the study, 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 given the task sheet (Appendix 3), to which contained the task name and summary and an optional post task questionnaire.

3.8 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 and analyzed for each participant.

The goals of the test were to assess:

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

Data Scoring

The quantitative information collected consisted of measurable results that we analyzed to determine how the test participants performed compared to established benchmarks. Some of the quantitative information we collected included time spent on task, the percentage of test participants succeeding or failing at tasks, and so on. The follow table below details how tasks were scored, errors evaluated, and the time data analyzed.

Measures	Rationale and Scoring
Effectiveness: Task Success	<p>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.</p> <p>The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage.</p> <p>Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency.</p>
Effectiveness: Task Failures:	If the participant abandoned the task, did not reach the correct answer or performed it

	<p>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.</p> <p>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.</p> <p>On a qualitative level, an enumeration of errors and error types should be collected.</p>
<p>Effectiveness: Task Deviations</p>	<p>The participant’s path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control.</p> <p>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 (e.g., procedural steps) should be recorded when constructing tasks.</p>
<p>Effectiveness: Task Time</p>	<p>Each task was timed from when the administrator said “Begin” until the participant said, “Done.” If he or she failed to say “Done,” the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation and standard error) were also calculated.</p>
<p>Effectiveness: Task Rating</p>	<p>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.</p>

Satisfaction: System Usability Scale (SUS)	Participant’s subjective impression of the ease of the application was measured by administering a standardized questionnaire post all tasks were administered
Satisfaction: Task Rating	At the end of each task, the participant was presented with the Single Ease of Use survey question. Using a Likert scale (with 1 as very difficult and 5 as very easy), they were asked to rate the difficulty of the task.

Some of the information collected was qualitative, consisting of subjective impressions and opinions about the solution. Some of the qualitative data collected included: facial expressions, verbal comments when participants “thought out loud”, spontaneous verbal expressions (comments), and miscellaneous activities performed by the participant during the test session. While much of the qualitative commentary was collected during testing, qualitative feedback was also gathered in the questionnaires and post-test interviews.

4. Results

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

The usability testing results for iClinic are detailed in the table below. The results should be seen in the 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.

4.1 170.315 (a) (1) Computerized Physician Order Entry –Medications

4.1.1 Data Analysis and Reporting

Participant\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
	#	Mean (SD)%	Deviation (Observed/Optimal)	Mean (S/D) seconds	Deviations (Observed/Optimal) seconds	Mean (SD)	Mean (S/D)
1.(a)(1) CPOE Medications	14	99.86 (0.53)	7/7	86.37 (47.66)	74.03/38	0.07(0.27)	4.79 (0.43)

4.1.2 Discussion of Findings

Participants in this test were assigned to record medication via CPOE, change medication via CPOE, and display changed CPOE medication order. No critical use errors were identified and observed and no risk prone errors were encountered or observed.

Efficiency

MDLand’s (iClinic) provides configuration options for the end-user personally and for the facility generally. However, participants in this scenario were instructed to find and add the medication, Ampicillin. Participating physicians did not encounter any difficulties in finding, ordering or revising the patient’s medication and had performed the task using the optimal method through the provider workflow component. Whereas, front desk participants worked a bit slower while learning how medication orders were organized in the testing environment.

Effectiveness

The task success of the participants was over 90% as users were familiar with the overall task in the program. All participants, as observed from the timing, were able to perform the tasks within the optimal number of steps and time.

Satisfaction

Average success score of the participants was 4.79 on average based on 5 point Likert-type scale. Most of the participants completed task successfully without difficulty or deviation.

Major Findings

Performance of the participants in this task is above 90% rate. The assigned task was completed quickly as each participant was able to successfully navigate the tasks and complete the designed workflow. The task was designed to mimic the common medication ordering process. Verbal comments in this task were positive.

Areas for Improvement

- Consider adding a refill quantity, 30, 60 days, etc. when selecting to refill a medication.
- As a physician had noted, consider adding an area for the date of when the medication was prescribed by the physician onto the medication list, other than the two dates, start and end date

4.2 170.315 (a) (2) Computerized Physician Order Entry –Laboratory

4.2.1 Data Analysis and Reporting

Participant\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
	#	Mean (SD)%	Deviation (Observed/Optimal)	Mean (S/D) seconds	Deviations (Observed/Optimal) seconds	Mean (SD)	Mean (S/D)
1.(a)(2) CPOE Laboratory	14	98.93 (4.01)	9/8	61.02 (62.09)	56.66/20	0(0)	4.71 (0.47)

4.2.2 Discussion of Findings

Participants were asked to record lab order via CPOE, change lab order via CPOE, and display changed CPOE lab order.

Efficiency

Participants in this task scenario performed tasks within optimal path and time, no critical use errors were identified and observed, no risk prone errors were noted.

Effectiveness

Participants were successful over 90 % (average) of the time when completing the task for ordering and modifying lab order. All participants, as observed from the timing, were able to perform the tasks within the optimal number of steps and time, only one participant completed first step with the assistance of moderator, but completed remaining steps without any assistance.

Satisfaction

Average success score of the participants was 4.71 on average based on 5 point Likert-type scale. Most of the participants completed task successfully without difficulty or deviation.

Major Findings

Performance of the participants in this task is above 90% rate. The assigned task was completed quickly as each participant was able to successfully navigate the tasks and complete the designed workflow. The task was designed to mimic the lab ordering process. Verbal comments in this task were positive.

Areas for Improvement

- Consider giving confirmation pop up alert once the lab order is placed

4.3 170.315 (a) (3) Computerized Physician Order Entry –Imaging Order

4.3.1 Data Analysis and Reporting

Participant\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
	#	Mean (SD)%	Deviation (Observed/Optimal)	Mean (S/D) seconds	Deviations (Observed/Optimal) seconds	Mean (SD)	Mean (S/D)
1.(a)(3) CPOE Imaging Order	14	98.64(2.68)	8/8	41.29 (22.79)	38.34/10	0(0)	4.79 (0.43)

4.3.2 Discussion of Findings

Participants were asked to record imaging order via CPOE, change imaging order via CPOE, and display changed CPOE imaging order.

Efficiency

Task times were consistently within range of the optimal time. Path deviation from the optimal path was also within range. Participants in this task scenario performed tasks within optimal path and time, no critical use errors were identified and observed, and no risk prone errors were noted.

Effectiveness

Participants were successful over 90 % (average) of the time when completing the task for ordering and modifying an image order. All participants, as observed from the timing, were able to perform the tasks within the optimal number of steps and time.

Satisfaction

Average satisfaction score of the participants was 4.79 on average based on 5 point Likert-type scale. Participants completed the task successfully without difficulty or any deviation.

Major Findings

Performance of the participants in this task is above 90% rate. Participants noticed the ease of sending imaging orders and through such quick step process. The assigned task was completed quickly as each participant was able to successfully navigate the tasks and complete the designed workflow. The task was designed to mimic the image ordering process. There were no errors made during this task by the participants.

Areas for Improvement

- Consider allowing moving future orders from the treatment screen to today’s visits

4.4 170.315 (a) (4) Drug-Drug, Drug-Allergy Interaction

4.4.1 Data Analysis and Reporting

Participant\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
	#	Mean (SD)%	Deviation (Observed/Optimal)	Mean (S/D) seconds	Deviations (Observed/Optimal) seconds	Mean (SD)	Mean (S/D)
1.(a)(4) Drug-Drug, Drug-Allergy Interaction	13	96 (6.87)	10/8	55.42 (39.23)	51.16/0	0.15 (0.55)	4.85 (0.38)

4.4.2 Discussion of Findings

Participants were assigned a reconciliation task in which they ordered medications or revised existing medication orders. In this task, one or more of the orders generated an alert for drug to drug interaction. In which, participants were then asked to adjust the severity level of a displayed drug-drug interaction.

Efficiency

Task times were consistently within range of the optimal time. Path deviation from the optimal path was also within range. Participants in this task scenario performed tasks within optimal path and time, no critical use errors were identified and observed, no risk prone errors were noted, and no additional opportunity is observed for improving efficiency.

Effectiveness

Participants were successful over 90 % (average) of the time when completing the task for ordering and modifying an image order. All participants, as observed from the timing, were able to perform the tasks within the optimal number of steps and time.

Satisfaction

Average satisfaction score of the participants was 4.85 on average based on 5 point Likert-type scale. Participants completed the task successfully without difficulty or any deviation.

Major Findings

Performance of the participants in this task is above 90% rate. Participants found the drug to drug and drug to allergy interactions with the alerts that popped up to be useful, with few clicks required. Participants did take time to look over the drug to drug and drug to allergy interaction section of the active medication list when the alert pop up appeared as the information was concise. A minor error was observed from one participant within the study, who had first continued through the alert without reviewing the content, but then returned back to review but, had clicked out of the active medication list screen in the patient’s medical history when seeing the alert, to locate the drug-drug, drug-allergy information in the allergy screen in the patient’s medical history. Such was viable, but had not been the optimal path.

Areas for Improvement

- Consider having an alert hierarchy, noting severity level in the alert pop up, to reduce case of ignoring an alert and in which case, the drug-drug, drug-allergy interaction that poses high risk and potential patient harm are an interruptive alert, and require a response by the participant and less serious alerts are presented in a non interruptive manner, as a passive notice. If necessary, a non-critical alert may eventually produce an interruption if action is required but not addressed.

4.5 170.315 (a) (5) Demographics

4.5.1 Data Analysis and Reporting

Participant\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
	#	Mean (SD)%	Deviation (Observed/Optimal)	Mean (S/D) seconds	Deviations (Observed/Optimal) seconds	Mean (SD)	Mean (S/D)

1.(a)(5) Demographics	13	98.85 (3.0)	7/7	44.18 (26.42)	40.78/0	0 (0)	4.92 (0.28)
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4.5.2 Discussion of Findings

Recording, changing and accessing patient demographics task times fell within the optimal task times with no errors. The workflow involved updating the patient’s preferred language and inputting the patient’s sex orientation.

Efficiency

Task times were consistently within range of the optimal time. Participants in this task scenario performed tasks within optimal path and time, no critical use errors were identified and observed, and no additional opportunity is observed for improving efficiency. While the task time varied, participants could complete the task succeeding more quickly once they learnt where the new fields for sexual orientation and gender identity were located on the page. No risk prone errors were observed.

Effectiveness

Participants were successful over 90 % (average) of the time when completing the task for ordering and modifying an image order. All participants, as observed from the timing, were able to perform the tasks within the optimal number of steps (7/7) and time.

Satisfaction

Average satisfaction score of the participants was 4.92 on average based on 5 point Likert-type scale. Participants completed the task successfully without much difficulty and no deviation. Feedback on this new field was that it could be controversial from the patients’ perspective.

Major Findings

Performance of the participants in this task is above 90% rate and no errors were made. All participants, as observed from the timing, were able to perform the tasks within the optimal number of steps (7/7) and time.

Areas for Improvement

- None noted in this area of testing

4.6 170.315 (a) (6) Problem List

4.6.1 Data Analysis and Reporting

Participant\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
	#	Mean (SD)%	Deviation (Observed/Optimal)	Mean (S/D) seconds	Deviations (Observed/Optimal) seconds	Mean (SD)	Mean (S/D)

1.(a)(6) Problem List	14	94.64 (8.15)	11/9	66.15 (44.36)	61.42/45	0.14(0.36)	4.71 (0.47)
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4.6.2 Discussion of Findings

Participants were asked to add a problem to the problem list, and to change and update an existing problem from the problem list, displaying both active and historical problem list together at the end.

Efficiency

The average task time was 66.15, which is shy of optimal time. Participants in this task scenario were able to complete the task and click path deviation was very comparable to the optimal path, only 2 clicks shy of the optimal path. The time on task deviation was for searching where to add the problem, we had had participants add the problem, hypertension from the ICD List. Path deviation occurred in this area, when the participant did not choose to select the problem from the ICD List, but rather to add the problem as new on their own. Minimal use errors were identified and observed but ultimately no risk prone errors were noted.

Effectiveness

Participants were successful over with an average of 94.64 % task success rate when completing the task for adding a problem to the problem list. Updating the problem list and displaying the active and historical problem list was noted by participants as a simple task. On average, all participants were able to complete the task and click path deviation was very comparable to the optimal path, only 2 clicks shy of the optimal path. The error mean was minimal, 0.14 and no task failures were noted.

Satisfaction

Average satisfaction score of the participants was 4.71 on average based on 5 point Likert-type scale. Participants completed the task successfully without much difficulty and with little deviation. Participants agreed that this task was easy to complete, and that the path was clear and concise, no major directions had to be given to complete task. When choosing the problem to add to the problem list, the status and resolve date, etc. appeared in the same box prior to saving the problem.

Major Findings

Performance of the participants in this task is above 90% rate.

Areas for Improvement

- None noted in this area of testing

4.7 170.315 (a) (7) Medication List

4.7.1 Data Analysis and Reporting

Participant\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
	#	Mean (SD)%	Deviation (Observed/	Mean (S/D) seconds	Deviations (Observed/Optimal)	Mean (SD)	Mean (S/D)

			Optimal)		seconds		
1. (a)(7) Medication List	14	95.71 (9.38)	9/8	82 (47.19)	76.15/40	0.21 (0.58)	4.79 (0.43)

4.7.2 Discussion of Findings

Participants were asked to add a new medication, and then make changes to the data in the list, and display the active medication list and historical medication list in the last step.

Efficiency

The click path deviation was very close to optimal for the task under the Medication List task, (9/8), shy by just one click. Such minor deviation and the difference in task time between observed and optimal came from participant, B02 attempting to change the frequency within the same window to when they added the new Medication, Claritin. However, to change the frequency, this was accessed upon saving the new medication, and through clicking into that added medication from the Active Medication List, and to change it in the Drug Detail Box that opened up, where there was an area to change Frequency. And where participant, D02 for when inputting the frequency, had manually text input and typed out every 12 hours instead of making the selection of every 12 hours that was available through the select box. Task time variation occurred in this area, but participants were able to complete the task succeeding more quickly once they learnt of the selection box and where to access frequency change. Minimal use errors were identified and observed but ultimately no risk prone errors were noted.

Effectiveness

The task completion rate for medication list task was high and performed successfully with a success rate of 95.71% in adding the new medication, Claritin, and changing the medication order, for the frequency to be every 12 hours, as well as in displaying the active and historical medication list. No major errors were identified or observed as part of the Medication List task, as the mean error was minimal, 0.21 with a standard deviation of 0.58. The error rate averaged 21%.

Satisfaction

Average task rating score of the participants was 4.79 based on 5 point Likert-type scale. Participants completed the task successfully without much difficulty and with little to no deviation, with the task success mean of 95.71%.

Major Findings

Performance of the participants in this task was above 95% rate.

Areas for Improvement

- Consider having the frequency box with the drop down selection available in the Rx Editor box when adding the new medication

4.8 170.315 (a) (8) Medication Allergy List

4.8.1 Data Analysis and Reporting

Participant\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
	#	Mean (SD)%	Deviation (Observed/Optimal)	Mean (S/D) seconds	Deviations (Observed/Optimal) seconds	Mean (SD)	Mean (S/D)
1. (a)(8) Medication Allergy List	14	96.07 (5.62)	9/8	67.8 (31.51)	62.96/60	0.07 (0.27)	4.79 (0.58)

4.8.2 Discussion of Findings

Participants were asked to add a new allergy, “Blue Dyes” from “Add from List”, and then to make the change in the allergy’s record date, as well as to display the active allergy list and historical allergy list in the last step.

Efficiency

The click path deviation was very close to optimal for the task under Medication Allergy, (9/8), shy by just one click. Such minor deviation and the difference in task time between observed and optimal came from participant, D02 typing in the allergy in the field as free text, but had spelled the allergy incorrectly. This also resulted in a slightly longer task time when taken into comparison with the other participants. However, the participant could have also chose the problem from the options list offered when adding the allergy from list. The task time was extremely close to the optimal time (62.96/60). No critical use errors were identified and observed, and no risk prone errors were noted.

Effectiveness

The task completion rate for medication list task was high and performed successfully with a success rate of 96.07% in adding the new allergy, Blue Dyes, and updating the allergy record date, as well as in displaying the active and historical allergy list. No major errors were identified or observed as part of the Medication Allergy List task, as the mean error was only 0.07, 7% with a standard deviation of 0.27.

Satisfaction

Average task rating score of the participants was 4.79 based on 5 point Likert-type scale. Participants completed the task successfully without difficulty and almost no deviation, other than that shown by participant D02. The task success mean was 96.07 % with only 5.62 % deviation.

Major Findings

The task proved effective, users did not struggle in locating medication allergy, and inputting the allergy to the active medication allergy list, the task rating was fairly high, as well as the task success rate, 4.79 and 96.07% respectively. The task time fell close to the optimal, and was shy by 2.96 seconds.

Areas for Improvement

- None were identified in this area of task

4.9 170.315 (a) (9) Clinical Decision Support

4.9.1 Data Analysis and Reporting

Participant\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
	#	Mean (SD)%	Deviation (Observed/Optimal)	Mean (S/D) seconds	Deviations (Observed/Optimal) seconds	Mean (SD)	Mean (S/D)
1.(a)(9) Clinical Decision Support	14	83.29 (12.03)	32/15	269.76 (173.35)	250.49/120	0.79 (0.8)	3.93 (1.14)

4.9.2 Discussion of Findings

Participants were asked to go into Health Registry and create a new decision support guideline, to add a CDS intervention with the following elements: problem list (hypertension), at least one demographic (both gender, age 18-80), lab result (LOINC code 4487-5), vital signs (add BP(sys) 130-160); BP(dia) 85-100), and then to trigger the CDS intervention using the applicable data elements.

Efficiency

The task completion rate for the task when taken in comparison with the previous task modules is relatively lower but still high, at 83.29%. However, for click rates, we can see that the optimal path had been 15 clicks, where as the observed is seen to be two times that of the optimal path, 32/15. Task times were also not within the range of the optimal, as the task time was seen also to be double that of the optimal (250.39/120). Future usability testing for this task should have a greater emphasis in making sure the users understand the task and spend more time explaining the where the CDS rules are created. Use errors were identified and observed but ultimately no risk prone errors were noted.

Effectiveness

Clinical decision support proved to be the more difficult test of all test tasks. While the CDS task was completed successfully, with a task success rate of 83.29 %. Participants communicated after this task that they were unfamiliar with where to create the CDS rule in the EHR. This explained why users had task time ratio and path that was longer and higher, as participants took the time to find the area to invoke the CDS rule, and in inputting the elements. The task was proven to be effective. Though error rate was high, 0.79, the task was proven to be effective as the success rate, with the participant being able to achieve the correct outcome.

Satisfaction

Participants gave this task a relatively low rating, of 3.93 on average based on the 5 point Likert-type scale. Participants were not used to creating CDS rules and navigating to the Health Registry to create the elements of the CDS intervention. This resulted in longer task times.

Major Findings

The numbers highlight the need to improve training on this task in the future as participants had completed the task successfully but with difficulty and deviation. Some users were initially uncertain

how to complete the CDS intervention and some users expressed concern that the CDS order was not performed correctly as there was not a confirmation on saving the added operators, but only a save action button.

Areas for Improvement

- For accessing the CDS link, some users had difficulty as it was located in Health Registry to add a new CDS action and when participants inputted the operators, participant was hesitant if it was saved as there was no save order button. Consider save order button as well. As some users had thought it saved, but had closed out of the order, and found the order was not added.

4.10 170.315 (a) (14) Implantable Device List

4.10.1 Data Analysis and Reporting

Participant\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
	#	Mean (SD)%	Deviation (Observed/Optimal)	Mean (S/D) seconds	Deviations (Observed/Optimal) seconds	Mean (SD)	Mean (S/D)
1. (a)(14) Implantable Device List	14	92.86 (6.42)	14/8	80.05 (51.54)	74.33/50	0.29 (0.61)	4.21 (1.19)

4.10.2 Discussion of Findings

MDLand’s iClinic 12.3 capability to capture Unique Device Identifiers (UDI) for Implanted Devices is new with this software release; therefore, no participant was familiar with the capability. The task details had entailed for recording of the UDI, changing the UDI status, and accessing the UDI, device description, identifiers, and attributes. Further, clinical processes will most likely capture this information by nurse or interventional staff using their systems and flows. Therefore, due to the point and type of workflow that would generally be expected for this information participants performed a review and update task.

The implantable device task scored well on success rate, with a 92.86 %. Click path deviated from optimal by 6 clicks, but time on task deviation was somewhat close to optimal. The task rating was 4.21 on the Likert scale system where 5 represent the task being very easy.

Efficiency

The click path deviation was very close to optimal for the task under Implantable Device List, (14/8). There was only one participant, B02 who had deviated away from the optimal path. Such was due to the participant having clicked into surgical history to look for the inputting the Implantable Device, to note that Implantable Device was its own section of the patient’s medical history. This also resulted in a slightly longer task time when taken into comparison with the other participants. The average task time was close to the optimal time (74.33/50). Minimal use errors were identified and observed but no risk prone errors were noted.

Effectiveness

The task completion rate for implantable device list task was high and performed successfully with a success rate of 92.86%. Minor errors were demonstrated by participants, B02, C01 and D01. Error occurred in transferring over the UDI code into the screen for look up through GUDID, or otherwise mentioned for B02, having attempted to look for implantable device input in the surgical history of the patient’s medical history.

Satisfaction

Average task rating score of the participants was 4.21 based on 5 point Likert-type scale. Participants completed the task successfully without difficulty and almost no deviation, other than that shown by participant B02. The task success mean was 92.86 % with only 6.42 % deviation.

Major Findings

Participants had a difficult time entering the UDI information without a barcode scanner, as if there was minor error; the UDI would be unsearchable through the Global Unique Device Identification Database. However, task success was 92.86 %, which is still relatively high in comparison to the other task. The observed task time of 80.05 was very close to the optimal time.

Areas for Improvement

- Consider adding a barcode scanner to scan the UDI and for it to automatically transfer the device code onto the implant screen
- Consider adding the implant option ability from the surgical history section of the patient’s medical history screen

4.11 170.315 (b) (2) Clinical Information Reconciliation and Incorporation

4.11.1 Data Analysis and Reporting

Participant\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
				Mean (S/D) seconds	Deviations (Observed/Optimal) seconds		
1. (b)(2) Clinical Information Reconciliation & Incorporation	13	80.77 (10)	14/10	231.19 (104.34)	213.41/100	0.85 (0.99)	3.31 (1.49)

4.11.2 Discussion of Findings

MDLand’s iClinic 12.3 provide reconciliation capabilities for the following clinical information from external C-CDA sources: Allergies Reconciliation, Medications Reconciliation, Problems Reconciliation and Reason of Referral Reconciliation. Participants were asked to go into health registry, to create a new decision support guideline, to then go into inbox, and find a transition of care, to match it with the appropriate patient, and then precede with going into medical history/reconciliation panel of the

patient to select one office visit to conduct reconciliation of the medications, medication allergies and problems in the CCDA with the information that was already available in the patient's record.

Efficiency

Task time to complete this task was high, whether taken into comparison with other tasks, or taking the observed and comparing it with the optimal task time deviation, 213.41/100. The observed time was twice that of the optimal. While the number of path deviation and error was higher than other task criteria, we felt this was normal based on the complexity of the task. Accessing and verifying the reconciliation file and information that came in and were transferred over into the patient's medical chart comprised the task time. Based on feedback, participants were unsure of what they were tasked to do for the test. There were minor deviations by more than half of our participants. Minimal use errors were identified and observed but no risk prone errors were noted.

Effectiveness

The task was completed successfully with an overall task success rate of 80.77%. Participants scored slightly higher than then optimal path ratio. Participants had a more difficult time understanding how to perform the action to reconcile the information into the patient's chart. Task time for the task case came in at 231.19 seconds. Additional training and explanation overview of the module should help improve this. There were minor errors observed, only one participant, A03 demonstrated error three times, the average error rate was .85, with a standard deviation of .99. Errors mainly came from the participants not being able to understand objective, and having had trouble in locating the reconciliation panel or not having reconciled what had been directed.

Satisfaction

Average task rating score of the participants was 3.31 based on 5 point Likert-type scale. Participants completed the task successfully without difficulty and almost no deviation. The task success mean was 80.77 % with 10 % deviation. Participants had described the task as being very difficult upon finish and noted that they'd need help even if they were to do it again.

Major Findings

Clinical information Reconciliation path was short of optimal by four clicks. Such was due to some participants having trouble navigate through the windows provided the steps of jumping from screen to screen, and to find the external transitions of care to match with patient. Whereas some participants had difficulty in understanding the objective of reconciling the transitions of care with the patient's chart. Additional time was taken after this particular task to explain the purpose.

Areas for Improvement

- Consider enhancing the visual appearance/design of the screen displaying the medication, allergies, etc. to be reconciled, for the one to whom the participant is focused on or wants to reconcile to stand out more from the other options. Providing clearer indication as to which line item pertains to which venue and to what can be reconciled

- Consider optimizing external reconciliation steps by providing the ability to reconcile or merge multiple external record items in a batch add or decline process
- Consider displaying option to display what was reconciled, apart from current visit
- Consider reducing the number of clicks needed to complete the reconciliation process
- Consider embedding tutorials for first time users

4.12 170.315 (b) (3) E-prescribing

4.12.1 Data Analysis and Reporting

Participant\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
	#	Mean (SD)%	Deviation (Observed/Optimal)	Mean (S/D) seconds	Deviations (Observed/Optimal) seconds	Mean (SD)	Mean (S/D)
1. (b)(3) E-prescribing	14	83.07 (6.14)	8/7	87.27 (62.76)	81.04/70	0.21 (0.43)	4.58 (0.51)

4.12.2 Discussion of Findings

Participants were asked to prepare the patient’s home medication, selecting the prescription from medication list, and in refilling the prescription, to then request and receive medication history information of the patient. The task success rate for the e-prescribing task was relatively lower when taken into comparison with other test modules, scoring 83.07 % task success rate. The click path deviation was very closer to optimal.

Efficiency

Electronic prescribing testing proved to be efficient and effective according to the time and paths observed during testing. The observed click path was shy from the optimal path by one click, 8/7. Participants did not show to have any major deviations, and the users were able to complete and finish the task on their own. Overall task rating was 4.58 and the average task time was 87.27 seconds, and the time on task deviation rates were shy by 9 seconds, be 81.04/70. As out of the 14 participants, 2 had minor deviation from the optimal path, but were successful with minor deviation. No critical use errors were identified and observed but ultimately no risk prone errors were noted.

Effectiveness

The task success rate was high and performed successfully with a rate of 83.07%. Three participants out of the total 14 participants had 1 minor error that had been observed and recorded, A04, B01 and D02. This was in part due to participants having trouble looking for the request to receive medication history information.

Satisfaction

Average task rating score of the participants was 4.58 based on 5 point Likert-type scale. Participants completed the task successfully without difficulty and almost no deviation. The task success mean was 83.07% with only 6.14 % deviation.

Major Findings

The observed path deviation was within a step from the optimal path deviation (8/7). Some participants expressed desire to send a message to the patient directly, per say when medication was refilled, or when an eRx was sent

Areas for Improvement

- For the e-Prescription module, some participants expressed difficulty in searching for a pharmacy, expressed that though street address and zip code as search could work, would like if it can provide search one word, i.e. the street name

Summary of Measures by Task

Tasks\Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Rating 5=Easy
	#	Mean (SD)%	Deviation (Observed/Optimal)	Mean (S/D)	Deviations (Observed/Optimal)	Mean (SD)	Mean (S/D)
1. (a)(1) CPOE Medication	14	99.86 (0.53)	7/7	86.37 (47.66)	74.03/38	0.07 (0.27)	4.79 (0.43)
2. (a)(2) CPOE Lab Order	14	98.93 (4.01)	9/8	61.02 (62.09)	56.66/20	0 (0)	4.71 (0.47)
3. (a)(3) CPOE Imaging Order	14	98.64 (2.68)	8/8	41.29 (22.79)	38.34/10	0 (0)	4.79 (0.43)
4. (a)(4) Drug-Drug, Drug-Allergy Interaction	13	96 (6.87)	10/8	55.42 (39.23)	51.16/0	0.15 (0.55)	4.85 (0.38)
5. (a)(5) Demographics	13	98.85 (3)	7/7	44.18 (26.42)	40.78/0	0 (0)	4.92 (0.28)
6. (a)(6) Problem List	14	94.64 (8.15)	11/9	66.15 (44.36)	61.42/45	0.14 (0.36)	4.71 (0.47)
7. (a)(7) Medication List	14	95.71 (9.38)	9/8	82 (47.19)	76.15/40	0.21 (0.58)	4.79 (0.43)
8. (a)(8) Medication-Allergy List	14	96.07 (5.62)	9/8	67.8 (31.51)	62.96/60	0.07 (0.27)	4.79 (0.58)
9. (a)(9) Clinical Decision Support	14	83.29 (12.03)	32/15	269.76 (173.35)	250.49/120	0.79 (0.8)	3.93 (1.14)
10. (a)(14) Implantable	14	92.86 (6.42)	14/8	80.05 (51.54)	74.33/50	0.29 (0.61)	4.21 (1.19)

Device List							
11. (b)(2) Clinical Information Reconciliation and Incorporation	13	80.77 (10)	14/10	231.19 (104.34)	213.41/100	0.85 (0.99)	3.31 (1.49)
12. (b)(3) e-Prescription	14	83.07 (6.14)	8/7	87.27 (62.76)	81.04/70	0.21 (0.43)	4.58 (0.51)

Overall Satisfaction Ratings

Overall, the EHRUT performed extremely well during this usability testing. Most tasks were performed efficiently and effectively with a high level of satisfaction reported by the participants. The results from the SUS (System Usability Scale) scored 84.82 with the subjective satisfaction of the system based on performance with these tasks. The SUS score far surpasses the benchmark of 68 for above average participant satisfaction.

Participant satisfaction of the EHR was rated to be from extremely high to above acceptable ranges. Using 3.3 as a common convention for average ratings, only one task landed at the average, with a task rating of 3.31 for Clinical Information, Reconciliation and Incorporation.

System Usability Scale		
Participant Identifier	Overall Task Rating - Scale Type	Task Rating
A01	System Usability Scale	100
A02	System Usability Scale	97.5
A03	System Usability Scale	95
A04	System Usability Scale	70
B01	System Usability Scale	82.5
B02	System Usability Scale	60
C01	System Usability Scale	100
C02	System Usability Scale	100
C03	System Usability Scale	77.5
C04	System Usability Scale	100
D01	System Usability Scale	100
D02	System Usability Scale	77.5
D03	System Usability Scale	47.5
D04	System Usability Scale	80
Average:		84.8214286

5. Discussion of Findings

The findings from the usability test show that overall, iClinic 12.3 application proved to be effective and efficient with an overall high level of customer satisfaction of the EHR based on testing results and user feedback. Many tasks demonstrated high completion rates (90% or higher). It was observed that those scoring moderately well (75%-89%) were in the following tasks: Clinical Decision Support, Clinical Information Reconciliation and Incorporation, and e-prescribing.

All the participants who assisted with the testing have used the iClinic 12.2 application in some way or another. All users completed tasks successfully with very few users completing certain tasks with minor task deviations. Most tasks were performed within the anticipated testing times as well. Based on the quantitative statistics, users that tested tasks that they did not perform in their day-to-day jobs caused certain task times to be higher than those that performed these tasks daily. Some of the testing tasks were unchanged or minor changes added between 12.2 and 12.3. This led to quick task times and easy navigation when performing these tasks. Other tasks were new to iClinic 12.3 and the participants, and reflected higher task time and high standard deviation times.

For most of the tasks, the path deviation (click count) rates were relatively low, in most cases, task path deviation when compared to the optimal click path was off by 2 clicks. This included the tasks: CPOE Lab Order, Drug-Drug & Drug-Allergy Interaction, Problem List, Medication List, Medication Allergy List, and e-Prescription. Few participants drastically deviated from the optimal path. There was a small number of tasks that had considerable click path deviations, specifically, Clinical Decision Support, Implantable Device, and Clinical Information Reconciliation and Incorporation. These tasks averaged over 3 times the number of clicks when compared to the optimal path. Time on task and deviation were higher across these tasks. The error rate was relatively low, ranging from 0-20%, with the exception of Clinical Information Reconciliation and Incorporation of 85% and Clinical Decision Support with 79%.

- Users stated that they do not like changes to the EHR but understood that some changes are necessary or required to improve the system, productivity and workflow, and were okay with the changes once they had a chance to view the changes in pre-test and perform these actions during testing, but in a regular day to day setting, some tasks would be too time consuming given the providers' already busy day with patients
- The participants liked the improvements to the system and provided feedback that they felt the EHR would be easy to use. All participants felt positive about system improvements and functionality.
- Areas that tested well were:
 - CPOE (Medication, Laboratory and Diagnostic Imaging Orders)
 - Drug-drug & Drug-allergy interaction
 - Demographics Information
 - Problem Lists
 - Medication Lists
 - Medication Allergy Lists
- Users liked the system they used and claimed they would be willing to recommend the system to colleagues from the results of the post test survey

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be 84.82 for all participants.

6. Areas for Improvement

While we have always worked with specific providers and front desk users for UCD, we engaged specific users that were willing and able to participate in the testing from the provider office. We found in general that these participants also expressed that they like the EHR technology and had also provided constructive feedback. Going forward, we would like to increase the number of participants which will give us more realistic numbers should one or a few users cause the results to shift dramatically.

- **Clinical Decision Support:** users noted that the main idea of this was good, but noted that creating CDS rules took time, and took participants who had no prior experience with rule creation, an even longer time. Such led to higher task times for CDS and also explains the larger standard deviation of this test case.
- **Clinical Information Reconciliation:** Reconciling clinical information with another source, and matching it to patient, it was noted that some participants had difficulty in navigating, and recalling the steps to reconcile and incorporate clinical information. Participants noted click fatigue, and that steps were tedious. This resulted in higher times and an increased standard deviation in task times. However, once this test was conducted, when this test purpose was explained in detail and walked through slowly by an administrator, participants had a better reaction.
- **Implantable Device List:** It was noted from participants that the concept was good, though not necessarily a used area by every physician, but was noted in the case they encountered patients with an implantable device. However, it was noticed to be tedious in recording the UDI, the long barcode number, and where if inputted incorrectly or with minor error, one would not be able to find the device from the global unique device identification database (GUDID). As suggested, we should implement some sort of barcode scanner for the device identifier to automatically be recognized and transferred into this area of the implantable device detail box.
- **Process to view more information about allergy alerts** was not intuitive for one participant
- While participants in this study had utilize certain functions in iClinic 12.2 and had some sort of prior experience with iClinic, it was concluded that especially to the newly added on functions, like clinical information reconciliation, etc. that providing a training manual with screen shots and step by step instructions, instead of having the participants watch the primary administrator perform each task, would in turn improve understanding and better overall task times. Provided that Clinical information reconciliation was new to most users and test times need to improve to bring them more in line with optimal times. Consider making main action buttons in the clinical reconciliation panel more prominent and clear.
- Address information for e-prescription to be sent, if can search up address from one word, i.e. the street name.
- In care guidelines, next to each care guideline lab order, have a column for the diagnosis to be associated to it.

7. Appendices

Appendix 1: Participant Demographics

User Questionnaire

Gender:

- Female
- Male
- Unknown/Other

Age: _____

Education:

- No high school degree
- High school graduate, diploma or the equivalent (ex. GED)
- Some college credit, no degree
- Trade/technical/vocational training
- Associate degree
- Bachelor's degree
- Master's degree
- Doctorate degree (ex. MD, DNP, DMD, PhD)

Occupational/Role:

- Medical Assistant
- Physician's Assistant
- Registered Nurse (RN)
- Office Manager
- Doctor of Medicine (MD)
- Other: _____

Professional Experience: _____ Years _____ Months

Computer Experience: _____ Years _____ Months

Computer Proficiency: (*Computer proficiency is a self-reported rating of comfort with computers)

- 1 (Not Comfortable)
- 2
- 3
- 4
- 5 (Very Comfortable)

iClinic Experience: _____ Years _____ Months

Appendix 2: Informed Consent Form

Informed Consent Form

MDLand International Corporation would like to thank you for participating in this study. The purpose of this study is to evaluate our electronic health records system through the provision of your usage feedback.

Agreement

I understand and agree that as a voluntary participant in the present study conducted by *MDLand International Corporation* I am free to withdraw consent or discontinue participation at any time. I agree to immediately raise any concerns or areas of discomfort during the session with the study administrator.

I understand and consent to the use and release of information by *MDLand International Corporation*. I understand that the information is for research purposes only and that my name and image will not be used for any other purpose. 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 understand and agree that the purpose of this study is to make *iClinic* applications more useful and usable in the future. I agree to participate in the study conducted by MDLand International Corporation.

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.

Participant's printed name: _____

Signature: _____ **Date:** _____

Appendix 3: Task Sheet

3.1 Task Sheet for User

Task Sheet for User

Task Number:

Task Name:

Task Details:

Difficulty Level: (*Difficulty level is a self-reported rating of how you felt completing this task through iClinic)

- 1 (Very Difficult)
- 2
- 3
- 4
- 5 (Very Easy)

SYSTEM USABILITY SCALE QUESTIONNAIRE

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

3.2 Task Sheet for Administrator

Task Number:

Task Name:

Task Sheet for Administrator

Task Time: _____ Minutes _____ Seconds

Comments:

Optimal Path: Screen A → Screen B → Drop Down B1 → “OK” Button → Screen X...

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

Comments:

Success of Task:

- Easily completed
- Completed with difficulty or help
- Not completed

Comments

Observed Errors and Verbalizations:

Comments:

Appendix 4: Post-Test Survey (Optional)

Post-Test Survey (Optional)

What is your overall impression of this system?

What aspects of the system do you like most? What did you like least?

Were there any features 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?)

Would you recommend this system to your colleagues?

Yes

No