![eDerm Systems logo]
Dermatology EHR and Practice Management Software

EHR Usability Test Report of eDerm Systems - version 2.8.0

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

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I.   Executive Summary

Usability testing of the eDerm Systems EHR (version 2.8.0), an ambulatory EHR were conducted virtually via web-conference between 5/27/2019 and 6/18/2019 by EMR Advocate, Inc., on behalf of eDerm Systems. The purpose of this testing was to test and validate several commonly performed tasks for usability within the newly 2015 Edition revised user interface and provide evidence of usability for the EHR Under Test (EHRUT). During the usability test, 10 healthcare providers matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks.

This study collected performance data on 8 tasks, corresponding to the 2015 Edition criteria, that are going through certification and would be realistic and representative of the kinds of activities a user might perform with this EHR. The tasks were **force-ranked based on the risk** as to the potential to cause patient harm if not completed correctly, including:

Task 1: Opening a Patient's Chart and Entering and Editing Demographics Information

> *§170.315 (a)(5) Demographics - TIME TO COMPLETE 0:45 (min/sec)*

Task 2: *Entering and* Editing the Problem List

> *§170.315 (a)(6) Problem list - TIME TO COMPLETE 0:25 (min/sec)*

Task 3: Adding an Implantable Device

> *§170.315 (a)(14) Implantable device list - TIME TO COMPLETE 0:15 (min/sec)*

Task 4: Clinical Decision Support

> *§170.315 (a)(9) Clinical decision support - TIME TO COMPLETE 3:00 (min/sec)*

Task 5: Clinical Information Reconciliation

> *§170.315 (b)(2) Clinical information reconciliation and incorporation -*
> > *TIME TO COMPLETE 1:35 (min/sec)*

 Task 6: *Entering and* Editing the Medication List

> *§170.315 (a)(7) Medication List - TIME TO COMPLETE 0:25 (min/sec)*

Task 7: *Entering and* Editing the Allergy List

> *§170.315 (a)(8) Allergy List - TIME TO COMPLETE 0:20 (min/sec)*

Task 8: Ordering and Editing Labs

> *§170.315 (a)(2) CPOE – laboratory - TIME TO COMPLETE 0:15 (min/sec)*

During the one-on-one usability test, each participant was greeted by the administrator and given an overview of the test procedure. All the participants had prior experience with the EHR; all were given the opportunity to see the new features for the 2015 Edition, where they could watch a trainer complete each of the objectives that were new features within the Treasure 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

electronically. The administrator did not give the participants any additional assistance in how to complete the objectives.

The following types of data were observed/collected for each participant:

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

All participant data was de-identified – no correlation can be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants verbally answered a post-test questionnaire. Participants were compensated for their time with a $25 gift card. 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 data collected on the EHRUT.

Task ID	Task Description	Measure / N	Task Success (%) # Mean (SD)	Path Deviation Observed / Optimal	Task Time (Seconds) Mean (SD)	Observed / Optimal	Task Failure (%) Mean (SD)	Task Ratings (5 = Easy) Mean (SD)
a.5.1	Add a new patient	10	100 (0)	0/0	15.9 (2)	17 / 20	0 (0)	4.6 (0.45)
a.5.2	Update an existing patient's demographics and review the changes	10	100 (0)	0/0	27.8 (3)	28 / 30	0 (0)	4.8 (0.3)
a.6.1	Record a problem	10	100 (0)	0/0	9 (2)	8 / 10	0 (0)	4.9(0.1)
a.6.2	Change a problem	10	100 (0)	0/0	5 (1)	5 / 5	0 (0)	4.9 (0.1)
a.6.3	View active problems	10	100 (0)	0 /0	5 (2)	5 / 5	0 (0)	4.9 (0.1)
a.6.4	View completed problems	10	100 (0)	0/0	5 (1)	5 / 5	0 (0)	5 (0)
a.14.1	Record an UDI	10	100 (0)	0/0	7 (1)	8 / 8	0 (0)	4.0 (0.9)
a.14.2	Access UDI, device description, identifiers, and attributes	10	100 (0)	0/0	4 (1)	4 / 5	0 (0)	4.0 (0.6)
a.14.3	Update the status of an UDI	10	100 (0)	0/0	6 (2)	7/ 7	0 (0)	4.0 (0.23)
a.9.1	Configure CDS rules for problem list, medication list, allergy list, demographics, lab test, vital signs and a combination of demographics and vital signs	10	100 (0)	0/0	270(10)	275 / 280	0 (0)	4.0 (0.65)
b.2.1	Open and complete reconciliation for Allergy	10	100 (0)	0/0	31(2)	33(35)	0 (0)	4.1 (0.4)
b.2.2	Open and complete reconciliation for Medications	10	100 (0)	0/0	30(1)	32(35)	0 (0)	4.1 (0.4)
b.2.3	Open and complete	10	100 (0)	0/0	30(2)	31(35)	0 (0)	4.1 (0.4)

Task ID	Task Description	Measure / N #	Task Success (%) Mean (SD)	Path Deviation Observed / Optimal	Task Time (Seconds) Mean (SD)	Observed / Optimal	Task Failure (%) Mean (SD)	Task Ratings (5 = Easy) Mean (SD)
	reconciliation for Problem							
a.7.1	View current medications	10	100 (0)	0/0	5 (2)	5 / 8	0 (0)	5 (0)
a.7.2	Record a medication	10	100 (0)	0/0	15(3)	15 / 20	0 (0)	5 (0)
a.9.3	Trigger and view the Medication List CDS Intervention and its additional information (Info-button)	10	100 (0)	0/0	32 (12)	35 / 40	0 (0)	4.5 (0.45)
a.7.3	Change a medication and review the change	10	100 (0)	0/0	15 (3)	17/ 20	0 (0)	5 (0)
a.7.4	View historical medications	10	100 (0)	0/0	5(1)	5 / 5	0 (0)	5 (0)
a.8.1	Record a medication allergy	10	100 (0)	0/0	15 (1)	15 / 20	0 (0)	5 (0)
a.8.2	Change a medication allergy	10	100 (0)	0/0	10 (3)	10 / 15	0 (0)	5 (0)
a.8.3	View active allergies	10	100 (0)	0/0	5 (1)	5 / 10	0 (0)	5 (0)
a.8.4	View inactive allergies	10	100 (0)	0/0	5 (1)	5 / 10	0 (0)	5 (0)
a.9.4	Trigger and view the Allergy CDS Intervention	10	100 (0)	0/0	30 (5)	34 / 40	0 (0)	5 (0)
a.9.2	Trigger and view the Problem List CDS intervention and its additional information (Info-button)	10	100 (0)	0/0	38 (8)	39 / 46	0 (0)	4.4 (0.3)
a.9.5	Trigger and view the Demographics CDS intervention and its additional information (Info-button)	10	100 (0)	0/0	65 (4)	67 / 70	0 (0)	4.5 (0.67)
a.9.7	Trigger and view the Vital Signs CDS intervention	10	100 (0)	0/0	32 (4)	32 / 45	0 (0)	4.7 (0.45)
a.9.8	Trigger and view the CDS Intervention with combined conditions (Demographics and Vital Signs)	10	100 (0)	0/0	56 (3)	57 / 70	0 (0)	4.6 (0.7)
a.2.1	Record a lab order	10	100 (0)	0/0	5 (1)	5 / 5	0 (0)	5 (0)
a.2.2	Change lab order and review the change	10	100 (0)	0/0	10 (3)	10 / 20	0 (0)	5 (0)
a.9.6	Trigger and view the Lab Test CDS intervention and its bibliographic citation, author, funding source and release version	10	100 (0)	0/0	132 (4)	135 / 145	0 (0)	4.0 (1)

TABLE 1

The results from the System Usability Scale scored the subjective satisfaction with the system based on the performance with these objectives to be 75.

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

- **Major Findings**
    - There were no deviations from the optimal path to complete the Tasks. The efficiency of data entry should improve when the new features become a part of the normal use. All participants successfully completed the tasks and stated that the ease of use was rated at 4's to 5's out of 5, where 5 is Easy.
    - Entering in demographics was not as familiar to clinical users since the demographic information was most often pre-entered by an admin role.
    - The need for the additional demographic fields (Gender Identity and Sexual Orientation) was deemed a nice addition and can enhance patient care.
    - The likelihood of an error, and the potential to cause harm to a patient is very low due to the logical workflow and intuitive design of the tasks.
    - The most risk prone area of the system, of the tasks performed, is clinical information reconciliation. This was mainly because the system requires so many clicks and going to different parts of the EHR.   Bringing in a C-CDA was the most foreign task for all participants. It is not currently a significant part of their daily routine to chart a patient encounter. The benefits of electronic incorporation of Medications, Problems and Medication Allergies needs to be realized by the participants as they do it more often.
    - Overall the EHR software was easy to use. Many of the users were surprised to learn about Clinical Decision Support and Clinical Information Reconciliation functionalities.
    - Several participants said that they would like to see the CDS configuration function expanding to other areas of patient process including administrative areas, like insurance verification and preventative care.
    - The participants liked the auto-complete feature when typing in Medication and Medication Allergies. This feature will help to reduce the risk of entering in the wrong medication.

- Areas for Improvement
    - Having a most common used list of Medications.
    - Add a Favorites dropdown to the Problem selection based on the Super Bill list.
    - Add a Favorites dropdown to the Lab Orders based on the most commonly ordered labs.
    - Reorder the Race and Ethnicity dropdowns to have the most often selected entries at the top of the list.

II.   Introduction

The EHRUT tested for this study was eDerm Systems version 2.8.0, an ambulatory EHR. Designed to allow documentation of medical information to healthcare providers in the Dermatology scope-of-practice. The EHRUT is cloud-based and can be accessed from anywhere with an internet connection and web-browser. The usability testing replicated realistic exercises and conditions.

The purpose of this study was to test and validate the usability of the current user interface and provide evidence of usability in the EHR Under Test (EHRUT). To this end, measures of effectiveness, efficiency, and user satisfaction, such as time on objective, objective ratings, and path deviations were captured during the usability testing.

III.   Method

A.   Participants

A total of 10 participants were tested on the EHRUT. Participants in the test were comprised of a group of NP's, PA's and a MD. Participants were recruited by eDerm Systems and were compensated for their time with a $25 gift certificate. The participants had no direct connection to the development or organization producing the EHRUT. 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 ID's so that an individual's data cannot be tied back to individual identities.

	Part ID	Gender	Age	Education	Organization Role	Computer Experience	Product Experience	Assistive Technology Needs
1	User 1	F	23-39	Postgraduate	NP	Proficient	7 years	None
2	User 2	F	23-39	Postgraduate	PA	Proficient	8 years	None
3	User 3	F	40-59	Postgraduate	PA	Moderate	5 years	None
4	User 4	F	40-59	College Graduate	PA	Moderate	10 years	None
5	User 5	F	40-59	College Graduate	NP	Proficient	6 years	None
6	User 6	M	23-39	College Graduate	PA	Proficient	5 years	None
7	User 7	F	40-59	College Graduate	PA	Proficient	8 years	None
8	User 8	F	40-59	College Graduate	PA	Proficient	15 years	None
9	User 9	M	40-59	Postgraduate	MD	Moderate	17 years	None
10	User 10	M	40-59	College Graduate	PA	Moderate	3 years	None

10 participants (matching the demographics in the table above) were recruited and 10 participated in the usability test.

Participants were scheduled for 1-hour sessions and GoToMeeting calendar invites were used to keep track of the participant schedule.

B.   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 EHR's provided the same objectives are used. In short, this testing serves as both a means to record or benchmark current usability, but also to identify areas where improvements must be made.

During the usability test, participants interacted with the eDerm Systems version 3.0.0 EHR as designed for the 2015 Edition Certification. Each participant was provided the same instructions. The system was evaluated for effectiveness, efficiency, and satisfaction as defined by measures collected and analyzed for each participant:

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

Additional information about the various measures can be found on Usability Metrics (See Section I)

C.   Objectives

Several **force-ranked** Tasks were constructed that would be realistic and representative of the kinds of activities a user might do with this EHR, including:

Task 1: Opening a Patient's Chart and Entering and Editing Demographics Information

Task 2: Ordering and Editing Labs

Task 3: Entering and Editing Problem Lists

Task 4: Entering and Editing an Implantable Device

Task 5: Recording and Changing and Triggering Clinical Decision Support elements

Task 6: Clinical Reconciliation

Task 7: Medication List

Task 8: Allergy List

The Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users. The Tasks were constructed considering the study objectives. Additionally, **based on the risk** as to the potential to cause patient harm if not completed correctly. The participants were asked to offer comments if they noticed any potential for data entry error, and or potentials to cause patient harm. None were offered.

D.   Procedures

Upon joining the GoToMeeting conference, participants were greeted. Participants were then assigned a participant ID.

The test administrator/usability tester ensured the tests ran smoothly. The usability tester conducting the test was an experienced usability practitioner with 15-plus years of experience conducting these tests.

The administrator/usability tester moderated the session including administering instructions and objectives. The administrator/usability tester also monitored objective times, obtained post

objective rating data, and took notes on participant comments.

The administrator/usability tester also served as the data logger and took notes on objective 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 could give immaterial guidance and clarification on objectives, but not instructions on use.
- Without using a think aloud technique.

For each objective, the participants were given a written copy of the objective. Objective timing began once the administrator finished reading the question. The objective time was stopped once the participant indicated they had successfully completed the objective. Scoring is discussed below in section 4.

Following the session, the administrator/usability tester gave the participant the post-test questionnaire and thanked everyone for their participation.

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

E.   Test Location

All tests were conducted virtually via GoToMeeting. Only the participant and the administrator/usability tester were on the web-conference.

F.   Test Environment

The EHRUT would be typically used in a healthcare office or facility. In this instance, the testing was conducted virtually. Some of the participants were in a healthcare office, and others were at home. For testing, all users used a Windows or computer with Google Chrome web-browser and an internet connection. The participants used a mouse and keyboard when interacting with the EHR.

Technically, the system performance (i.e. response time) was representative to what actual users would experience in a field implementation. Additionally, participants were instructed not to change any of the default system settings (such as control of font size).

G.   Test Forms and Tools

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

1) Test Session Agenda
2) Post-test Questionnaire

Examples of these documents can be found in Appendices 1 and 3 respectively.
The participant's interaction with the EHRUT was not captured or recorded digitally.

H. Participant Instructions

The administrator reads the following instructions aloud to each participant:

"Hi, Thanks for taking the time to participate in our EHR usability testing study.

Before we get started I would like to provide a little context around the flow of today's session. You will be completing a set of 8 Tasks in your typical EHR. For the first 5 minutes we will review each of the Tasks you will be asked to complete during the test. Once you're comfortable with the objectives we will begin the test (approximately 30 minutes). I want to call out that this is not a test of how well you know or use the system, but rather you are testing the system for us. After each objective I will ask you to rate the difficulty of the objective on a 1-5 scale, 1 being extremely difficult and 5 being very easy. Once you are finished with the test I will ask you to complete the post-test questionnaire. Any questions? Alright let's begin."

Participants were given 8 Tasks to complete. The detailed objectives are listed in Appendix 2.

I. Usability Metrics

Effectiveness: Objective Failures	If the participant abandoned the objective, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the objective was counted as an "Failures." No objective times were taken for errors.
	The total number of errors was calculated for each objective and then divided by the total number of times that objective was attempted. Not all deviations would be counted as errors.[11] This should also be expressed as the mean number of failed objectives per participant.
	On a qualitative level, an enumeration of errors and error types should be collected.
Efficiency: Objective 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 objective deviations be reported. Optimal paths (i.e., procedural steps) should be recorded when constructing objectives.
Efficiency: Objective Time	Each objective 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 objective. Only objective times for objectives that were successfully completed were included in the average objective time analysis. Average time per objective was calculated for each objective. Variance measures (standard deviation and standard error) were also calculated.

Satisfaction: Objective Rating	Participant's subjective impression of the ease of use of the application was measured by administering both a simple post-objective question as well as a post-session questionnaire. After each objective, the participant was asked to rate "Overall, this objective 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 [EHRUT] 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 UsabilityScore questionnaire in Appendix 3.

According to the NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records, EHR's 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 EHRUT by measuring participant success rates and errors
2) Efficiency of EHRUT by measuring the average objective time and path deviations
3) Satisfaction with EHRUT by measuring ease of use ratings

IV.   Data Scoring

The following table (Table 1) details how objectives were scored, errors, evaluated, and the time data analyzed.

Measures	Rationale and Scoring
Effectiveness: Objective Success	An objective was counted as a "Success" if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per objective basis.
	The total number of successes were calculated for each objective and then divided by the total number of times that objective was attempted. The results are provided as a percentage.
Table 1	Objective times were recorded for successes. Observed objective times divided by the optimal time for each objective is a measure of optimal efficiency. Optimal objective performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing objectives. Target objective times used for objective times in the Moderator's Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by some factor, e.g. 1.5, that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on an objective was 60 seconds then allotted objective time performance was 1.25 seconds. This ratio should be aggregated across objectives.

V.   Results

A.   Data Analysis and Reporting

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. If a participant failed to follow session and Task instructions would have had their data excluded from the analyses. None occurred.

The usability testing results for the EHRUT are detailed below (see Table 2). The results should be seen considering the objectives and goals outlined in Section B - Study Design. The data should yield actionable results that, if corrected, yield material, positive impact on user performance.

Task ID	Task Description	N	Task Success (%)	Path Deviation	Task Time (Seconds)		Task Failure (%)	Task Ratings (5 = Easy)
	Measure	#	Mean (SD)	Observed / Optimal	Mean (SD)	Observed / Optimal	Mean (SD)	Mean (SD)
a.5.1	Add a new patient	10	100 (0)	0/0	15.9 (2)	17 / 20	0 (0)	4.6 (0.45)
a.5.2	Update an existing patient's demographics and review the changes	10	100 (0)	0/0	27.8 (3)	28 / 30	0 (0)	4.8 (0.3)
a.6.1	Record a problem	10	100 (0)	0/0	9 (2)	8 / 10	0 (0)	4.9(0.1)
a.6.2	Change a problem	10	100 (0)	0/0	5 (1)	5 / 5	0 (0)	4.9 (0.1)
a.6.3	View active problems	10	100 (0)	0 /0	5 (2)	5 / 5	0 (0)	4.9 (0.1)
a.6.4	View completed problems	10	100 (0)	0/0	5 (1)	5 / 5	0 (0)	5 (0)
a.14.1	Record an UDI	10	100 (0)	0/0	7 (1)	8 / 8	0 (0)	4.0 (0.9)
a.14.2	Access UDI, device description, identifiers, and attributes	10	100 (0)	0/0	4 (1)	4 / 5	0 (0)	4.0 (0.6)
a.14.3	Update the status of an UDI	10	100 (0)	0/0	6 (2)	7/ 7	0 (0)	4.0 (0.23)
a.9.1	Configure CDS rules for problem list, medication list, allergy list, demographics, lab test, vital signs and a combination of demographics and vital signs	10	100 (0)	0/0	270(10)	275 / 280	0 (0)	4.0 (0.65)
b.2.1	Open and complete reconciliation for Allergy	10	100 (0)	0/0	31(2)	33(35)	0 (0)	4.1 (0.4)
b.2.2	Open and complete reconciliation for Medications	10	100 (0)	0/0	30(1)	32(35)	0 (0)	4.1 (0.4)
b.2.3	Open and complete reconciliation for Problem	10	100 (0)	0/0	30(2)	31(35)	0 (0)	4.1 (0.4)
a.7.1	View current medications	10	100 (0)	0/0	5 (2)	5 / 8	0 (0)	5 (0)
a.7.2	Record a medication	10	100 (0)	0/0	15(3)	15 / 20	0 (0)	5 (0)
a.9.3	Trigger and view the Medication List CDS Intervention and its additional information (Info-button)	10	100 (0)	0/0	32 (12)	35 / 40	0 (0)	4.5 (0.45)
a.7.3	Change a medication and review the change	10	100 (0)	0/0	15 (3)	17/ 20	0 (0)	5 (0)
a.7.4	View historical medications	10	100 (0)	0/0	5(1)	5 / 5	0 (0)	5 (0)

Task ID	Task Description	N #	Task Success (%) Mean (SD)	Path Deviation Observed / Optimal	Task Time (Seconds) Mean (SD)	Task Time (Seconds) Observed / Optimal	Task Failure (%) Mean (SD)	Task Ratings (5 = Easy) Mean (SD)
a.8.1	Record a medication allergy	10	100 (0)	0/0	15 (1)	15 / 20	0 (0)	5 (0)
a.8.2	Change a medication allergy	10	100 (0)	0/0	10 (3)	10 / 15	0 (0)	5 (0)
a.8.3	View active allergies	10	100 (0)	0/0	5 (1)	5 / 10	0 (0)	5 (0)
a.8.4	View inactive allergies	10	100 (0)	0/0	5 (1)	5 / 10	0 (0)	5 (0)
a.9.4	Trigger and view the Allergy CDS Intervention	10	100 (0)	0/0	30 (5)	34 / 40	0 (0)	5 (0)
a.9.2	Trigger and view the Problem List CDS intervention and its additional information (Info-button)	10	100 (0)	0/0	38 (8)	39 / 46	0 (0)	4.4 (0.3)
a.9.5	Trigger and view the Demographics CDS intervention and its additional information (Info-button)	10	100 (0)	0/0	65 (4)	67 / 70	0 (0)	4.5 (0.67)
a.9.7	Trigger and view the Vital Signs CDS intervention	10	100 (0)	0/0	32 (4)	32 / 45	0 (0)	4.7 (0.45)
a.9.8	Trigger and view the CDS Intervention with combined conditions (Demographics and Vital Signs)	10	100 (0)	0/0	56 (3)	57 / 70	0 (0)	4.6 (0.7)
a.2.1	Record a lab order	10	100 (0)	0/0	5 (1)	5 / 5	0 (0)	5 (0)
a.2.2	Change lab order and review the change	10	100 (0)	0/0	10 (3)	10 / 20	0 (0)	5 (0)
a.9.6	Trigger and view the Lab Test CDS intervention and its bibliographic citation, author, funding source and release version	10	100 (0)	0/0	132 (4)	135 / 145	0 (0)	4.0 (1)

TABLE 2

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these objectives to be 75. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.

B.   Discussion of the Findings

- Task Success: All Tasks were completed successfully via the optimum path.
- There was a slight deviation up from the optimum time due to the relative newness of the Tasks. This indicates that as users practice and gain familiarity with our system, their ability to complete objectives within, or better than, the optimal time will be likely.
- Path Deviation: We had no path deviations observed for all Tasks. This can be attributed to the

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fact that the system was designed so that clicks and steps were meant to be obvious. Notably, we had the largest potential for deviations on Task 6 -Clinical Reconciliation, which we can attribute to needing to click on so many areas to achieve the desired results. We have made a note of that and will take it into consideration for improvement.

- Task Time: Overall the mean objective times were good, considering the range of users' familiarity with the system; some users were performing Tasks that go beyond their usual job duties. There were a few Tasks where they were well within the optimal objective time, and others where they were close to the optimal time, but none were over.
- Errors: No errors were observed throughout the test. Risk prone errors exist in the C- CDA reconciliation areas of the system. Risks include accidentally not completing the full reconciliation of all the data.
- Task ratings: Overall the Tasks ratings were ranked a 4 to 5 - Easy.

VI.   Effectiveness

We found the EHRUT to be extremely effective in completing the Tasks. This is validated by no path deviations observed during testing.

VII.   Efficiency

Several the test participants stated that their favorite part of the system was the ability to complete each Tasks on one screen.

VIII.   Satisfaction

Based on the objective ratings we can infer that users are very satisfied with the system. If you average all the Tasks ease ratings, they were 100% successful and a 4.5 on the 5-point scale. The average of all the System Usability Score questionnaire scores was 75.

IX.   Major Findings

The major findings from this test are that all users found the software easy to use. A common remark was that they liked the ability to complete most of the Tasks from one screen.

- There were no deviations from the optimal path to complete the Tasks. The efficiency of data entry should improve when the new features become a part of the normal use. All participants successfully completed the tasks and stated that the ease of use was rated at 4's to 5's out of 5, where 5 is Easy.
- Entering in demographics was not as familiar to clinical users since the demographic information was most often pre-entered by an admin role.
- The need for the additional demographic fields (Gender Identity and Sexual Orientation) was deemed a nice addition and can enhance patient care.
- The likelihood of an error, and the potential to cause harm to a patient is very low due to the logical workflow and intuitive design of the tasks.
- The most risk prone area of the system, of the tasks performed, is clinical information reconciliation. This was mainly because the system requires so many clicks and going to

different parts of the EHR.   Bringing in a C-CDA was the most foreign task for all participants. It is not currently a significant part of their daily routine to chart a patient encounter. The benefits of electronic incorporation of Medications, Problems and Medication Allergies needs to be realized by the participants as they do it more often.

- o Overall the EHR software was easy to use. Many of the users were surprised to learn about Clinical Decision Support and Clinical Information Reconciliation functionalities.
- o Several participants said that they would like to see the CDS configuration function expanding to other areas of patient process including administrative areas, like insurance verification and preventative care.
- o The participants liked the auto-complete feature when typing in Medication and Medication Allergies. This feature will help to reduce the risk of entering in the wrong medication.

Many of the participants were surprised to learn about Clinical Decision Support and Clinical Information Reconciliation functionalities. There was a lot of positive feedback given to the modern look and feel of the system, as well as the consistency of menus and icons throughout the system. We learned that the users will be able to complete objectives quicker and more efficiently as they gain more experience with the system. Additionally, below are some of the verbal remarks from participants:

- "I use it every day and I am very comfortable with the EHR."
- "Dependable"
- "Ability to edit things all located in one area and similar ways to edit each thing"
- "Easy to navigate, it's a good system"
- Participant liked "having everything on page"

X.   Areas for Improvement

- o Add a Favorites dropdown to the Problem selection based on the Super Bill list.
- o Add a Favorites dropdown to the Lab Orders based on the most commonly ordered labs for Wound Care.
- o Reorder the Race and Ethnicity dropdowns to have the most often selected entries at the top of the list.

XI.   Appendices

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

1) Recruiting Screener
2) Moderator's Guide and Step-by-Step task guide
3) System Usability Scale Questionnaire

A. Appendix 1

1. Recruiting

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 gather participation information. This should only take a few minutes of your time. This is strictly for research purposes. You will be paid to participate in Training and Testing.

Please answer the following questions:

1. Are you male or female?   Male _____   Female _____

2. Have you participated in a focus group or usability test in the past 6 months?   Yes ____
_____   No _____

3. Do you, or does anyone in your home, work in marketing research, usability research, web design, or other computer work?   Yes _____   No _____

4. Do you, or does anyone in your home, have a commercial or research interest in an electronic health record software or consulting company?   Yes _____   No _____

5. Which of the following best describes your age?
    23 to 39 _____   40 to 59 _____   60 to 74 _____   75 or older

    _____

6. Which of the following best describes your race or ethnic group?
    Caucasian _____   Asian _____   Black/African American _____   Latino/a or
Hispanic _____   Other _____

7. Do you require any assistive technologies to use a computer?   Yes _____   No _____
    If Yes, Please Describe: _____
_____

Professional Demographics:

8. What is your current position and title? (Must be healthcare related)

    _____RN: Specialty _____

    _____Physician: Specialty _____

    _____Resident: Specialty _____

    _____Administrative Staff

    _____Other Medical: Specialty _____

9. How long have you held this position? _____

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

_____

11. Which of the following describes your highest level of education?
    High School/GED _____   Some College _____   College Graduate (RN/BSN) _____
Postgraduate (MD/PhD) _____   Other: Please Describe: _____

1.   Recruiting

Computer Expertise:

12. Besides reading email, what professional activities do you do on the computer?
    Access EHR _____   Research _____   News _____   Shopping/Banking _____   Digital Pictures _____
    Programming _____   Microsoft Office Products _____

13. About how many hours per week do you spend on the computer?
    0 to 10 _____   11 to 25 _____   26 or More _____

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 record/retrieve patient records?
    On Paper _____   Some Paper/Some Electronic _____   All Electronic _____

Contact Information:
Name of participant: _____
Email address: _____

When the group is done with one task, I will allow some time to review the instructions for the next task. Wait for me to say BEGIN to start the actual work.

Prior to the test navigate to Client Tracking → Client Record. Search for "sed". Select the user associated with you (user-one|user-two|user-three|etc), then click Select. You will automatically be directed to the Patient Record tab where you can view/edit demographics.

Task 1. Demographics
1) Verify the Sex - **Male**
2) Select Gender Identity from pull-down – **Male Gender Identity**
3) Select Sexual Orientation from pull-down – **Homosexual**
4) Select Race from pull-down – **West Indian**. (Selected Race will auto fill with "**Black or African American**".) Note: If Patient specifies mixed race, two races may be selected.
5) Select Ethnicity from pull-down – **Not Hispanic or Latino**
6) Select Preferred Language from pull-down – **English**
7) After Update Edit Preferred Language to **French**

Enter Time, Score and Comments on Scoresheet.

Task 1: Demographics

Goal Task Time: 0:50 Minute   **Actual Average Time:** TBD Seconds/Minutes
Optimal Path: *Patient Record → Edit → Update*

4 Correct
   Minor Deviations / Cycles: Describe below

   Major Deviations: Describe below

Observed Errors and Verbalizations:
Comments: Described as "easy" with some discussion of new requirements.

Average Rating:
Overall, this task was: TBD
Very Easy = 5; Easy = 4; Average = 3; Slightly Difficult = 2; Very Difficult = 1; Deficient = 0
Administrator / Notetaker Comments:

Task 2. Computerized provider order entry
Click "Add Order"
Add a **Lab** Order: **Fasting Blood Glucose**.
Enter any **Start Date Time** you'd like.
Update.
Then **edit** the Lab Order by setting the **order duration** to **"1 Time".**
Update.

Enter Time, Score and Comments on Scoresheet.

Task 2: Computerized provider order entry

Goal Task Time: 0:20 Seconds   **Actual Average Time:** TBD Minutes
Optimal Path: *Orders tab→Add Order button → Select Order Category "Lab" → Select Order Template → Start Date Time → Update → Edit → Select Order Duration → Update*

4 Correct
4 Minor Deviations / Cycles: Describe below
A few users had some difficulty finding pull-down to choose what sort of Order.
_____
    Major Deviations: Describe below

_____

Observed Errors and Verbalizations:
Comments:
_____

Average Rating:
Overall, this task was: TBD
Very Easy = 5; Easy = 4; Average = 3; Slightly Difficult = 2; Very Difficult = 1; Deficient = 0

Administrator / Notetaker Comments:
 _____

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Prior to the test navigate to Client Tracking → Patient. Search for "sed". Select the user associated with you (user-one), then click Select. You should land on the "Patient Record" tab.
Click the "Problem" tab.

Task 3. PROBLEM LIST
Add the following Problem:

Search for Acne vulgaris. L70.0

Make all Problems Active and use the default date.
Edit Problem and Update

Enter Time, Score and Comments on Scoresheet.

Task 3: Problem List

Goal Task Time: 0:25 Seconds   **Actual Average Time**: TBD Minutes
Optimal Path: *Diagnosis Tab → Add Button → Enter following data:*
*Diagnosis ICD-10 Code: Click "…" box, search for "*Acne vulgaris. L70.0*",*
click OK
Click Update.
Edit Diagnosis and change entry date

4 Correct
4 Minor Deviations / Cycles: Describe below
A few did not follow instructions about how to search for problems; a few added problems one at a time, rather than in a group, raising their entry time.
   Major Deviations: Describe below

Observed Errors and Verbalizations:
Comments:

Average Rating:
Overall, this task was: TBD
Very Easy = 5; Easy = 4; Average = 3; Slightly Difficult = 2; Very Difficult = 1; Deficient = 0

Administrator / Notetaker Comments:

Task 4. Implantable Device
Under Implantable Devices, **add** an Implantable Device.
From Notepad, **enter the Universal Device Identifier**:
UDI Code = (01)10884521062856(11)141231(17)150707(10)A213B1(21)1234
Click Retrieve Data
Update
Click Edit and add comments to UDI section

Enter Time, Score and Comments on Scoresheet.

Task 4: Implantable Device

Goal Task Time: 0:20 Seconds   **Actual Average Time:** TBD Minutes
Optimal Path: *Implantable Devices tab → "Add" button → Paste UDI code into the UDI field → Click "Retrieve Data" → Click Update*

4 Correct
4 Minor Deviations / Cycles: Describe below
Some issues finding the icon to go to the next screen after entering Procedures.

4 Major Deviations: Describe below
After entering UDI, 2nd Save was overlooked.

Observed Errors and Verbalizations:
Comments:

Average Rating:
Overall, this task was: TBD

Very Easy = 5; Easy = 4; Average = 3; Slightly Difficult = 2; Very Difficult = 1; Deficient = 0

Administrator / Notetaker Comments:

 _____

Task 5. Clinical Decision Support
Add new active Alert in Administration → Clinical Intervention Rules Configuration.

> **Specify those between ages 40 and 75.**
> Select **Problem** triggering alert: Malignant neoplasm of colon NOS (disorder)
> **Discipline** (who will see the Alerts): **Physicians**
> **Clinical Intervention: Screen for colorectal cancer trial. Screen for possible inclusion in colorectal**
cancer trial.

Add the required reference data:
> Bibliographic Citation (Link): https://www.cancer.gov/research/areas/clinical-trials
> Funding Source: **NIH**
> Reference Date: **1/11/2017**
> Click **Update.**

Edit the Rule to change the **age range** from **40-75** to **40-80.**

Enter Time, Score and Comments on Scoresheet.

Task 5: Clinical Decision Support

Goal Task Time: 3:30 Minutes   **Actual Average Time:** TBD Minutes

Optimal Path: *Administration → Clinical Intervention Rules → "Add" button →*
Next to Demographics, enter age range → Enter problem triggering alert → Next to Problem click "…" →
Next to Rule Active? check box → Select users who will see alert by selecting the Discipline→ In the Clinical
Intervention text box, enter Alert Description and Alert Text → Enter the link used as reference in the
Bibliographic Citation→ *Enter who funded the reference → Update → In Alert list, click "Edit" button next*
to alert → Make desired change → Update
Trigger Alerts for Problems, Vitals, Labs, Demographics, Medications, Allergies and a Combination
Additionally, observe the Alerts for Medications, Problems and Allergies during a C-CDA incorporation
Click and review each of the InfoButton Bibliographic reference.

4 Correct
4 Minor Deviations / Cycles: Describe below
Some confusion with 2 instances of User Roles and Activation buttons.

   Major Deviations: Describe below

Observed Errors and Verbalizations:
Comments: Participants wondered how this would fit into their own work flow.
Average Rating:
Overall, this task was: TBD
Very Easy = 5; Easy = 4; Average = 3; Slightly Difficult = 2; Very Difficult = 1; Deficient = 0

Administrator / Notetaker Comments:

Task 6. Clinical information reconciliation

Navigate to the **Clinical Summary** tab of the client record. Reconcile with your Patient's record by incorporating the CCDA into the client record.

Resolve the Allergies via the **Resolve Allergies** link.

Select data from the External List (C-CDA) on the left for inclusion into the Epitomax List on the right.

Review the consolidated list and **Update**.

Resolve the Allergies via the **Resolve Medications** link.

Select data from the External List (C-CDA) on the left for inclusion into the Epitomax List on the right.

Review the consolidated list and **Update**.

Resolve the Allergies via the **Resolve DX (Diagnosis)** link.

Select data from the External List (C-CDA) on the left for inclusion into the Epitomax List on the right.

Review the consolidated list and **Update**.

Observe the CDS Alerts when incorporating Medications, Allergies and Problems

Enter Time, Score and Comments on Scoresheet.

Task 6: Clinical information reconciliation

Goal Task Time: 1:45 Minutes **Actual Average Time:** TBD Minutes

Optimal Path:
Clinical Summary tab → Click Incorporate → Click Resolve Allergies → Merge All → Review → Update

4 Correct
4 Minor Deviations / Cycles: Describe below
Some slight confusion determining Current from External information.
_____

    Major Deviations: Describe below

_____

Observed Errors and Verbalizations:
Comments:
_____

Average Rating:
Overall, this task was: TBD
Very Easy = 5; Easy = 4; Average = 3; Slightly Difficult = 2; Very Difficult = 1; Deficient = 0

Administrator / Notetaker Comments:
Most felt this task to be very easy and looked forward to using. _____

Task 7. MEDICATION LIST
Add the following Medication:

Search for Cipro – 500 MG BID

Make all Problems Active and use the default date.
Edit Problem and Update

Enter Time, Score and Comments on Scoresheet.

Task 7: Medication List

Goal Task Time: 0:30 Seconds   **Actual Average Time**: TBD Minutes
Optimal Path: *Diagnosis Tab → Add Button → Enter following data:*
Medication Cipro 500 MG BID ICD-10 Code: Click Save,
click OK
Click Update.
Edit Frequency to TID

4 Correct
4 Minor Deviations / Cycles: Describe below
A few did not follow instructions about how to search for problems; a few added problems one at a time, rather than in a group, raising their entry time.

   Major Deviations: Describe below

Observed Errors and Verbalizations:
Comments:

Average Rating:
Overall, this task was: TBD
Very Easy = 5; Easy = 4; Average = 3; Slightly Difficult = 2; Very Difficult = 1; Deficient = 0

Administrator / Notetaker Comments:

Task 8. ALLERGY LIST

Add the following Problem:

Search for Penicillin G

Make all Allergies Active and use the default date.
Edit Problem and Update

Enter Time, Score and Comments on Scoresheet.

Task 8: Allergy List

Goal Task Time: 0:20 Seconds   **Actual Average Time**: TBD Minutes
Optimal Path: *Diagnosis Tab → Add Button → Enter following data:*
Search for Penicillin G, add reaction as Hives
click OK
Click Update.
Edit Reaction to Wheezing

4 Correct
4 Minor Deviations / Cycles: Describe below
A few did not follow instructions about how to search for problems; a few added problems one at a time, rather than in a group, raising their entry time.

   Major Deviations: Describe below

Observed Errors and Verbalizations:
Comments:

Average Rating:
Overall, this task was: TBD
Very Easy = 5; Easy = 4; Average = 3; Slightly Difficult = 2; Very Difficult = 1; Deficient = 0

Administrator / Notetaker Comments:

C. Appendix 3: System Usability Scale Questionnaire

In 1996, Brooke published a "low-cost usability scale that can be used for global assessments of systems usability" known as the System Usability Scale or SUS.[16] Lewis and Sauro (2009) and others have elaborated on the SUS over the years. Computation of the SUS score can be found in Brooke's paper, in at http://www.usabilitynet.org/trump/documents/Suschapt.doc *or in Tullis and Albert (2008).*

	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

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[16] Brooke, J.: SUS: A "quick and dirty" usability scale. In: Jordan, P. W., Thomas, B., Weerdmeester, B. A., McClelland (eds.) *Usability Evaluation in Industry* pp. 189--194. Taylor & Francis, London, UK (1996). SUS is copyrighted to Digital Equipment Corporation, 1986.

Lewis, J R & Sauro, J. (2009) "The Factor Structure Of The System Usability Scale." in *Proceedings of the Human Computer Interaction International Conference (HCII 2009), San Diego CA, USA*