2015 Edition Health IT Certification

User-Centered Design

NIST 7742 Customized Common Industry Format Template for Electronic Health Record Usability Testing

MaximEyes EHR 3.0
First Insight Corporation

USABILITY TEST REPORT: MaximEyes EHR 3.0

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

MaximEyes EHR 3.0 by First Insight Corporation

Date(s) of Usability Test(s): 5/30/2017-6/06/2017

Date of Report: 6/08/2017

Report Prepared By: Shandra Cossey, Product Specialist
shandrac@first-insight.com
First Insight Corporation
6723 NE Bennett Street, Suite 200
Hillsboro, OR 97124

Table of Contents

EXECUTIVE SUMMARY

Usability testing of MaximEyes EHR 3.0 was conducted from 5/30/2017-6/06/2017. Session A location was Portland, OR. Session B was conducted via remote connection. The purpose of this test was to test and validate the usability of the current user interface, and provide evidence of usability in MaximEyes EHR 3.0. During the usability test, 27 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 21 tasks typically conducted on an EHR:

1.1 Access & record patient demographics
1.2 Change patient demographics
2.1 Incorporate a CCDA
2.2 Reconcile a CCDA with the EHR elements
2.3 Create a new CCDA with reconciled data
3.1 Access, display, & change an active problem list
3.2 Record a new problem to an active problem list
4.1 Access, change, record & create an implanted device list
5.1 Request, receive & obtain medication history & fill status
5.2 Create a new electronic prescription
5.3 Trigger & adjust drug-drug & drug-allergy interactions
5.4 Change & cancel an electronic prescription
5.5 Request, receive & obtain updated medication information
6.1 Trigger & receive decision interventions based on patient data
6.2 Access diagnostic & therapeutic references & intervention attributes
0.3 Access, review & add to an existing medication allergy list
0.4 Access, review & add to an existing medication list
0.5 Order a lab test
0.6 Enter lab test results
0.7 Order a radiology test
0.8 Enter radiology test results

During the 20-40 min one-on-one Session A usability test, participants were greeted upon arrival, their identity was verified and matched with a name on the participant schedule. Participants were then assigned a participant ID. Each participant reviewed and signed an informed consent and release form. A representative from the test team witnessed the participant's signature.

During testing Session B each participant reviewed and signed an NDA Agreement & Informed Consent prior to their scheduled test date/time. At each scheduled test date/time participants were greeted upon screen & audio connection arrival, their identity was verified and matched with a name on the participant ID previously assigned.

A total of 27 participants were tested on MaximEyes EHR 3.0. Participants in the test were Optometrists, Ophthalmologists, Office Managers, Clinic Technicians & other office staff. Participants had no direct

connection to the development of or organization producing MaximEyes EHR 3.0. Participants were actual end users of various previous First Insight PMS & EHR products.

During the test the Administrator & Moderator introduced the test, oriented participants with the materials & tools to be used, instructed participants to complete a series of tasks & kept time. No instructions were given on how to perform the tasks. Participant & Administrator screen/audio were recorded for subsequent analysis.

The following types of data were collected for each participant:

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

All participant data was de-identified – no correspondence could be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants were asked to complete a post-test questionnaire and were compensated with $100 Max Bucks credits for their time. Various recommended metrics, in accordance with the examples set forth in the NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records, were used to evaluate the usability of the EHRUT.

Following is a summary of the performance and rating data collected on the EHRUT.

Task ID	Attempts	Success		Failures		Efficiency: Deviations			Efficiency: Time			Satisfaction: Ratings			
	# of Participants	# of Successes	% Success Mean	# of Failures	% Failures Mean	# Optimal Path	# Observed Path	% Observed Mean	Task Time Mean (seconds)	Task Time Optimal Mean (seconds)	Time Observed/ Optimal	Grouped Tasks Rating Average	Task Rating Mean	Task Score	SUS Scale
1.1	13	12	92.31%	1	7.69%	39	35	89.74%	52	35	149%	4.59	4.85	97%	82%
1.2	13	13	100.00%	0	0.00%	39	37	94.87%	40	35	114%		4.85	97%	
2.1	13	11	84.62%	2	15.38%	39	34	87.18%	43	35	123%		4.08	82%	
2.2	13	13	100.00%	0	0.00%	39	37	94.87%	54	59.5	91%		4.08	82%	
2.3	13	11	84.62%	2	15.38%	39	31	79.49%	36	35	103%		4.08	82%	
3.1	13	13	100.00%	0	0.00%	39	36	92.31%	25	31.5	79%		4.85	97%	
3.2	13	13	100.00%	0	0.00%	39	35	89.74%	30	28	107%		4.85	97%	
4.1	13	13	100.00%	0	0.00%	39	39	100.00%	27	35	77%		4.92	98%	
5.1	11	11	100.00%	0	0.00%	33	33	100.00%	16	21	76%	4.82	4.73	95%	
5.2	11	11	100.00%	0	0.00%	33	33	100.00%	21	42	50%		4.73	95%	
5.3	11	11	100.00%	0	0.00%	33	32	96.97%	19	35	54%		4.82	96%	
5.4	11	11	100.00%	0	0.00%	33	33	100.00%	21	24.5	86%		4.91	98%	
5.5	11	11	100.00%	0	0.00%	33	33	100.00%	3	3.5	86%		4.91	98%	
6.1	13	13	100.00%	0	0.00%	39	39	100.00%	11	24.5	45%	4.59	4.69	94%	
6.2	13	13	100.00%	0	0.00%	39	38	97.44%	16	17.5	91%		4.69	94%	
0.3	14	13	92.86%	1	7.14%	42	39	92.86%	28	35	80%	4.38	4.69	94%	75%
0.4	14	12	85.71%	2	14.29%	42	36	85.71%	47	35	134%		4.67	93%	
0.5	14	11	78.57%	3	21.43%	42	33	78.57%	63	70	90%		4.18	84%	
0.6	14	10	71.43%	4	28.57%	42	32	76.19%	67	52.5	128%		3.90	78%	
0.7	14	11	78.57%	3	21.43%	42	34	80.95%	38	70	54%		4.55	91%	
0.8	14	11	78.57%	3	21.43%	42	33	78.57%	46	52.5	88%		4.27	85%	
	269	**248**	**92.73%**	**21**	**7.27%**	**807**	**732**	**91.21%**	**33**	**37**	**91%**	**4.60**	**4.59**	**92%**	**78.45%**

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 78.

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

Major Findings

- Compared to previous usability test 2 specific areas for improvement had drastically improved. Data entry value lists timing & usability had improved. Maintaining entry processes & wording was recognized by participants.
- Overall the usability scores were dramatically increased compared to past tests.
- The standard deviation of effectiveness, efficiency & ratings were the most spread for tasks related to Summary of Care creation & Reconciliation. During testing, it was observed that most participants were either familiar with these processes or not familiar at all.
- Six of the total 27 test participants are users that are not as familiar with the encounter module as typical day to day users (doctors or scribe type clinic technicians) were also recruited to participate. These 6 participants attended training in the past on the MaximEyes EHR in general and had little or no actual usage experience in the encounter module specifically. They were the lowest of our scores and had the most negative feedback regarding the final questions and usability scores.

- During Session B multiple participants reported the screen was hard to see and go to meeting connection tools were in the way of what they needed to find.
- Give better instruction for SUS as related to paying attention to the scale for each question & to base ratings on the system under test & not current system version installed at their practices.
- The system of data entry was intuitive.
- Finding pages of an encounter is easily accessible.

Areas for Improvement

- Path deviations were highest for tasks related to creating a new Summary of Care & Lab Tests. Summary of Care resulted with a deviation mean of 20%. Which indicates better training for certification criteria related name changes like Clinical Summary to Summary of Care to increase identification is necessary. Also, possibly increasing visibility of high usage functionality needs. Tasks of ordering a specific lab test & entering a lab result with deviation means of 21% & 23%. As this is certification criteria that our users typically are not familiar with they were confused about the purpose.
- Give better instruction for SUS as related to paying attention to the scale for each question & to base ratings on the system under test & not current system version installed at their practices.
- "Ok" button to add result is easily confused with the "Add & Continue" that closes the data entry screen.
- System of data entry for medications needs to be allowed without sig value.

INTRODUCTION

MaximEyes EHR 3.0 by First Insight Corporation was the subject of this usability test. MaximEyes EHR (all versions) are designed to present medical information to Optometry & Ophthalmology healthcare providers in an ambulatory private practice setting.

The purpose of this study was to test and validate the usability of the current user interface, and provide evidence of usability in MaximEyes EHR 3.0. To this end, measures of effectiveness, efficiency and user satisfaction, such as rating difficulty and optimal path were captured during the usability testing. The usability testing attempted to represent realistic exercises and conditions.

METHOD

PARTICIPANTS

A total of 27 participants were tested on MaximEyes EHR 3.0. Participants in the test were Optometrists, Ophthalmologists, Office Managers, Clinic Technicians & other office staff. Participants were recruited by Shandra Cossey (FIC Product Specialist) and were compensated $100 Max Bucks Credits for their time. In addition, participants had no direct connection to the development of or organization producing MaximEyes EHR 3.0.

Participants were actual end users of various previous First Insight PMS & EHR products. 8 of the 27 participants had no prior experience with an EHR. They were given repeated verbal instruction during the test so they did not have to memorize verbal instruction. None of the participants received any orientation or training with the product.

For the test purposes, end-user characteristics were identified and translated into a recruitment screener used to solicit potential participants. Recruited participants had a mix of backgrounds and demographic characteristics conforming to the recruitment screener. The following is a table of participants by characteristics, including demographics, professional experience, computing experience and user needs for assistive technology. Participant names were replaced with Participant IDs so that an individual's data cannot be tied back to individual identities.

27 participants (matching the demographics in the section on Participants) were recruited and 27 participated in the usability test. No participants failed to show for the study.

Participants were scheduled for 1 hour sessions. A spreadsheet was used to keep track of the participant schedule, and included each participant's demographic characteristics.

ID	Gender	Age	Education	Occupation/Role	Professional Experience (months)	Computer Experience (months)	Product Experience (months)	Assistive Technology Needs
1001	Male	50-59	Doctorate degree (e.g., I	Optometrist	252	60	12	No
1002	Female	50-59	Bachelor's degree	Manager	192	60	12	No
1003	Female	30-39	Bachelor's degree	Practice Manager	12	120	12	No
1005	Female	40-49	Doctorate degree (e.g., I	OD	204	300	132	No
1006	Female	50-59	Doctorate degree (e.g., I	Optometrist	360	240	204	No
1007	Male	30-39	Doctorate degree (e.g., I	Optometrist	24	240	12	No
1008	Female	30-39	Bachelor's degree	Biller	12	240	24	No
1009	Male	50-59	Doctorate degree (e.g., I	Optometrist	420	240	84	No
1010	Female	30-39	Doctorate degree (e.g., I	Optometrist	72	240	30	No
1011	Male	50-59	Doctorate degree (e.g., I	Optometrist	336	120	96	No
1012	Male	60-69	Doctorate degree (e.g., I	Optometrist	408	60	72	No
1013	Male	50-59	Doctorate degree (e.g., I	Optometrist	396	18	18	No
1014	Male	60-69	Doctorate degree (e.g., I	Ophthalmologist	360	36	06	No
1015	Male	30-39	Doctorate degree (e.g., I	Optometrist	60	60	96	No
2025	Female	40-49	Doctorate degree (e.g., I	OD	252	360	180	No
2027	Female	40-49	High school graduate, di	Optical Technician	24	180	24	No
2028	Female	40-49	Associate degree	LPN/Ophthalmic Tech	360	300	180	No
2030	Male	40-49	Doctorate degree (e.g., I	Optometrist	204	384	108	N/A
2031	Female	30-39	Bachelor's degree	Special Projects Manager	204	300	120	No
2026	Male	50-59	Bachelor's degree	Optometric Technician	30	300	30	no
2032	Female	50-59	Doctorate degree (e.g., I	Owner/Optometrist	300	300	132	no
2037	Female	30-39	Some college credit, no	Office Manager	192	216	84	No
2036	Male	40-49	Doctorate degree (e.g., I	Optometric Tech	144	240	84	no
2035	Male	50-59	Doctorate degree (e.g., I	Optometrist	204	480	132	No
2033	Female	20-29	Trade/technical/vocatio	receptionist	42	96	42	No
2034	Female	20-29	High school graduate, di	Receptionist	42	120	42	no
2029	Female	20-29	Bachelor's degree	Lead Clinic	36	120	24	no

STUDY DESIGN

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

During the usability test, participants interacted with 1 EHR. 14 participants used the system onsite during Session A and were provided with the same instructions. 13 participants used the system via remote connection during Session B and were 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 written, open ended satisfaction observations
- Participant's satisfaction ratings of the system

Additional information about the various measures can be found in sections Usability Metrics & Data Scoring.

TASKS

Tasks were constructed that would be realistic and representative of the kinds of activities a user might do with this EHR. Task design was based on the 2015 Edition certification criteria as well as their frequency of use & criticality of function. Prioritization of the tasks was based on findings associated with critical use risks that align with the guidance in NIST 7804-1 and framework of NIST 7804.

1.1 Access & record patient demographics

1.2 Change patient demographics

2.1 Incorporate a CCDA

2.2 Reconcile a CCDA with the EHR elements

2.3 Create a new CCDA with reconciled data

3.1 Access, display, & change an active problem list

3.2 Record a new problem to an active problem list

4.1 Access, change, record & create an implanted device list

5.1 Request, receive & obtain medication history & fill status

5.2 Create a new electronic prescription

5.3 Trigger & adjust drug-drug & drug-allergy interactions

5.4 Change & cancel an electronic prescription

5.5 Request, receive & obtain updated medication information

6.1 Trigger & receive decision interventions based on patient data

6.2 Access diagnostic & therapeutic references & intervention attributes

0.3 Access, review & add to an existing medication allergy list

0.4 Access, review & add to an existing medication list

0.5 Order a lab test

0.6 Enter lab test results

0.7 Order a radiology test

0.8 Enter radiology test results

PROCEDURES

During testing Session A participants were greeted upon arrival, their identity was verified and matched with a name on the participant schedule. Participants were then assigned a participant ID. Each participant reviewed and signed an informed consent and release form. A representative from the test team witnessed the participant's signature.

To ensure that the test ran smoothly, three staff members participated in this test, the usability administrator, administrator assistant, and the data logger. The usability testing staff conducting the test was EHRUT staff members. Each data logger was given training ahead of the test with specific instructions. The same guidance was given to each data logger. The administrator moderated the session including administering instructions and tasks an monitored task times. The data logger, obtained post-task rating data, and took notes on task success, path deviations, number and type of errors, and comments.

Participants were instructed to perform the tasks…

- As quickly as possible making as few errors and deviations as possible without assistance. Administrators were allowed to give immaterial guidance and clarification on tasks, but not instructions on use.
- To not do anything more or less than the task instructions itself.
- Without using a think aloud technique.

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

Following the session, the administrator gave the participant the post-test questionnaire, compensated them for their time, and thanked each individual for their participation. Participants signed a receipt and acknowledgement form (See Appendix 6) indicating that they had received the compensation.

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

During testing Session B each participant reviewed and signed an NDA Agreement & Informed Consent prior to their scheduled test date/time. At each scheduled test date/time participants were greeted upon screen & audio connection arrival, their identity was verified and matched with a name on the participant ID previously assigned.

To ensure that the test ran smoothly, two staff members participated in this test, the usability moderator and the test administrator. The usability testing staff conducting the test were First Insight staff members, each either certified usability designer or fully trained & oriented by a certified usability designer. Session B assigned moderator responsibilities included administering instructions, tasks and obtained post-task rating data, and took notes on task success, path deviations, number and type of errors, and comments. Administrator was responsible for starting & ending session recording, monitored task times, changed screens when appropriate and assisted as a backup for obtaining post-task rating data, and took notes on task success, path deviations, number and type of errors, and comments.

Participants were instructed to perform the tasks…

- As quickly as possible making as few errors and deviations as possible without assistance. Administrators were allowed to give immaterial guidance and clarification on tasks, but not instructions on use.
- To not do anything more or less than the task instructions itself.
- Without using a think aloud technique.

For each task, the participants were given repeated verbal instructions of each task. Task timing began once the administrator finished reading the full set of instruction for each task & instructed the participant to 'begin' the task. The task time was stopped once the participant indicated they had successfully completed the task or when the completion of the task was observed.

Following the session, the administrator asked the participant to complete the system usability scale & feedback questions via an online survey tool. Incentive compensation was recorded in the customers account & a receipt was mailed to each participant within 1 week of their completed test.

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

TEST LOCATION

Session A test facility included a quiet testing room with 7 tables, 7 computers for the participants. 7 participants were tested at one time. The only people in the room were the administrator, administrator assistant, a data logger for each participant, and 7 participants. To ensure that the environment was comfortable for users, noise levels were kept to a minimum with the ambient temperature within a normal range.

Session B was conducted via remote connection into development version 3.0 of MaximEyes EHR. The participant, moderator & administrator were connected from separate locations. Connection and computer settings were unchanged for each test. The administrator shared control of their screen, same screen & connection for all tests. Each tests screen & audio were recorded.

TEST ENVIRONMENT

MaximEyes EHR would be typically be used in a healthcare office or facility. In Session A instance, the testing was conducted in training room with similar setup of computer as would be at their office workspace. For testing, the computer used a Dell running windows 7. The participants used mouse, keyboard, touch screen monitor when interacting with MaximEyes EHR. Specifications of the test hardware used was 21 inch monitors, windows 7 basic color scheme, 1920 x 1080 resolution. The application was set up by the First Insight technical staff according to the vendor's documentation describing the system set-up and preparation. The application itself was on a cloud server using a training / test database on a LAN connection. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation. Additionally, participants did not change any of the default system settings (such as control of font size).

In Session B instance, testing was conducted via remote connection into development version 3.0 of MaximEyes EHR. The participant, moderator & administrator were connected from separate locations. Connection and

computer settings were unchanged for each test. The administrator shared control of their screen, same screen & connection for all tests. Each tests screen & audio were recorded. The testing was conducted in each participants own workspace using hardware they are familiar with. For testing, the computer used a Dell running windows 10. The participants used their own mouse, keyboard & monitor when interacting with MaximEyes EHR. Specifications of the test hardware used was 21 inch monitors, windows 10 basic color scheme, 1920 x 1080 resolution. The application was set up by the First Insight technical staff according to the vendor's documentation describing the system set-up and preparation. The application itself was on a remote server via wireless connection. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation. Additionally, participants did not change any of the default system settings (such as control of font size). Connection and computer settings were unchanged for each test. The administrator shared control of their screen, same screen & connection for all tests. Each tests screen & audio were recorded.

TEST FORMS AND TOOLS

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

- Informed Consent
- Non-Disclosure
- Administrator packet
- Moderator's Guide
- Feedback Questionnaire
- Incentive Receipt
- Online Survey Tool

The participant's interaction with the EHRUT was captured and recorded digitally with screen capture software running on the test machine. An audio recording was made of administrator, moderator & participants.

PARTICIPANT INSTRUCTIONS

The administrator read the following aloud to the participant:

"Thank you for participating in this study. Our session today will last 20-40 minutes. During this time, you will be asked to complete tasks using MaximEyes EHR development version 3.0 and answer a few questions. This is not a test of your knowledge, it is a usability evaluation of specific functionality in MaximEyes EHR 3.0. The intend of this evaluation is to assist First Insight Engineering Team in developing products & features around our users' needs. 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.

The product you will be using today is an in-progress development version of MaximEyes EHR 3.0. All patient & encounter data is fictional test data. Some of the pre-populated data or data you are asked to enter may not be clinically accurate as it is test data.

The computer screen & audio of your session today is being recorded for research & evaluation purposes only. All of the information that you provide will be de-identified & kept confidential."

Following the procedural instructions, participants were given 6 minutes to complete preliminary questions via online survey tool. Participants were then shown the EHR on screen and given the following instruction:

"Next, you will be given some scenarios and associated tasks. You are expected to complete these tasks on your own, attempting to do them as quickly as possible and with the fewest possible errors or deviations. Do not do anything more than asked per the task itself. If you experience difficulty with a task we cannot supply any answers or assistance regarding use of the EHR.

To ensure accurate time keeping we ask that you please save detailed comments/feedback until the final Q&A of the session when we can discuss freely.

I will read each task's complete set of instructions before I ask you to begin the task. Some of the tasks have multiple parts or specific data, I will repeat parts of the instructions one at a time whenever you ask me or if I feel the instruction needs emphasis."

Session A participants were given a total of 9 tasks to complete, 6 of those tasks are included in this summative results report. Session B participants were given a total of 15 tasks to complete, all 15 of those tasks are included in this summative results report. Task scenarios and instructions were read aloud before each task:

"The scenario related to the next task is [scenario read aloud]. Please do not start the task until all I say start. Task instructions in their entirety are [task instructions read aloud]. Start the task."

Following task completion each task was rated, the below text was read aloud to the participant and ratings were recorded by the administrator & moderator:

"Overall, on a scale of 1 to 5, with 1 being very difficult to 5 being very easy, how would you rate the task for [task instruction summary]?"

USABILITY METRICS

According to NIST 7741 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 was 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 the following areas of MaximEyes EHR 3.0:

1. Effectiveness by measuring participant success rates and errors
1. Efficiency & Task Difficulty by measuring the average task time and path deviations
2. Satisfaction by measuring ease of use ratings and post-test SUS
3. Critical Risk Areas identified by evaluation guidance of NIST 7801-1
4. Areas for Improvement

DATA SCORING

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

Measures	Rationale and Scoring
Effectiveness: Task Success	A task was counted as "Easily Completed" (Success) if the participant was able to achieve the correct outcome, within the time allotted on a per task basis. No assistance was given for any task. 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 via Task Success Mean & Task Success Standard Deviation. Note: Task times were recorded for successes only.
Effectiveness: Task Failures	If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as a "Failure/Error". No task times were taken for errors. Not all deviations were counted as errors. The total number of failures were calculated for each task and then divided by the total number of times that task was attempted, this is reported via Failures Mean & Failures Standard Deviation. On a qualitative level, an enumeration of errors and error types were collected and further evaluated for discussion of the findings.
Efficiency: Task Deviations	The participant's path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. Correct Path, Minor Deviations, Major Deviations were recorded. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.

Efficiency: Task Time	Each task was timed from when the administrator said "Start" until the participant had completed the task. Task times were recorded for successes only. Optimal task performance time, as benchmarked by expert performance under realistic conditions, was recorded when constructing tasks. Target task times used were operationally defined by taking multiple measures of optimal performance and multiplying by 1.5 to allow some time buffer as the participants are not trained to expert performance. If expert optimal performance on a task was [x] seconds then allotted task time performance was [x * 1.5] seconds. This ratio was aggregated across tasks and reported with mean and variance scores. Average time per task was calculated for each task. Optimal task time for each task was calculated by time to complete task/optimal task time. Observed task times divided by the optimal time for each task (Task Time Mean/Task Time Observed Mean) is a measure of optimal efficiency. Variance measures (standard deviation and standard error) were also calculated and reported via Task Time Standard Deviation.
Difficulty: Task Rating	Participant's subjective impression of the ease of use of the application was measured by administering both a simple post-task question as well as a post-session questionnaire. After each task, the participant was asked to rate each task on a scale from 1 (Very Difficult) to 5 (Very Easy). These data are averaged across participants and reported via Task Rating Mean & Task Rating Standard Deviation. To measure participants' confidence in and likeability of MaximEyes EHR 3.0 overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. The System Usability Score questionnaire consists of 10 questions, each measured on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree). Results

RESULTS

DATA ANALYSIS AND REPORTING

The results of the usability test were calculated according to the methods specified in the Usability Metrics & Data Scoring sections above. There were no participants excluded from the data.

The usability testing results are displayed in the tables below.

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
Total Usability Results		**93%**	**16%**	**91%**	**91%**	**92%**
1.1	13	92.31%	27.74%	89.74%	149%	97%
1.2	13	100.00%	0.00%	94.87%	114%	97%
2.1	13	84.62%	37.55%	87.18%	123%	82%
2.2	13	100.00%	0.00%	94.87%	91%	82%
2.3	13	84.62%	37.55%	79.49%	103%	82%
3.1	13	100.00%	0.00%	92.31%	79%	97%
3.2	13	100.00%	0.00%	89.74%	107%	97%
4.1	13	100.00%	0.00%	100.00%	77%	98%
5.1	11	100.00%	0.00%	100.00%	76%	95%
5.2	11	100.00%	0.00%	100.00%	50%	95%
5.3	11	100.00%	0.00%	96.97%	54%	96%
5.4	11	100.00%	0.00%	100.00%	86%	98%
5.5	11	100.00%	0.00%	100.00%	86%	98%
6.1	13	100.00%	0.00%	100.00%	45%	94%
6.2	13	100.00%	0.00%	97.44%	91%	94%
0.3	14	92.86%	26.73%	92.86%	80%	94%
0.4	14	85.71%	36.31%	85.71%	134%	93%
0.5	14	78.57%	42.58%	78.57%	90%	84%
0.6	14	71.43%	46.88%	76.19%	128%	78%
0.7	14	78.57%	42.58%	80.95%	54%	91%
0.8	14	78.57%	42.58%	78.57%	88%	85%

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
A5: Demographics Measure Results		**96%**	**14%**	**92%**	**131%**	**97%**
1.1	13	92.31%	27.74%	89.74%	149%	97%
1.2	13	100.00%	0.00%	94.87%	114%	97%

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
B2: Clinical Information Reconciliation Measure Results		**93%**	**20%**	**89%**	**102%**	**89%**
2.1	13	84.62%	37.55%	87.18%	123%	82%
2.2	13	100.00%	0.00%	94.87%	91%	82%
2.3	13	84.62%	37.55%	79.49%	103%	82%
3.1	13	100.00%	0.00%	92.31%	79%	97%
3.2	13	100.00%	0.00%	89.74%	107%	97%
0.3	14	92.86%	26.73%	92.86%	80%	94%
0.4	14	85.71%	36.31%	85.71%	134%	93%

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
A6: Problems List Measure Results		**96%**	**9%**	**89%**	**95%**	**89%**
3.1	13	100.00%	0.00%	92.31%	79%	97%
3.2	13	100.00%	0.00%	89.74%	107%	97%
2.2	13	100.00%	0.00%	94.87%	91%	82%
2.3	13	84.62%	37.55%	79.49%	103%	82%

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
A1: CPOE Medications Measure Results		**95%**	**12%**	**93%**	**92%**	**91%**
0.4	14	85.71%	36.31%	85.71%	134%	93%
2.2	13	100.00%	0.00%	94.87%	91%	82%
2.3	13	84.62%	37.55%	79.49%	103%	82%
5.2	11	100.00%	0.00%	100.00%	50%	95%
5.4	11	100.00%	0.00%	100.00%	86%	98%
5.5	11	100.00%	0.00%	100.00%	86%	98%

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
A7: Medications List Measure Results		**96%**	**11%**	**94%**	**86%**	**91%**
0.4	14	85.71%	36.31%	85.71%	134%	93%
2.2	13	100.00%	0.00%	94.87%	91%	82%
2.3	13	84.62%	37.55%	79.49%	103%	82%
5.2	11	100.00%	0.00%	100.00%	50%	95%
5.5	11	100.00%	0.00%	100.00%	86%	98%
6.1	13	100.00%	0.00%	100.00%	45%	94%
6.2	13	100.00%	0.00%	97.44%	91%	94%

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
A8: Medications Allergy List Measure Results		**95%**	**13%**	**93%**	**83%**	**90%**
0.3	14	92.86%	26.73%	92.86%	80%	94%
2.2	13	100.00%	0.00%	94.87%	91%	82%
2.3	13	84.62%	37.55%	79.49%	103%	82%
5.3	11	100.00%	0.00%	96.97%	54%	96%
5.5	11	100.00%	0.00%	100.00%	86%	98%

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
B3: ePrescribe Measure Results		**100%**	**0%**	**100%**	**74%**	**96%**
5.1	11	100.00%	0.00%	100.00%	76%	95%
5.2	11	100.00%	0.00%	100.00%	50%	95%
5.4	11	100.00%	0.00%	100.00%	86%	98%
5.5	11	100.00%	0.00%	100.00%	86%	98%

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
A4: Drug-Drug, Drug-Allergy Interaction Alerts Measure Results		**96%**	**13%**	**95%**	**79%**	**95%**
5.3	11	100.00%	0.00%	96.97%	54%	96%
5.1	11	100.00%	0.00%	100.00%	76%	95%
5.2	11	100.00%	0.00%	100.00%	50%	95%
0.3	14	92.86%	26.73%	92.86%	80%	94%
0.4	14	85.71%	36.31%	85.71%	134%	93%

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
A2: CPOE Laboratory Measure Results		**75%**	**45%**	**77%**	**109%**	**81%**
0.5	14	78.57%	42.58%	78.57%	90%	84%
0.6	14	71.43%	46.88%	76.19%	128%	78%

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
A3: CPOE Radiology Measure Results		**79%**	**43%**	**80%**	**71%**	**88%**
0.7	14	78.57%	42.58%	80.95%	54%	91%
0.8	14	78.57%	42.58%	78.57%	88%	85%

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
A14: Implanted Device List Measure Results		**100%**	**0%**	**100%**	**77%**	**98%**
4.1	13	100.00%	0.00%	100.00%	77%	98%

Results Table		Effectiveness		Efficiency		Satisfaction
Measure/Task	# of Part.	Success %	Failures (SD)	Deviations Obs/Opt	Time Observed /Optimal	Rating 5=Easy
A9: Clinical Decision Support Measure Results		**95%**	**12%**	**94%**	**90%**	**94%**
6.1	13	100.00%	0.00%	100.00%	45%	94%
6.2	13	100.00%	0.00%	97.44%	91%	94%
0.4	14	85.71%	36.31%	85.71%	134%	93%

DISCUSSION OF THE FINDINGS

EFFECTIVENESS

Overall success score of 92, calculated via (# of successful completions) / (# of attempts). Tasks for never before seen elements like implanted device list & new demographic fields were highly successful.

Average failure standard deviation of 37% for tasks of importing a CDA & Creating a new CDA indicates additional focus needs to be put on this functionality.

Highest success rates came from measures related to ePrescribe, problems list & implanted device list.

Highest failure rates came from measures related to lab & radiology tests & results.

EFFICIENCY

Overall deviation from observed path mean of 9% indicates familiar & strong optimal path coordination. Highest deviation rate for a new functionality was entry of demographics into new fields of sexual orientation & gender identity at 10%. Lowest deviation rates were related to familiar functionality of ePrescribing. 0% deviation from the path for entering implanted devices was surprising as it is brand new.

Overall observed task time mean of 33 seconds compared to optimal task time of 37 seconds lead to the belief that the calculation of [x*1.5] for optimal time was created accurately.

Largest standard deviation of time was for task 1.1 entering demographics into the new fields at 149%, the lowest deviation was for task at 50% was entering an ePrescribe medication.

SATISFACTION

Overall task ratings were 92. Although participants had not been previously exposed to several of the new data elements, not one of them commented on being surprised to see them. Several comments were made on the pre-population of fields and how that makes it easier to enter data quickly. Lowest scored tasks were entering lab test results & highest scored were accessing/receiving updated medication lists as well as accessing/entering problems lists.

The System Usability Scale questionnaire received a score of 78. I believe the positioning of the rating scale for each question being back & forth creates confusion & many users stop looking at where the scale sits related to the question. I also observed some participants that rated tasks high but had low SUS ratings which does not make sense. I assume they were rating the EHR based on their current version & not on the elements that were presented in the test.

CRITICAL RISK ERROR ANALYSIS

No critical use errors were observed as part of patient identification related to data/order entry or identifying inaccurate information. Several participants received system prompts or warnings via tooltip and pop outs to ensure entry of all required information.

MAJOR FINDINGS

Compared to last usability test 2 specific areas for improvement had drastically improved. Data entry value lists timing & usability had improved. Maintaining entry processes & wording was recognized by participants.

Overall the usability scores were dramatically increased compared to past tests.

The standard deviation of effectiveness, efficiency & ratings were the most spread for tasks related to Summary of Care creation & Reconciliation. During testing, it was observed that most participants were either familiar with these processes or not familiar at all.

Six of the total 27 test participants are users that are not as familiar with the encounter module as typical day to day users (doctors or scribe type clinic technicians) were also recruited to participate. These 6 participants attended training in the past on the MaximEyes EHR in general and had little or no actual usage experience in the encounter module specifically. They were the lowest of our scores and had the most negative feedback regarding the final questions and usability scores.

During Session B multiple participants reported the screen was hard to see and go to meeting connection tools were in the way of what they needed to find.

Give better instruction for SUS as related to paying attention to the scale for each question & to base ratings on the system under test & not current system version installed at their practices.

AREAS FOR IMPROVEMENT

Path deviations were highest for tasks related to creating a new Summary of Care & Lab Tests. Summary of Care resulted with a deviation mean of 20%. Which indicates better training for certification criteria related name changes like Clinical Summary to Summary of Care to increase identification is necessary. Also, possibly increasing visibility of high usage functionality needs. Tasks of ordering a specific lab test & entering a lab result with deviation means of 21% & 23%. As this is certification criteria that our users typically are not familiar with they were confused about the purpose.

Give better instruction for SUS as related to paying attention to the scale for each question & to base ratings on the system under test & not current system version installed at their practices.