TriMed Technologies

EHR Usability Test Report of e-Medsys EHR Version 8

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

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EXECUTIVE SUMMARY

A usability test of e-Medsys EHR Version 8 was conducted between March 9th through March 16 by TriMed Technologies staff in High Point, NC through remote sessions. The purpose of this test was to test and validate the usability of the current user interface, and provide evidence of usability in the EHR Under Test (EHRUT). During the usability test, 10 healthcare workers matching the target demographic criteria served as participants and used e-Medsys EHR in simulated, but representative tasks.

The study collected performance data on 13 tasks typically conducted by physicians, nurses, administrators, and clinical staff in e-Medsys EHR.

- Entering demographics
- Interacting with a Clinical Decision Support
- Reviewing the medication list
- Entering a lab order
- Entering a X-ray order
- Entering an Implantable Device Number
- Reviewing and updating the problem list
- Reviewing and updating the allergy list
- Responding to a drug intervention
- Write and send a prescription
- Cancel a prescription
- Respond to a refill request
- Reconciling and incorporating clinical information from a CCD

During the 30-minute one-on-one usability test, each participant was greeted virtually by the administrator. Each participant was read a request for informed consent/release and asked to give their verbal consent (see Appendix 3, Recording Consent). Participants were instructed that they could withdraw at any time.

All participants had prior experience with the system. The administrator introduced the test, and instructed participants to complete a series of tasks (given one at a time) using e-Medsys EHR. During the testing, the administrator timed the test and, along with the data loggers recorded user performance data on paper and electronically. The administrator did not give the participant assistance in how to complete the task. Participant screens and audio were recorded for subsequent analysis. All participant data was de-identified – no correspondence could be made from the identity of the participant to the data collected.

In accordance with the examples in the NIST 7742 Customized Common Industry Format Template for Electronic Health Record Usability Testing, various recommended metrics were

used to evaluate the usability of the software. 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 satisfaction ratings of the system

In addition to the performance data, the following qualitative observations were made:
- Participant’s verbalizations
- Major Findings
- Areas for improvement

INTRODUCTION

The EHR Under Test (EHRUT) tested for this study was e-Medsys EHR 8, an ambulatory electronic health records. Designed to present medical information to the intended users which include healthcare providers and their medical staff in an outpatient setting for various specialties, The usability testing attempted to represent realistic exercises and conditions.

The purpose of this study was to test and validate the usability of the current user interface, and provide evidence of usability in e-Medsys EHR. To this end, measures of effectiveness, efficiency and user satisfaction, such as task completion rate, time on task, path deviation rate, and errors were captured during the usability testing.

METHOD

Participants

A total of 10 participants were tested on e-Medsys EHR. Participants in the test were doctors, medical assistant, administrative staff, and clinical users. Participants were recruited by TriMed Technologies. In addition, participants had no direct connection to the development of or organization producing the EHRUT. 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 product experience. Participant names were replaced with Participant IDs so that an individual's data cannot be tied back to individual identities.

Part ID	Gender	Age Range	Education	Occupation/ role	Professional Experience	Computer Experience	Product Experience	Assistive Technology Needs
1	female	40-49	Asso. degree	Admin	240 months	264 months	60 months	No
2	female	40-49	Bachelor degree	Admin	300 months	420 months	36 months	No
3	male	30-39	Doctorate	Physician	156 months	240 months	4 months	No
4	female	20-29	Vocatio. training	Clinical User	60 months	180 months	36 months	No
5	male	50-59	Doctorate	Physician	360 months	480 months	144 months	No
6	female	20-29	Asso. degree	Clinical User	96 months	216 months	96 months	No
7	female	30-39	Bachelor degree	Admin	120 months	228 months	84 months	No
8	female	20-29	Vocation. training	Clinical User	48 months	144 months	6 months	No
9	female	30-39	Bachelor degree	MA	168 months	252 months	84 months	No
10	female	20-29	Bachelor degree	Admin	144 months	300 months	8 months	No

Ten participants matching the demographics in the section on Participants were recruited and ten participated in the usability test. See Appendix 2 for participant demographics. Participants were scheduled for 30 minute sessions with a minimum of 20 minutes in between each session for debrief by and administrators and data loggers, and to reset systems to proper test conditions.

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 e-Medsys EHR. 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 only e-medsys EHR. Each participant used the system in the same development environment and was provided with the same instructions. The system was evaluated for effectiveness, efficiency and satisfaction as defined by measures collected and analyzed for each participant:

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

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

Tasks

A number of tasks were constructed that would be realistic and representative of the kinds of activities a user might do within the e-Medsys EHR. Tasks were selected based on ONC CEHRT2015 certification criteria, their frequency of use, criticality of function, and those that may be most troublesome for users. The tasks included:

Task	Safety Enhanced Design Criteria
1. Entering Demographics	170.315(a)(15)- Demographics
2. Interacting with Clinical Decision Support	170.315(a)(9)-Clinical Decision Support
3. Updating the Problem List	170.315(a)(6)- Problem List
4. Reviewing and updating the Allergy List	170.315(a)(8)- Allergy List
5. Reviewing the medication list and refill a medication	170.315(a)(7) Medication list

6. Ordering a lab	170.315(a)(2)Computerized provider Order Entry- laboratory
7. Entering a X-ray Order	170.315(a)(3)- Computerized Provider order entry- diagnostic imaging
8. Responding to a drug intervention	170.315(a)(4)- drug-allergy interaction checks
9. Entering an Medical Device List	170.315(a)(14)- Implantable Device
10. Write and send a Prescription	170.315(a)(1)-CPOE Medications, 170.315(b)(3)- Electronic Prescribing
11. Cancel a Prescription	170.315(b)(3)- Electronic Prescribing
12. Respond to a Refill Request	170.315(b)(3)- Electronic Prescribing
13. Reconciling and incorporating clinical data	170.315(b)(3)- Clinical Information Reconciliation and Incorporation

Procedures

TriMed staff conducted the study during remote sessions using GoToMeeting which allows screen-sharing, audio-conferencing and the ability to take mouse control of another person's computer. The test administrator moderated the session including administering instructions and tasks. The administrator also monitored task times, obtained post-task rating data, and took notes on participant comments. A second person served as the data logger and took notes on task success, path deviations, number and type of errors and comments.

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

- As quickly as possible making as few errors and deviations as possible.
- Without assistance; administrators were allowed to give immaterial guidance and clarification on tasks, but not instructions on use.

Task timing began once the administrator finished reading the question. The task time was stopped once the participant indicated they had successfully completed the task. Scoring is discussed below in the Usability Metrics section.
Participants' demographic information, task success rate, time on task, errors, deviations, verbal responses, and post-test questionnaire were recorded into a spreadsheet.

Test Location

Test sessions were held remotely via GoToMeeting. The test administrator logged into the session from a quiet office at TriMed Technologies, Corp in High Point, NC. Participants logged into the session from various locations. During the session, the test administrator could see only the participant's screen and listen to the participant's responses.

Test Environment

e-Medsys EHR would typically be used in a healthcare office or facility. In this instance, the testing was conducted remotely via GoToMeeting. For testing, the test administrator used an Apple iMac desktop running Mac OS with a 5K screen resolution. The participants used their own computer, keyboard and mouse when interacting with the system and were given remote control of the test administrator's system.

The application was set up by TriMed staff according to the documentation describing the system set-up and preparation. The application itself was running on a web-based browser platform using a test database on a wireless connection. Technically, the system performance (i.e., response time) was somewhat slower than what actual users would experience in a field implementation due to the remote connection.

Test Forms and Tools

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

- Recording Consent Statement
- Task List
- GoToMeeting Software

Examples of these documents can be found in the Appendices.
The participant's interaction with e-Medsys EHR was captured and recorded digitally with the GoToMeeting recording tool running on the test administrator's computer. Verbal comments were recorded with the participants' computer microphones or telephones.

Participant Instructions

The administrator read the following instructions aloud to each participant:

Thank you for participating in TriMed's Usability Test! Your input is very important to us. Our session today will last about 30 minutes. You will be using e-Medsys EHR 8. During this time, I will ask you to complete a few tasks using the system and answer some questions.
We are interested in how easy (or how difficult) this system is to use and how we could improve it. The purpose of this study is to test the usability of our software and not to test you. Therefore, if you have difficulty with something there may be something in the system that we need to improve. 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
The results from this study will help us to make our software more useful and usable in the future.

With your permission, I would like to record today's session. Do you agree to grant TriMed's team permission to use screen recording and audio recordings of this session for internal purposes related to the improvement of the product?

Once permission was given, the administrator read the following instructions:

Thank you so much. If for any reason you feel it necessary to take a break or withdraw from the test you may do so.

I have prepared the testing system for you and we are about to start the tasks. I have made it so that you can take control of the screen. Are you able to see the testing system on your screen and can you move the mouse? Great!
For each task, I will read the instructions to you and they will appear on screen for you to read as well.

Please work at your normal speed and only do what you are specifically asked to do in the system. I will be here in case you are stuck, but I won't be able to instruct you or provide specific steps on how to use the application.
Please verbally indicate when you are done with each task. I will then ask you to rate the ease of completing each task and whether you have any feedback.
Do you have any questions or concerns?

Participants were then given the thirteen tasks to complete. The tasks are listed in Appendix 4.

Usability Metrics

According to the NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records, EHRs should support a process that provides a high level of usability for all users. The goal is for users to interact with the system effectively, efficiently, and with an acceptable level of satisfaction. To this end, metrics for effectiveness, efficiency and user satisfaction were captured during the usability testing. The goals of the test were to assess:

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

Data Scoring

Measures	Rationale and Scoring
Effectiveness: Task Success	A task was counted as a "Success" if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis. The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage. Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency. Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target task times used for task times in the Moderator's Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by 2 that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was 20 seconds then allotted task time performance was 40 seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.
Effectiveness: Task Failures	If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as an "Failures." No task times were taken for errors. The total number of errors was calculated for each task

	and then divided by the total number of times that task was attempted. Not all deviations would be counted as errors. This should also be expressed as the mean number of failed tasks per participant. On a qualitative level, an enumeration of errors and error types should be collected.
Efficiency Task Deviations	The participant's path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.
Efficiency: Task Time	Each task was timed from when the administrator said "Begin" until the participant said, "Done." If he or she failed to say "Done," the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation and standard error) were also calculated.
Satisfaction: Task Rating	A subjective impression of the ease of use of the application was measured by administering both a simple post-task question. A scale of Very Easy (5) to Neutral(3) to Very Difficult (1) was used to determine the satisfaction. This data are averaged across participants.

Results

Data Analysis and Reporting

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

The usability testing results for e-Medsys EHR are detailed below. The results should be seen in light of the objectives and goals outlined in the Study Design section. The data yielded actionable results that, when corrected, will yield a material, positive impact on user performance.

Measure / Task	*N*	Task Success	Path Deviation	Task Time		Errors	Task Ratings 5=Easy
	#	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Mean (SD)
1. Entering Demographics	10	60% (.52)	24.9/24 clicks	2 mins 55 sec (62.3)	151/147 seconds	0.4 (.52)	3 (.94)
2. Interacting with a Clinical Decision Support	10	90% (.31)	2/2 clicks	20.4 sec (17.3)	20.4/42 seconds	0.1 (.31)	5 (0)
3. Reviewing and updating the problem list	10	60% (.52)	4/4 clicks	51.7 sec (20.5)	51.7/60 seconds	0.4 (.52)	4.2 (0.78)
4. Reviewing and updating the allergy list	10	70% (.48)	7.1/7 clicks	56.1 sec (17.14)	56.1/60 seconds	0.3 (.48)	4.1 (0.56)
5. Reviewing the Medication List	10	100% (0)	2.4/2 clicks	17.4 sec (7.80)	17.4/36 seconds	0	4.3 (0.82)
6.Entering a Lab Order	10	80% (.42)	1.1/1 clicks	21.9 sec (19.6)	21.9/23 seconds	0.2 (.42)	4.5 (0.85)
7.Entering a X-ray Order	10	100% (0)	1/1 clicks	8.7 sec (10.89)	8.7/12 seconds	0	5 (0)
8. Entering a Medical Device Number	10	70% (.48)	5/4 clicks	1 min 38 sec (121.56)	92/35 seconds	0.3 (.48)	3.7 (0.48)
9. Responding to a drug intervention	10	100% (0)	1/1 clicks	13.3 sec (12.38)	13.3/10 seconds	0	5 (0)
10. Write and send prescription	10	70% (.48)	5/5 clicks	33.1 sec (12.66)	33.1/40 seconds	0.3 (.48)	4.3 (0.67)
11. Cancel a Prescription	10	50% (.53)	2.6/2 clicks	1 min 8 sec (33.34)	67/40 seconds	0.5 (.53)	3.5 (0.70)
12. Respond to a Refill Request	10	80 (.42)	5.5/5 clicks	51.8 sec (22.37)	51.8/50 seconds	0.2 (.42)	4 (1.05)
13.Reconciling and incorporating clinical information from a CCD	10	60% (0.52)	4.3/ 4 clicks	1 min 6 sec (39.12)	66/60 seconds	0.4 (.52)	3.6 (0.52)

Effectiveness

Overall, e-Medsys was found to be very effective. There was an average of 76% success rate across the 13 tasks and four tasks had a 90% or higher success rate. The only failures were due to time. These participants who failed took longer than the allotted time, many times it was only one to five seconds over the allotted time.

Efficiency

e-Medsys EHR was also found to have high measures of efficiency. The path deviation rate was found to be very low with the highest only being 1.1 (the closer to 1, the better) proving that the software pathways are intuitive to users and efficient. The task time deviation rate was also fairly low for most tasks.

Satisfaction

Participants rated e-Medsys with a high satisfaction rating overall. The average satisfaction rating for all tasks was 4.17 out of 5.

Major Findings

e-Medsys was found to be a very usable system and overall intuitive, efficient and with a high satisfaction rate. Participants struggled the most in the areas of the product they were unfamiliar with but after attempting the tasks found the areas to be straightforward.

Areas for Improvement

Areas for improvement for each individual task are detailed below. An area of improvement that came up more was having more tooltips or instructions. Once the users completed the task (even the new ones), they agreed it made sense but training helps the task be less intimidating and confusing.

Task Results and Discussion of Findings

Task 1: Entering Demographics (a,5)

Effectiveness

Entering Demographics was found to be 60% effective, since more than half were able to successfully finish the task. Four out of ten failed the task due to going over the allotted time, due to the new feature of choosing ‘Race’ was unfamiliar to them.

Efficiency

The participants were able to complete the task although the time took longer than the optimal time. The average click was 24.9 clicks, and compared to the 24 clicks optimal time. There was several path deviations when selecting a Race for the patient.

Satisfaction

The participants were pleased with the Demographic changes, but did not think entering the Race was very easy. The average rating was a 3 due to the complex nature of the Race field and all the sub-categories.

Major Findings
Overall the Demographics was a usable module in e-Medsys. The participants seem to struggle with the new features: Race, Sexuality, Gender Identity. The were confused in how to select the proper race with some many sub-groups and arrows.

Areas of Improvement-
An area of improvement would be to make the 'Race' field easier to navigate. When the user clicks on the race field, this action should add it to the screen, instead of having to use arrows to move the race over to the selected field. A tooltip on the screen would also help users know how to navigate this feature.

Task 2: Interacting with a Clinical Decision Support (a.9)

Effectiveness
There was a 90% success rate for this task. It was very easy for participants to interact with a clinical decision support.

Efficiency
The participants were able to complete the task with no path deviations. The observed path and optimal path were the same for all the participants. The average observed time was also a lot quicker (20.4 seconds) than the optimal time (42 seconds).

Satisfaction
There was a overall satisfaction rating of 5.

Major Findings
Interacting with Clinical Decision Support was easy and intuitive for the participants.

Areas of Improvement
There were no areas of improvement for this task at this time.

Task 3: Reviewing and updating the problem list (a.6)

Effectiveness
There was a 60% success rate for this task with six out of ten participants completing the task. The task failures was due to going over the time allotted for the task. This was due to unfamiliarity and taking their time on the given task.

Efficiency
The average task time was 51.7 seconds with most participants completing the task quicker than the optimal task time, which was 60 seconds. The observed path versus the optimal path were the same, with both being 4.

Satisfaction
This task had a satisfaction rating of 4.2 out of 5. Even though the task took longer for some, the participants were still satisfied.

Major Findings
The participants were slow finding their path through the task, but it was still the correct path and they were satisfied with the task. There was confusion for some participants on what would be included on the Problem List, and what all would be included on this list.

Areas for Improvement
Look into ways to speed up users entering data into the problem list. There are a quite a few dropdowns to enter data and some of the participants paused as they were looking at the dropdown.

Task 4: Reviewing and updating the Allergy List (a.8)

Effectiveness
There was a 70% success rate of participants entering data onto the the allergy list. The three participants failed this task due to going over the allotted time.

Efficiency
The average time it took on this task was 51.7, which was faster than the optimal time (at 60 seconds).There were a few more path deviations on this task, with the average being 7.1 versus the optimal of 7 clicks. The few path deviations came from unsure of where to go for entering an Allergy.

Satisfaction
The task had a satisfaction rate of 4.1 out of 5. Participants were still satisfied even though it might have taking longer to finish.

Major Findings
There were some participants roles who were not as used to these screens and therefore took more time in completing the task.

Areas for Improvement
There seemed to be hesitation in the categories field on the Allergy screen. Adding a tooltip at each of the dropdown to help the users know what they should be adding.

Task 5: Review the Medication List (a.7)

Effectiveness

There was a 100% success rate for this task. It was very easy for participants to access the patient's medication list and review.

Efficiency

Most participants completed the task faster than the optimal time with no path deviations. The average task time was 17.4 seconds, which is a lot lower than the optimal task time of 36 seconds.

Satisfaction

This task had a high satisfaction rate of 4.3 out of 5. Most participants were familiar with the task and found it very easy to complete.

Major Findings

The participants found it easy to review the medication list within the chart.

Areas for Improvement

The 100% success rate indicates there is not much need for improvement.

Task 6: Entering a Lab Order (a.2)

Effectiveness

There was a 80% success rate for this task. It was very easy for participants to enter a lab order for a patient. Two of the participants went over the allotted time so therefore they failed the task.

Efficiency

The average observed time was 21.9 seconds which was quicker than the optimal time (23 seconds). The path deviation came from unfamiliarity of this feature, and choosing a longer path to complete the task.

Satisfaction

The participants average satisfaction rate was a 4.5 out of 5. There were no complaints about this task.

Major Findings

Overall this task was pretty straightforward, and there were not any major findings. There were a few ways to do this task, some quicker than others.

Areas of Improvement

There are no areas of improvement for this task at this time.

Task 7: Entering a X-ray Order (a.3)

Effectiveness

There was a 100% success rate for this task. All of the participants had were able to complete the task with no difficulties.

Efficiency

Overall this task was very effective. The observed time was 8.7 seconds which was quicker than the optimal time of 12 seconds. There were also no path deviations from the participants.

Satisfaction

This was one of the higher satisfactions scores of 5 out of 5.

Major Findings

The participants were able to complete task very straightforward.

Areas of Improvement

There were no areas of improvement since this was a 100% success rate.

Task 8: Entering a Medical Device Number (a.14)

Effectiveness

This task had a 70% success rate. Three out of the 10 participants failed due to going over the time allotted. This was a new feature and therefore unfamiliarity played a role with the participants.

Efficiency

The average observed time was 92 seconds compared to the optimal time of 35 seconds. There were also a few more path deviations with 5 being the average number of clicks compared to 4 from the optimal path. This task was a new feature and the participants were unsure of what to do.

Satisfaction

The average satisfaction score was 3.7 out of 5. The lower satisfaction score speaks to the unfamiliarity of the task.

Major Findings

Some of the participants were unclear as to what this was for, since there were not used to utilizing this in their specialty. This coupled with the new feature led to more path deviations and longer times. After the participants figured out what to do with the medical device number, they sped up in completing the task.

Areas of Improvement
Adding a tooltip over the label could help minimize what to do with this field. After training, this use would be easy to use and once the practice is need of utilizing this feature.

Task 9: Respond to a Drug Intervention (a.4)

Effectiveness
This task had a 100% success rate with zero errors and all participants found it very easy to respond to the drug-drug intervention.

Efficiency
None of the participants had any path deviations and over half of the participants were able to complete the task faster than the optimal time.

Satisfaction
This task had a very high satisfaction rating with an average of 5 out of 5.

Major Findings
Having a drug intervention alert made it easy for the participants to respond to.

Areas for Improvement
No major suggestions for improvement were given since the task was easily completed.

Task 10: Write and Send a Prescription (a.1, b.3)

Effectiveness
This task had an 70% success rate due to participants due to going over the time allotted.

Efficiency
The average time for the task was 33.1 seconds with the optimal time being 40 seconds. There were also no path deviations for this task. The participants knew where to go, but they just took awhile to complete the task.

Satisfaction
The task had a high satisfaction rate of 4.3 out of 5. Most participants found writing and sending a prescription straightforward and easy.

Major Findings
The participants seemed to be familiar with the most optimal path to write and e-send a prescription, but they took their time. A few participants made comments that they do not write prescriptions, so they were taking their time to ensure they clicked on the right dropdowns. Having prescription templates help make sense of the screen.

Areas for Improvement
There is not a lot of areas of improvement with this task, as it was pretty successful, and efficient. It is better for providers to use templates when selecting the prescription template, than by searching for the drug by itself, since there are a lot of dropdowns and can sometimes slow the drug writing process down.

Task 11: Cancel a Prescription (b.3)

Effectiveness
This task had an 50% success rate due to this being a new feature and the participants were unfamiliar with where this feature would be. Five out of ten participants went over the time allotted for this task.

Efficiency
The average observed time of 67 seconds was higher than the optimal time of 40 seconds. This was due to the participants going to other screens in order to look for the feature of e-canceling a prescription.

Satisfaction
The task had an average satisfaction rate of 3.5 out of 5.

Major Findings
Half of the participants were able to complete this task in the time allotted. The participants who went over the time allotted, saw that it made sense after the fact, but was unsure where to look for the feature at first.

Areas for Improvement
An area of improvement could be to make the e-cancel button a tad bigger and move it down on the screen, so it is set apart from the rest of the screen.

Task 12: Respond to a Refill Request (b.3)

Effectiveness
There was a 80% success rate from the participants,and this was due to going over the time allotted.

Efficiency
There were a few path deviations with the observed time being 51.8 seconds versus the optimal time of 51 seconds. A few of our participants forgot to enter a Refill number before submitting the prescription refill.

Satisfaction
This task had a satisfaction rate of 4 out of 5.

Major Findings
Most of all the participants spent more time finding the ‘send/refill’ button. There are a lot of blue buttons on this screen, so it seems hard to distinguish which one will execute the ‘send’ function.

Areas for Improvement
The screen seemed jumbled and hard to read. The ‘send/refill’ button was hard to find and did not stand out on the page.

Task 13: Reconciling and incorporating clinical information from a CCD (b.2)

Effectiveness
The task success rate was 60% due to this being a new feature and the participants went over the time allotted.

Efficiency
The average time it took to complete the task was 66 seconds versus the optimal time of 60 seconds. The longer time and some path deviations (4.3 observed clicks vs 4 optimal clicks) were due to the participants unsure of where to go to complete the task.

Satisfaction
The satisfaction rate was 3.6, so it was average compared to the other task.

Major Findings
Even though this task did not seem very efficient at first glance, the participants were able to finish the task. They all finished the task, even though it took a lot longer than expected.

Areas of Improvement
Searching for the patient’s name and or date of birth seemed to be confusing to the participants, so making the search fields easier to decipher could be an improvement.

Appendices

Appendix 1: Recruiting Screener

The test administrator asked the questions at the beginning of the session.

1. Name
2. Email address
3. Gender
    a. Male
    b. Female
    c. Other/decline to answer
4. Age Range
    a. 20-29
    b. 30-39
    c. 40-49
    d. 50-59
    e. 60-69
5. What is your role in the medical office?
6. How many years have you been working in your field?
7. How many years of experience do you have using computers for personal and professional activities?
8. How long have you used e-Medsys EHR?

Appendix 2: Participant Demographics

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

Gender

Male	2
Femal	8
Total Participants	10

Occupation/Role

Admin	4
Physician	2
Clinical User	3
Medical Assistant (MA)	1

Professional Experience

0-10 years	4
11-20 years	4
21+ years	2

Computer Experience

5-15 years	4
16-25 years	3
25-35 years	2
36+ years	1

e-Medsys Experience

0-12 months	3
2-5 years	3
6-10 years	3
10 + years	1

Appendix 3: Recording Consent

Participants were asked to give a verbal consent to the statement below:

Do you agree to grant the TriMed team permission to use screen recording and audio recordings of this session for internal purposes related to the improvement of the product?

Appendix 4: Tasks

Today you will be Dr. Adam Aarons working out of the Boston Department. The first patient you are seeing today is Stephanie Williams female. She is a regular patient of yours who is already in the system and has come in due to having a rash on her arms and legs.

Task 1 Entering Demographics.

You are going to create a new patient with the following information (this information was emailed to them as well.

- Name: Smith, John
- Address: 1234 Test Lane 27265
- Cell Phone: 123-456-7890
- Race: Chinese
- Ethnicity: Non Hispanic or Latino
- DOB: 1/1/2015
- Gender: Male
- Sexual Orientation: Straight or heterosexual
- Gender Identity: Male

At this point, you can ‘Save’ the patient

Task 2 Interacting with Clinical Decision Support

An alert popped up for the provider to ‘Please check blood pressure at every visit’ due to the patient having a history of high blood pressure.
Respond to the clinical alert.

Task 3 Update the Problem List

Add ‘Asthma-mild intermittent, uncomplicated’ to the Problem List
Save the information.

Task 4 Reviewing and Update the Allergy List

Next, add ‘ibuprofen’ as an allergy to your patient's chart. The edit ‘Benadryl to include a reaction of ‘breaks out in hives’. Save the information.

Task 5 Review the medication list

Now go and review, and document that you have reviewed the patient’s current medications.

Task 6 Ordering a lab

Order a CBC lab for your patient.

Task 7 Entering a X-ray Order

Order a chest X-ray for your patient.

Task 8 Enter a Medical Device Number

Get the number from your email and insert that as a medical device into your patients chart.

(01)00821329900273(17)210228(10)75431234)

Task 9 Respond to a drug intervention

Write a prescription for Amoxicillin 250mg chewable tablets- take 1 tablet 2 times a day and then send it to the patient's pharmacy. You decide to prescribe the patient Amoxicillin. There's a drug-drug interaction warning and realize Amoxicillin interaction with a drug allergy ibuprofen the patient is currently taking. Respond to the alert.

Task 10 Write and send a prescription

Start a new prescription for Bactrim 40-200mg/5ml, and e-send to the patients pharmacy
CA Pharmacy Store 10.6

Task 11 Cancel a prescription

The patient decided not to take the prescription, so go in an cancel the Prescription for Bactrim.

Task 12 Respond to a refill request

Now please go and check for and see if you have any Rx Refills waiting to be refilled. Pick one refill and Accept it for 3 more refills.

Task 13 Reconciling and incorporating clinical data

Now check and see if you have CCD's from other practices that need to be imported.

Appendix 5: 170.315(b)(11) Decision Support Interventions - Usability Report

EXECUTIVE SUMMARY

A usability test of e-Medsys E.H.R. version 8 was conducted on Dec 09, 2024 by TriMed Technologies staff in High Point, NC, through in-person sessions. The purpose of this test was to test and validate the usability of the current user interface and provide evidence of usability in the EHR Under Test (EHRUT). During the usability test, 10 healthcare workers matching the target demographic criteria served as participants and used e-Medsys E.H.R. in simulated, but representative tasks.

The study focused on measuring the effectiveness, efficiency and satisfaction of using e-Medsys E.H.R. version 8 as outlined by ISO 13407:1999 – Human-Centered Design Processes for Interactive Systems. ISO 13407 specifies a human-centered design process for developing interactive systems. It outlines a structured approach to ensure systems are usable and meet user needs through active user involvement and iterative design. The standard emphasizes understanding the context of use, specifying user and organizational requirements, producing design solutions, and evaluating them against usability requirements. This standard focuses on integrating usability into the development lifecycle to ensure effectiveness, efficiency, and user satisfaction (Citation: *ISO 13407:1999. Human-Centered Design Processes for Interactive Systems. International Organization for Standardization (ISO), Geneva, Switzerland, 1999*).

The study collected performance data on multiple tasks typically conducted by physicians, nurses, Administrators, and clinical staff in e-Medsys E.H.R. which included those listed below:

- (b)(11).1. Decision Support Intervention Setup
- (b)(11).2. Decision Support Intervention Feedback Setup
- (b)(11).3. Source Attribute for Decision Support Intervention Setup
- (b)(11).4. Decision Support Intervention with Feedback
- (b)(11).5. View Source Attributes during Intervention
- (b)(11).6. Response to Feedback during Intervention
- (b)(11).7. Review the Predictive Decision Support Information Setup

During the 20-minute one-on-one usability test, each participant was greeted by the administrator. Each participant was read a request for informed consent/release and asked to give their verbal consent (see Appendix 3, Recording Consent). Participants were instructed that they could withdraw at any time.

All participants had prior experience with the system. The administrator introduced the test and instructed participants to complete a series of tasks (given one at a time) using e-Medsys E.H.R.. During the testing, the administrator timed the test and, along with the data loggers recorded user performance data on paper and electronically. The administrator did not give the participant assistance in how to complete the task. All participant data was de-identified – no correspondence could be made from the identity of the participant to the data collected.

In accordance with the examples in the NIST 7742 Customized Common Industry Format Template for Electronic Health Record Usability Testing, various recommended metrics were used to evaluate the usability of the software.
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 satisfaction ratings of the system

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

- Participant's verbalizations
- Major Findings
- Areas for improvement

INTRODUCTION

The EHR Under Test (EHRUT) tested for this study was e-Medsys E.H.R., an ambulatory electronic health records. Designed to present medical information to the intended users which include healthcare providers and their medical staff in an outpatient setting for various specialties. The usability testing attempted to represent realistic exercises and conditions.

The purpose of this study was to test and validate the usability of the current user interface and provide evidence of usability in e-Medsys E.H.R.. To this end, measures of effectiveness, efficiency, and user satisfaction, such as task completion rate, time on task, path deviation rate, and errors were captured during the usability testing.

METHOD

Participants

A total of 10 participants were tested on e-Medsys E.H.R.. Participants in the test were doctors, nurses, Administrative staff, and clinical users. Participants were recruited by TriMed Technologies. In addition, participants were all regular end-users of the EHRUT. 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 5.1.

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 product experience. Participant names were replaced with Participant IDs so that an individual's data cannot be tied back to individual identities.

Part ID	Gender	Age Range	Education	Occupation/ role	Professional Experience	Computer Experience	Product Experience	Assistive Technology Needs
11	Female	30-39	Bachelor Degree	Front Office	84 months	180 months	8 months	No
12	Female	30-39	Assoc. Degree	Front Office	48 months	150 months	1 month	No
13	Female	50-59	Assoc. Degree	Admin	360 months	240 months	1 month	No
14	Male	40-49	Bachelor Degree	Admin	252 months	276 months	3 months	No
15	Female	40-49	Assoc Degree	Admin	180 months	240 months	36 months	No
16	Male	40-49	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Admin	300 months	336 months	1 month	No
17	Female	20-29	Bachelor Degree	Admin	300 months	336 months	3 months	No
18	Female	30-39	Bachelor Degree	Clinical User	360 months	204 months	3 months	No
19	Male	40-49	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Physician	300months	312 months	4 months	No
20	Female	40-49	Bachelor Degree	Physician	300 months	300 months	12 months	No

Ten participants matching the demographics in the section on Participants were recruited and ten participated in the usability test. See Appendix 5.2 for participant demographics. Participants were scheduled for a 20-minute session.

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 e-Medsys E.H.R.. 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 only e-Medsys E.H.R.. Each participant used the system in the same development environment and was provided with the same instructions. The system was evaluated for effectiveness, efficiency and satisfaction as defined by measures collected and analyzed for each participant:

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

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

Tasks

A number of tasks were constructed that would be realistic and representative of the kinds of activities a user might do within e-Medsys E.H.R.. Tasks were selected based on ONC certification criteria, their frequency of use, criticality of function, and those that may be most troublesome for users. The tasks included:

Task	Safety Enhanced Design Criteria
(b)(11).1. Decision Support Intervention Setup	170.315(b)(11)-Decision Support Interventions
(b)(11).2. Decision Support Intervention Feedback Setup	170.315(b)(11)-Decision Support Interventions
(b)(11).3. Source Attribute for Decision Support Intervention Setup	170.315(b)(11)-Decision Support Interventions

(b)(11).4. Decision Support Intervention with Feedback	170.315(b)(11)-Decision Support Interventions
(b)(11).5. View Source Attributes during Intervention	170.315(b)(11)-Decision Support Interventions
(b)(11).6. Response to Feedback during Intervention	170.315(b)(11)-Decision Support Interventions
(b)(11).7. Review the Predictive Decision Support Information Setup	170.315(b)(11)-Decision Support Interventions

Procedures

TriMed staff conducted the study during sessions onsite with the participants. The test administrator moderated the session, including administering instructions and tasks. The administrator also monitored task times, obtained post-task rating data, and took notes on participant comments. A second person served as the data logger and took notes on task success, path deviations, number and type of errors, and comments.
Participants were instructed to perform the tasks (see specific instructions below):

- As quickly as possible making as few errors and deviations as possible.
- Without assistance; administrators were allowed to give immaterial guidance and clarification on tasks, but no instructions on use.

Task timing began once the administrator finished reading the question. The task time was stopped once the participant indicated they had successfully completed the task. Scoring is discussed below in the Usability Metrics section.
Participants' demographic information, task success rate, time on task, errors, deviations, verbal responses, and post-test questionnaires were recorded into a spreadsheet.

Test Location

Test sessions were held at the user's normal principal place of work. During the session, the test administrator could see the participant's screen, listen to the participant's response, and monitor ambient surroundings.

Test Environment

The participants used their own computer, keyboard, and mouse when interacting with the system.

The application was set up by TriMed staff according to the documentation describing the system setup and preparation. The application itself was running on a web-based browser platform using a test database on a wireless connection.

Test Forms and Tools

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

- Recording Consent Statement
- Task List

Participant Instructions

The administrator read the following instructions aloud to each participant:

Thank you for participating in TriMed's Usability Test! Your input is very important to us. Our session today will last about 20 minutes. You will be using e-Medsys E.H.R.. During this time, I will ask you to complete a few tasks using the system and answer some questions.
We are interested in how easy (or how difficult) this system is to use and how we could improve it. The purpose of this study is to test the usability of our software and not to test you. Therefore, if you have difficulty with something there may be something in the system that we need to improve. 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
The results from this study will help us to make our software more useful and usable in the future. If for any reason you feel it necessary to take a break or withdraw from the test you may do so.

I have prepared the testing system for you, and we are about to start working on the tasks. For each task, I will read the instructions to you.

Please work at your normal speed and only do what you are specifically asked to do in the system. I will be here in case you are stuck, but I won't be able to instruct you or provide specific steps on how to use the application.

Please verbally indicate when you are done with each task. I will then ask you to rate the ease of completing each task and whether you have any feedback.
Do you have any questions or concerns?

Participants were then given seven tasks to complete. The tasks are listed in Appendix 5.3.

Usability Metrics

According to the NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records, EHRs should support a process that provides a high level of usability for all users. The goal is for users to interact with the system effectively, efficiently, and with an acceptable level of satisfaction. To this end, metrics for effectiveness, efficiency and user satisfaction were captured during the usability testing. The goals of the test were to assess:

1. Effectiveness of e-Medsys E.H.R. by measuring participant success rates and errors
2. Efficiency of e-Medsys E.H.R. by measuring the average task time and path deviations
3. Satisfaction with e-Medsys E.H.R. by measuring ease of use ratings

Data Scoring

Measures	Rationale and Scoring
Effectiveness: Task Success	A task was counted as a "Success" if the participant was able to achieve the correct outcome, without assistance, within the time allotted. The total number of successes was calculated for the task and then divided by the total number of times that task was attempted. The results are provided as a percentage. Task times were recorded for successes. Observed task times divided by the optimal time for the task is a measure of optimal efficiency. Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target task times used for task times in the Moderator's Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by 2 that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was 20 seconds

	then the allotted task time performance was 40 seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.
Effectiveness: Task Failures	If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as a “Failures.” No task times were taken for errors. The total number of errors was calculated for the task and then divided by the total number of times that task was attempted. Not all deviations would be counted as errors. This should also be expressed as the mean number of failed tasks per participant. On a qualitative level, an enumeration of errors and error types should be collected.
Efficiency Task Deviations	The participant’s path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.
Efficiency: Task Time	The task was timed from when the administrator said “Begin” until the participant said, “Done.” If he or she failed to say “Done,” the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation and standard error) were also calculated.
Satisfaction: Task Rating	A subjective impression of the ease of use of the application was measured by administering both a simple post-task question. A scale of Very Easy (5) to Neutral(3) to Very Difficult (1) was used to determine satisfaction. These data are averaged across participants.

Results

Data Analysis and Reporting

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. Participants who failed to follow session and task instructions had their data excluded from the analyses.
The usability testing results for e-Medsys E.H.R. are detailed below. The results should be seen in light of the objectives and goals outlined in the Study Design section. The data yielded actionable results that, when corrected, will yield a material, positive impact on user performance.

Measure / Task	*N*	Task Success	Path Deviation	Task Time		Errors	Task Ratings 5=Easy
	#	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Mean (SD)
(b)(11).1. Decision Support Intervention Setup	10	80% (40%)	7 / 5 clicks	28 sec (7)	28 sec /22 sec	20% (40%)	4.6 (0.49)
(b)(11).2. Decision Support Intervention Feedback Setup	10	90% (30%)	5 / 4 clicks	13 sec (4)	13 sec /11 sec	10% (30%)	4.7 (0.46)
(b)(11).3. Source Attribute for Decision Support Intervention Setup	10	100% (0%)	5 / 3 clicks	13 sec (3)	13 sec / 11 sec	0% (0%)	4.8 (0.40)
(b)(11).4. Decision Support Intervention with Feedback	10	100% (0%)	4 / 4 clicks	24 sec (8)	24 sec /18 sec	10% (30%)	5 (0)
(b)(11).5. View Source Attributes during Intervention	10	100% (0%)	4 / 3 clicks	4 sec (1)	4 sec / 3 sec	0% (0%)	5 (0)
(b)(11).6. Response to Feedback during Intervention	10	100% (0%)	4 / 3 clicks	5 sec (3)	5 sec /4 sec	0% (0%)	5 (0)
(b)(11).7. Review the Predictive Decision Support Information Setup	10	80% (40%)	4 / 3 clicks	15 sec (5)	15 / 12 sec	20% (40%)	4.7 (0.46)

Effectiveness

Overall, e-Medsys E.H.R. was found to be very effective. There was a success rate greater than 80% across all tasks and five out of seven tasks had a 90% success rate or higher.

Efficiency

e-Medsys E.H.R. was also found to have high measures of efficiency. The path deviation rate was found to be very low with the average being 1.29 (the closer to 1, the better) proving that the software pathways are intuitive to users and efficient. The task time deviation rate was also fairly low for most tasks.

Satisfaction

Participants rated e-Medsys E.H.R. with a high satisfaction rating overall. The average satisfaction rating for all tasks was 4.83 out of 5.

Major Findings

e-Medsys E.H.R. was found to be a usable system with a high satisfaction rate. Participants struggled the most with understanding some of the newer screens.

Areas for Improvement

While results were very good overall and high marks summarized the overall feedback there are opportunities for improvement with labeling some of the screens.

Appendices

Appendix 5.1: Recruiting Screener

The test administrator asked the questions at the beginning of the session.

1. Name
2. Email address
3. Gender
    a. Male
    b. Female
    c. Other/decline to answer
4. Age Range
    a. 20-29
    b. 30-39
    c. 40-49
    d. 50-59
    e. 60-69
5. What is your role in the medical office?

6. How many years have you been working in your field?

7. How many years of experience do you have using computers for personal and professional activities?

8. How long have you used e-Medsys E.H.R.?

Appendix 5.2: Participant Demographics

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

Gender

Male	2
Female	8
Total Participants	10

Occupation/Role

Admin	4
Physician	2
Clinical User	1
Nurse	1
Front Office	2

Professional Experience

0-10 years	3
11-20 years	2
21+ years	5

Computer Experience

5-15 years	3
16-25 years	2
21+ years	5
36+ years	0

e-Medsys E.H.R. Experience

0-12 months	9
2-5 years	1
6-10 years	0
10 + years	0

Appendix 5.3: Tasks

(b)(11).1. Decision Support Intervention Setup

Users went to the Admin module for the Decision Support Setup. Users identified an X-ray intervention for patients with radiation sensitivities and observed the alert and trigger that should be shown to clinicians. Users saved the setup, thus setting up an evidenced-based DSI.

- Associated Criteria:
  170.315(b)(11) Decision Support Intervention

(b)(11).2. Decision Support Intervention Feedback Setup

Users initiated the task in the Decision Support Admin module and were guided to the Feedback Admin module. In this step, the admin user selected the evidence-based DSI identified in the previous step. The user was then able to view the available feedback option templates associated with the DSI and save the feedback prompt.

- Associated Criteria:
  170.315(b)(11) Decision Support Intervention

(b)(11).3. Source Attribute for Decision Support Intervention Setup

While remaining in the Decision Support Admin module, the user was directed to select the evidence-based DSI within the Source Attribute section. In this step, the user could view and modify any of the source attributes related to the DSI setup from previous steps. After making adjustments to a value, the user successfully saved the changes.

- Associated Criteria:
  170.315(b)(11) Decision Support Intervention

(b)(11).4. Decision Support Intervention with Feedback

At the chart level, the user completed an X-ray order, triggering an alert for the provider:
“This pediatric patient has a documented condition associated with increased radiation sensitivity or has undergone frequent imaging. Consider alternative imaging options (e.g., MRI or ultrasound) when clinically appropriate, per American College of Radiology (ACR) and American Academy of Pediatrics (AAP) guidelines.”
This alert was prompted by the patient’s diagnosis indicating increased radiation sensitivity. The task was deemed complete once the user successfully read and acknowledged the alert, as confirmed verbally by the user.

- Associated Criteria:
  170.315(b)(11) Decision Support Intervention

(b)(11).5. View Source Attributes during Intervention

From the evidence-based DSI triggered in the chart, the user was able to locate and review the various source attributes. These attributes corresponded to those previously configured by the user within the Decision Support Admin module.

- Associated Criteria:
  170.315(b)(11) Decision Support Intervention

(b)(11).6. Response to Feedback during Intervention

After reviewing the source attributes, the user selected a feedback prompt and entered any desired comments related to the evidence-based DSI alert. Upon completing their selection, the intervention closed, and the user was returned to their clinical task.

- Associated Criteria:
  170.315(b)(11) Decision Support Intervention

(b)(11).7. Review the Predictive Decision Support Information Setup

Users returned to the Decision Support Admin module, where they were directed to the section for reviewing user-supplied predictive DSI and its associated source attributes. In this area, users could view, modify the intervention, and save changes to the source attributes.

- Associated Criteria:
  170.315(b)(11) Decision Support Intervention