OpenEMR Usability Test Report

Safety Enhanced Design

EHR Usability Test Report of OpenEMR Version 7.0.0

Report based on NISTIR 7742 Customized Common Industry Format Template for Electronic Health Record Usability Testing, ISO/IEC 25062:2006 Common Industry Format for Usability Test Reports

OpenEMR version 7.0.0

Date of Usability Test: February 3, 2022 – March 17, 2022
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1. EXECUTIVE SUMMARY

A usability test for OpenEMR version 7.0.0, an open source electronic health record, was conducted remotely between February 3, 2022 and March 17, 2022 using a virtual meeting platform by the 2022 Cohort of the Professional Certificate in Health Information Technology Program at Columbia University. The purpose of this test was to validate the usability of the current user interface, and provide evidence of usability in the EHR Under-Test (EHRUT). During the usability test, 11 healthcare personnel matching the target demographic served as participants and used the EHRUT in simulated, but representative tasks. This study collected performance data on four tasks typically conducted on an EHR:

1. Enter and modify patient demographics

2. Enter in medication order

3. Add an implantable device

4. Order a lab test

During the 30 to 45 minute one-on-one usability tests, each participant was greeted by the administrator and asked to review and sign an informed consent and release form (included in Appendix 5.2). All participants, except one, had prior experience with the EHR. Prior to the usability test, all participants were given the opportunity to complete training similar to that received by a real end user. The administrator introduced the test, and told participants to complete a series of tasks given one at a time. During the testing, the administrator timed the test and, along with the data logger 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. The following 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 were de-identified – no correspondence can be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants were asked to complete a post-test questionnaire. Various recommended metrics, in accordance with the examples set forth in the *NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records*, were used to evaluate the usability of the EHRUT. Following is a summary of the performance and rating data collected on the EHRUT.

Measure Task	N #	Task Success Mean (SD)	Path Deviation Deviations (Observed / Optimal)	Task Time Mean(SD) seconds	 Deviations (Observed / Optimal)	Errors Mean (SD)	Task Ratings 5=Easy Mean (SD)
1. Enter and modify demographics	11	100 (0)	15/8	87 (77)	87/81	0.27 (0.65)	4.45 (0.68)
2. Enter in medication order	11	100 (0)	5/8	77 (46)	77/94	0.27 (0.47)	4 (1.12)
3. Add an implantable device	11	100 (0)	6/7	84 (103)	84/63	0.09 (0.3)	4.45 (0.52)
4. Order a lab	11	100 (0)	15/8	78 (83)	78/63	0.18 (0.6)	4 (1.13)

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 55. In addition to the performance data, the following qualitative observations were made:

- Major findings

  o All tasks were completed with no major deviations which determines that OpenEMR is an effective and efficient system.

  o The screen layout is bright and uncluttered, and patient information is easy to enter, read, and is readily available when opening patient profile.

- Search bar fails to query and return relevant matches when different name formats are entered as input.
- Standard EMR flow/Dashboard flow is easy to follow.

- Areas for improvement
  - Expand search input parameters for the patient search bar, pressing "Enter" to initiate a search, and auto-complete capabilities for entering drug names.
  - Reorganizing tab placements, such as moving Implantable Devices from "Issues" tab to the "Medical Devices" tab.
  - Standardizing the "Save" and "Done" button locations and functions across all the tabs.
  - Differentiating the Medication and Prescription tab for more clarification with Task 2.

2. INTRODUCTION

The EHRUT tested for this study was the OpenEMR version 7.0.0. Designed to present patient medical information to healthcare providers, the EHRUT consists of a provider facing, open source, electronic health record which is used to manage various aspects of patient care. 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 user centered design in accordance with Safety Enhanced Design certification criteria. To this end, measures of effectiveness, efficiency, and user satisfaction, such as task success and task time, were captured during the usability testing.

3. METHODS

3.1 PARTICIPANTS

A total of 11 participants were tested on the EHRUT. Participants in the test were physicians, a nurse practitioner, nurse informatics IT specialist, pharmacists, a laboratory manager, and a research scientist. Participants were recruited by a OpenEMR community leader and students of the 2022 Cohort of the Health Information Technology program at Columbia University. When participants were recruited, they were informed that the test would take place virtually. Participants

were not compensated for their time and they were informed that they could withdraw at any point. In addition, participants had no direct connection to the development of or producing the EHRUT. Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received.

Recruited participants completed a pre-test questionnaire (see Appendix 5.3) which detailed the mix of professional backgrounds and demographic characteristics. The following is a table of participants by characteristics, including demographics, professional experience, EHR experience, number of EHRs used/familiar with, 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.

Part ID	Gender	Age	Education	Occupation	Professional Experience (months)	Computer Experience (months)	Product Experience (months)	Assistive Technology Needs
1	F	40 - 49	Doctorate degree (MD, DNP, DMD, PhD)	Physician	96	156	0	None
2	F	50 - 59	Bachelor's Degree	Clinical Laboratory Manager	180	180	0	None
3	F	30 - 39	Doctorate degree (MD, DNP, DMD, PhD)	Psychiatry Nurse Practitioner	84	180	0	None
4	M	20 - 29	Bachelor's Degree	Nurse Informatics IT Specialist	18	120	0	None
5	M	20 - 29	Doctorate degree (MD, DNP, DMD, PhD)	Pharmacist	60	96	0	None
6	F	50 - 59	Doctorate degree (MD, DNP, DMD, PhD)	Physician	24	240	0	None
7	F	40 - 49	Doctorate degree (MD, DNP, DMD, PhD)	Physician	216	6	0	None
8	M	20 - 29	Doctorate degree (MD, DNP, DMD, PhD)	Pharmacist	36	60	0	None
9	M	20 - 29	Doctorate degree (MD, DNP, DMD, PhD)	Pharmacist	42	54	0	None
10	M	60 - 69	Doctorate degree (MD, DNP, DMD, PhD)	Dentist	360	180	0	None
11	F	30 - 39	Master's Degree	City Research Scientist	84	84	0	None

Table 1. Participant Demographics

11 participants were recruited and 11 participated in the usability test. No participants failed to show for the study. Participants were scheduled for 30 to 45 minutes sessions which included a debrief by the administrator. A spreadsheet was used to keep track of the schedule and each participant's demographic characteristics.

3.2 STUDY DESIGN

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

During the usability test, participants interacted with OpenEMR and each participant 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 Section 3.9 Usability Metrics.

3.3 TASKS

A number of tasks were constructed that are realistic and representative of the activities a user might do with this EHR. Tasks were selected based on their frequency of use, criticality of function, those that may be most troublesome for users, and the tasks were constructed in light of the study objectives. These tasks, stemming from § 170.315(g)(3) Safety Enhanced Design, include:

1. Enter and modify demographics
    a. § 170.315 (a)(5) Demographics
    b. § 170.315 (a)(9) Clinical Decision Support
2. Enter in medication order

      a. § 170.315 (a)(1) Computerized Provider Order Entry – medications

3. Add an implantable device

      a. § 170.315 (a)(14) Implantable Device List

4. Order a lab

      a. § 170.315 (a)(2) Computerized Provider Order Entry - laboratory

3.4 PROCEDURE

Upon connecting to the online meeting platform, participants were greeted; their identity was verified and matched with a name on the participant schedule. Participants were then assigned a participant ID. Each participant signed an informed consent and release form (See Appendix 5.2).

Two usability testing members participated in this test, the usability administrator and the data logger. The usability testing staff conducting the test were usability practitioners from the Columbia University Professional Certificate in Health Information Technology Program.

The administrator moderated the session including administering instructions and tasks. The administrator also monitored task times, obtained post-task rating data, and took notes on participant comments. The data logger and took notes on task success, path deviations, number and type of errors, and comments into a spreadsheet. 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.
- Without using a think aloud technique.

For each task, the participants were sent the task prompt through the Chat box. Task timing began once the administrator finished reading the task. The task time was stopped once the participant indicated they had successfully completed the task. The scores are discussed in the Data Scoring section below. Following the session, the administrator emailed the participant the post-test questionnaire (see Appendix 5.3), and thanked each individual for their participation.

3.5 TEST LOCATION

The testing was conducted via a virtual online meeting platform. Participants used their personal computer for the testing. A link to the scheduled testing was provided to the participant. The participant's screen and audio was recorded.

3.6 TEST ENVIRONMENT

The EHR would be typically be used in a healthcare office or facility. In this instance, the testing was conducted remotely via Zoom and the participant used their own computer, keyboard and mouse to interact with the EHR. Participants were instructed not to change any of the default system settings (such as font size). The testing environment was set up by OpenEMR according to the documentation describing system set-up and preparation, and used a test database accessed via wireless connection. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation.

3.7 TEST FORMS AND TOOLS

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

- Moderator's Guide (Appendix 5.3)
- Pre-test questionnaire (Appendix 5.3)
- Post-test questionnaire (Appendix 5.3)
- System Usability Scale Questionnaire (Appendix 5.4)

These documents can be found in the Appendices referenced above. The Moderator's Guide was devised so as to be able to capture required data. The questionnaires were hosted on Google Forms and sent via email to the participants. The participant's interaction with the EHRUT was captured and recorded with screen capture software on the administrator's computer and verbal comments were recorded with a microphone.

3.8 PARTICIPANT INSTRUCTIONS

The administrator reads the following instructions aloud to each participant (also see the Orientation in the full moderator's guide in Appendix 3):

> *Our session today will last for 30-45 minutes. During training you were provided instructions for logging in, but as a reminder, this info will be provided again in the Chat box if you need it. We are recording the audio and screen of our session today.*
>
> *I will ask you to complete a few tasks using this system and answer some questions afterward. You will be asked to complete these tasks on your own, as quickly as possible. If you have difficulty I am not able to instruct or provide help with anything to do with the system itself. I would like to request that you* not *talk aloud or verbalize while you are doing the tasks. Please save your detailed comments until the end of a task or the end of the session as a whole when we can discuss freely. I did not have any involvement in its creation, so please be honest with your opinions. All of the information that you provide will be kept confidential and your name*

will not be associated with your comments at any time. Should you feel it necessary you are able to withdraw at any time during the testing.

The product you will be using today is the OpenEMR EHR. Please log into the testing environment.

Following the procedural instructions, participants were instructed to log-in to the usability testing environment of OpenEMR. After logging in, the administrator gave the following instructions:

After presenting the task, I will say "Begin". At that point, please complete the task and note out loud once you are done.

Do you have any questions or concerns?

Participants were then given four tasks to complete. Tasks are listed in the moderator's guide in Appendix 5.3.

3.9 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:

- Effectiveness of OpenEMR measuring participant success rates and errors
- Efficiency of OpenEMR by measuring the average task time and path deviations
- Satisfaction with OpenEMR by measuring ease of use ratings

DATA SCORING

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

Measures	Rationale and Scoring
Effectiveness: Task Success	A task was counted as a "Success" if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis.
	The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage.
	Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency.
	Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target task times used for task times in the Moderator's Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by some factor [e.g., 1.25] that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was [65 seconds] then allotted task time performance was [65 * 1.25 = 81 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 "Failure". 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.[11] This should also be expressed as the mean number of failed tasks per participant.
	On a qualitative level, an enumeration of errors and error types should be collected.
Efficiency: Task Deviations	The participant's path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.
	It is strongly recommended that task deviations be reported. Optimal paths (i.e., procedural steps) should be recorded when constructing tasks.
Efficiency: Task Time	Each task was timed from when the administrator said "Begin" until the participant said, "Done." If he or she failed to say "Done," the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation and standard error) were also calculated.

Satisfaction: Task Rating	Participant's subjective impression of the ease of use of the application was measured by administering both a simple post-task question as well as a post-session questionnaire. After each task, the participant was asked to rate "Overall, this task was:" on a scale of 1 (Very Difficult) to 5 (Very Easy). These data are averaged across participants. Common convention is that average ratings for systems judged easy to use should be 3.3 or above. To measure participants' confidence in and likability of OpenEMR version 7.0.0 overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, "I think I would like to use this system frequently," "I thought the system was easy to use," and "I would imagine that most people would learn to use this system very quickly." See full System Usability Score questionnaire in Appendix 5.4.

Table 2. Details of how observed data were scored.

4. RESULTS

4.1 DATA ANALYSIS AND REPORTING

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. The usability testing results for the EHRUT are detailed below (see Table 3). The results should be seen in light of the objectives and goals outlined in Section 3.2 Study Design.

Measure Task	N #	Task Success Mean (SD)	Path Deviation Deviations (Observed / Optimal)	Task Time Mean (SD) seconds	 Deviations (Observed / Optimal)	Errors Mean (SD)	Task Ratings 5=Easy Mean (SD)
1. Enter and modify demographics	11	100 (0)	15/8	87 (77)	87/81	0.27 (0.65)	4.45 (0.68)
2. Enter in medication order	11	100 (0)	5/8	77 (46)	77/94	0.27 (0.47)	4 (1.12)
3. Add an implantable device	11	100 (0)	6/7	84 (103)	84/63	0.09 (0.3)	4.45 (0.52)
4. Order a lab	11	100 (0)	15/8	78 (83)	78/63	0.18 (0.6)	4 (1.13)

Table 3: Performance Data

4.2 DISCUSSION OF THE FINDINGS

The goal of EHR usability test is for users to interact with the system effectively, efficiently, and with an acceptable level of satisfaction. To measure these parameters, the data was collected after conducting virtual video recordings and analysis: time taken for each task, task successes, path deviations, task errors, and ease of use ratings were analyzed in addition to system usability scoring that was obtained from the post-test questionnaire. Each task was analyzed individually.

EFFECTIVENESS

In light of the test findings, the participants were able to complete all tasks with a success rate of 100%.

EFFICIENCY

Based on the observations, OpenEMR is an efficient system to use as all tasks were completed within optimal time ranges. Each optimal time for task performance was benchmarked at 81, 94, and 63 seconds. The average time taken for each task was calculated and compared to the optimal task times. Task 2 (Enter in medication order) took the least amount of time at 77 seconds and had the least number of path deviations. Task 1 (Enter and modify demographics) took the longest amount of time (87 seconds) and had a high number of path deviations (15/8 clicks). Task 4 had a high number of path deviations (15/8 clicks) but was completed closer to the optimal time.

SATISFACTION

Participants rated the tasks on the level of ease based on a five point Likert scale, with 1 being difficult and 5 being easy. Satisfaction ratings averaged to 4 or higher which indicates that users did not perceive the tasks as difficult. The results from the System Usability Scale scored the subjective satisfaction with the system on task performance to be 55. This highlights that the overall satisfaction of system usability can be improved upon, even when each task is perceived as easy.

MAJOR FINDINGS

All participants were able to complete tasks within the optimal time range. Nonetheless, there were slight uncertainties which were discovered while testing. Regarding Task 1, when first and last names were entered into the Search bar, the correct patient failed to query. This discrepancy caused more path deviations and seconds spent on the task. However, users found the correct patient by inputting the last name, quickly bringing them back on track. While testing Task 2, two

participants clicked on "Medication", instead of "Prescription", at the start of the task which deviates from the path. Additionally, after entering the prescription and clicking "Add", users were given two options, "Add" or "Quit". Instead of clicking "Quit", participants clicked on "Add", as it was not clear whether their entries were saved, and this generated a new medication entry page rather than returning participants to the dashboard. When beginning Task 3 and Task 4, three participants repeatedly clicked at different tabs in order to begin the task. Overall, the participants noted that the screen layouts were not cluttered, patient profiles were easy to understand, and the information was readily available. The general flow of the EHR was easy to follow.

AREAS FOR IMPROVEMENT

Despite the mostly positive comments about OpenEMR, there are a few design aspects which can be improved. Firstly, locating an optimal spot to place "Save" button and standardizing it across the different tasks, as well as, changing the "Quit" button to "Done" to clearly indicate that the users entries and changes are saved. Functionality improvements include adding an auto-complete capability for drug name searches, and expanding the patient search parameters to accommodate more input formats. To improve Task 3, allowing the user to press "Enter" to initiate the search for device UDI strings, instead of clicking "Process UDI", will make the search faster. Additionally, including an alternative method to search devices in case the user does not have the specific UDI string present will be useful. Lastly, organizational changes are suggested for recategorizing the placement of certain tabs. Adding an implantable device is categorized under "Issues", however relocating it under "Medical Devices" will be more intuitive to users. Furthermore, when ordering a lab, moving "Procedure Order" to its own unique category classified under "Clinical" will be easier to locate than under "Administrative", where it currently is.

5. APPENDICES

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

1. Participant Demographics
2. Non-Disclosure Agreement (NDA) and Informed Consent Form
3. Example Moderator's Guide
    i. Orientation
    ii. Tasks
    iii. Pre-Test Questionnaire
    iv. Post-Test Questionnaire
4. System Usability Scale Questionnaire

Appendix 1: PARTICIPANT DEMOGRAPHICS

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

Gender	Count
Men	5
Women	6
Other	0

Occupation	Count
Nurse Practitioner	1
Physician	4
Pharmacist	3
Admin Staff	3

Years of Experience	Years
EHR Use	0-9 years – 5 participants 10- 19 years – 5 participants 20+ years – 1 participant

Appendix 2: NON-DISCLOSURE AGREEMENT AND INFORMED CONSENT FORM

Non-Disclosure Agreement
THIS AGREEMENT is entered into as of _____, 2022, between
_____ (Participant) and the testing organization, Columbia University's
Professional Certificate in Health Information Technology Program.

The Participant acknowledges his or her voluntary participation in today's usability study
may bring the Participant into possession of Confidential Information. The term
"Confidential Information" means all technical and commercial information of a
proprietary or confidential nature which is disclosed by Columbia Health IT, or otherwise
acquired by the Participant, in the course of today's study.

By way of illustration, but not limitation, Confidential Information includes trade secrets,
processes, formulae, data, know-how, products, designs, drawings, computer aided design
files and other computer files, computer software, ideas, improvements, inventions, training
methods and materials, marketing techniques, plans, strategies, budgets, financial
information, or forecasts.

Any information the Participant acquires relating to this product during this study is
confidential and proprietary to Columbia Health IT and is being disclosed solely for the
purposes of the Participant's participation in today's usability study. By signing this form the
Participant acknowledges that s/he will receive monetary compensation for feedback and
will not disclose this confidential information obtained today to anyone else or any other
organizations.

Participant's printed name: _____

Signature: _____   **Date:** _____

Informed Consent

Columbia University's Health Information Technology Certificate Program would like to thank you for participating in this study. The purpose of this study is to evaluate an electronic health records system. If you decide to participate, you will be asked to perform several tasks using the prototype and give your feedback. The study will last about *60* minutes. At the conclusion of the test, you will be compensated for your time.

Agreement

I understand and agree that as a voluntary participant in the present study conducted by *Columbia University's Health Information Technology Certificate Program,* I am free to withdraw consent or discontinue participation at any time. I understand and agree to participate in the study conducted and videotaped by the *Columbia University's Health Information Technology Certificate Program.*

I understand and consent to the use and release of the videotape by *Columbia University's Health Information Technology Certificate Program*. I understand that the information and videotape is for research purposes only and that my name and image will not be used for any purpose other than research. I relinquish any rights to the videotape and understand the videotape may be copied and used without further permission.

I understand and agree that the purpose of this study is to make software applications more useful and usable in the future.

I understand and agree that the data collected from this study may be shared with outside of *Columbia University's Health Information Technology Certificate Program and it's* client. I understand and agree that data confidentiality is assured, because only de-identified data – i.e., identification numbers not names – will be used in analysis and reporting of the results.

I agree to immediately raise any concerns or areas of discomfort with the study administrator. I understand that I can leave at any time.

Please check one of the following:

☐   YES, I have read the above statement and agree to be a participant.

☐   NO, I choose not to participate in this study.

Signature:_____   **Date:** _____

Appendix 3: MODERATOR'S GUIDE

Orientation

Thank you for participating in this study.

Can I verify that you took the pre-test survey?

Our session today will last for 30-45 minutes. During training you were provided instructions for logging in, but as a reminder, this info will be provided again in the Chat box if you need it. We are recording the audio and screen of our session today.

I will ask you to complete a few tasks using this system and answer some questions. You will be asked to complete these tasks on your own, as quickly as possible. If you have difficulty I am not able to instruct or provide help with anything to do with the system itself. I would like to request that you not *talk aloud or verbalize while you are doing the tasks. Please save your detailed comments until the end of a task or the end of the session as a whole when we can discuss freely. I did not have any involvement in its creation, so please be honest with your opinions. All of the information that you provide will be kept confidential and your name will not be associated with your comments at any time. Should you feel it necessary you are able to withdraw at any time during the testing.*

The product you will be using today is the OpenEMR EHR. Please log into the testing environment. Some of the data may not make sense as it is placeholder data.

After presenting the task, I will say "Begin". At that point, please complete the task and note out loud once you are done.

Do you have any questions or concerns?

Task 1: Enter and Modify Demographics (81 Seconds)

Ed Smith is a patient in the user's clinic. In this scenario, the user will modify this patient's demographics.

Edit demographics for 'Ed Smith'
1. Gender Identity choose 'Identifies as Male'
2. Sexual Orientation choose 'Straight or Heterosexual'
3. DOB change to '1968-12-30'
4. After saving changes, clinical decision support will display a pop up window with new due reminders based off new age information (Colon Cancer Screening)

On a scale of 1 to 5, with 5 being easiest to perform, how would you rate this task?

Success:
- ☐ Easily completed
- ☐ Completed with difficulty or help (Describe)
- ☐ Not completed

Task Time: _____ Seconds

Optimal Path: *Screen A Enter "Smith" in patient selector at top right → Click the "Smith, Ed" patient → Click the edit icon/button for Demographics → Gender Identity set "Identifies as Male"; Sexual Orientation set "Straight or Heterosexual". DOB change to 1968-12-30. → Click "Save" → Click "OK"*

- ☐ Correct
- ☐ Minor Deviations / Cycles (Describe)
- ☐ Major Deviations (Describe)

Observed Errors and Verbalizations:

Rating:
Overall, this task was: _____

Administrator / Notetaker Comments:

Task 2: Enter in Medication Order (94 Seconds)

Add prescription for 'Ed Smith'
1. Lipitor 20mg tabs Per Oris q.d. with quantity of 30

On a scale of 1 to 5, with 5 being easiest to perform, how would you rate this task?

Success:
- ☐ Easily completed
- ☐ Completed with difficulty or help (Describe)
- ☐ Not completed

Task Time: _____ Seconds

Optimal Path: Screen A, *Scroll to bottom of patient summary screen → click the edit icon/button → Screen B click "Add" → Enter "Lipitor in the text box and then select the Lipitor entry → Enter Quantity 30, Enter Medicine Units 20 mg, Enter Direction in tablet Per Oris q.d. → Click "Save" Button → Click "Quit"*

- ☐ Correct
- ☐ Minor Deviations / Cycles (Describe)
- ☐ Major Deviations (Describe)

Observed Errors and Verbalizations:

Rating:
Overall, this task was: ___

Administrator / Notetaker Comments:

Task 3: Add an Implantable Device (63 Seconds)

Add Implantable Device for 'Ed Smith'
- UDI is (01)00889095205923(11)141231(17)150707(10)A213B1(21)1234

On a scale of 1 to 5, with 5 being easiest to perform, how would you rate this task?

Success:
☐ Easily completed
☐ Completed with difficulty or help (Describe)
☐ Not completed

Task Time:_____Seconds

Optimal Path: Screen A, *click "Issues" at the top of patient summary screen →click "Add" at Medical Devices → Paste following into UDI textbox: UDI is (01)00889095205923(11)141231(17)150707(10)A213B1(21)1234 → Click "Process UDI" →   Scroll down and click "Save" Button*

☐ Correct
☐ Minor Deviations / Cycles (Describe)
☐ Major Deviations (Describe)

Observed Errors and Verbalizations:

Rating:
Overall, this task was: _____

Administrator / Notetaker Comments:

Task 4: Order a Lab (63 Seconds)

Order lab for 'Ed Smith'
- PSA

On a scale of 1 to 5, with 5 being easiest to perform, how would you rate this task?

Success:
- ☐ Easily completed
- ☐ Completed with difficulty or help (Describe)
- ☐ Not completed

Task Time:_____Seconds

Optimal Path: *Click "Visit Past Encounters" at the top of the screen → click "2022-01-18 Office Visit" from dropdown → in encounter menu, click "Administrative" → Click "Procedure Order" → Click Procedure Test textbox → enter "PSA" → Click "Search" → Click "psa_level_order" → Click "Save" Button*

- ☐ Correct
- ☐ Minor Deviations / Cycles (Describe)
- ☐ Major Deviations (Describe)

Observed Errors and Verbalizations:

Rating:
Overall, this task was: ____

Administrator / Notetaker Comments:

This concludes the test. Please take the post-testing survey.

Thank you for your participation!

Pre-Test Questionnaire

1. What is your name? (this will not be shared in the testing report)

2. What is your gender?
   Male
   Female
   Other:

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

4. Do you, or does anyone in your home, work in marketing research, usability research, or web design?
   Yes
   No

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

6. What is your age (in years)?
   0-19
   20-29
   30-39
   40-49
   50-59
   60-69
   70-79
   80+

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

8. Do you require any assistive technologies to use a computer?

9. What is your current position?
   RN
   Physician
   Resident
   Administrative Staff
   Other:

10. What is your current title?

11. How long have you held this position (in years)?

12. What are some of your main responsibilities in this role?

13. What is your work location and environment?
    private practice
    health system
    government
    clinic
    Other:

14. Which of the following describes your highest level of education?
    high school graduate/GED
    some college
    college graduate (RN, BSN)
    postgraduate (MD/PhD)
    Other:

15. In the last month, on how many days did you use an electronic health record?

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

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

Post- Test Questionnaire

1. What is your name? (this will not be reported)

2. What was your overall impression of this system?

3. What aspects of the system did you like most?

4. What aspects of the system did you like least?

5. What aspects of the system did you like least?

6. Were there any features that you were surprised to see?

7. What features did you expect to encounter but did not see? That is, is there anything that is missing in this application?

8. Compare this system to other systems you have used.

9. Would you recommend this system to your colleagues?

Appendix 4: SYSTEM USABILITY SCALE QUESTIONNAIRE

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

	Strongly disagree				Strongly agree

1. I think that I would like to use this system frequently

| 1 | 2 | 3 | 4 | 5 |

2. I found the system unnecessarily complex

| 1 | 2 | 3 | 4 | 5 |

3. I thought the system was easy to use

| 1 | 2 | 3 | 4 | 5 |

4. I think that I would need the support of a technical person to be able to use this system

| 1 | 2 | 3 | 4 | 5 |

5. I found the various functions in this system were well integrated

| 1 | 2 | 3 | 4 | 5 |

6. I thought there was too much inconsistency in this system

| 1 | 2 | 3 | 4 | 5 |

7. I would imagine that most people would learn to use this system very quickly

| 1 | 2 | 3 | 4 | 5 |

8. I found the system very cumbersome to use

| 1 | 2 | 3 | 4 | 5 |

9. I felt very confident using the system

| 1 | 2 | 3 | 4 | 5 |

10. I needed to learn a lot of things before I could get going with this system

| 1 | 2 | 3 | 4 | 5 |

OpenEMR Usability Test Report

Safety Enhanced Design

Addendum 1 §170.315(b)(11) Decision Support Interventions

EHR Usability Test Report of OpenEMR Version 7.0.2

Report based on NISTIR 7742 Customized Common Industry Format Template for Electronic Health Record Usability Testing, ISO/IEC 25062:2006 Common Industry Format for Usability Test Reports

OpenEMR version 7.0.2

Date of Usability Test: October 20th, 2024 – November 23rd, 2024
Date of Report: December 3rd, 2024
Report Prepared By: OpenEMR Foundation
Report Organized By: Brady Miller, Executive Director
  brady.miller@open-emr.org
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Addendum Table of Contents

1. EXECUTIVE SUMMARY

A usability test for OpenEMR version 7.0.2, an open source electronic health record, was conducted remotely between October 20th, 2024 and November 23rd, 2024 using a virtual meeting platform by the OpenEMR Foundation. The purpose of this test was to validate the usability of the current user interface's enhancements

for the §170.315(b)(11) Decision support interventions changes, and provide evidence of usability in the EHR Under-Test (EHRUT). The process used for the user centered design (UCD) testing was the *NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records (NISTIR 7741)[1]*. During the usability test, 10 healthcare personnel matching the target demographic served as participants and used the EHRUT in simulated, but representative tasks. This study collected performance data on three tasks typically conducted on an EHR for the §170.315(b)(11) functionality:

1.	View and update Decision Support Intervention source attribute information.

2.	Provide feedback on incorrect Decision Support Intervention rule usage.

3.	View and update 3rd party Decision Support Intervention source attribute information.

During the 15 to 30 minute one-on-one usability tests, each participant was greeted by the administrator and asked to review and sign an informed consent and release form (included in Appendix 5.2). All participants, except two, had prior experience with the EHR. Prior to the usability test, all participants were given the opportunity to complete training similar to that received by a real end user. The administrator introduced the test, and told participants to complete a series of tasks given one at a time. During the testing, the administrator timed the test and recorded user performance data on paper and electronically. The administrator did not give the participant assistance in how to complete the task. Participant screens and audio were recorded for subsequent analysis. The following 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 were de-identified – no correspondence can be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants were asked to complete a post-test questionnaire. Various recommended metrics, in accordance with the examples set forth in *NIST 7741*, were used to evaluate the usability of the EHRUT. Following is a summary of the performance and rating data collected on the EHRUT.

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[1] Schumacher, R. and Lowry, S. (2010), (NISTIR 7741) NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records, NIST Interagency/Internal Report (NISTIR), National Institute of Standards and Technology, Gaithersburg, MD, [online], https://doi.org/10.6028/NIST.IR.7741, https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=907313

Measure Task	N	Task Success	Path Deviation	Task Time		Errors	Task Ratings 5=Easy
	#	Mean (SD)	Deviations (Observed / Optimal)	Mean(SD) seconds	Deviations (Observed / Optimal)	Mean (SD)	Mean (SD)
1. View and update Decision Support Intervention source attribute information.	10	90 (32)	10/8	96 (45)	96/123	2.4 (3.2)	4.5 (0.71)
2. Provide feedback on incorrect Decision Support Intervention rule usage.	10	90 (32)	7/6	86 (70)	86/72	0.9 (1.45)	4.1 (1.29)
3. View and update 3rd party Decision Support Intervention source attribute information.	10	90 (32)	8/8	110 (71)	110/102	0.4 (0.7)	4.5 (0.85)

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

- Major findings

  - All tasks were completed with few major deviations which determines that OpenEMR is a safe and effective and efficient system. Each task had only one user who did not successfully complete the task.

  - The user ratings for the viewing, editing, and providing feedback for Decision Support Intervention (DSI) information were all rated highly as easy to accomplish showing that this functionality of OpenEMR meets usability requirements.

  - The dashboard is uncluttered and easy to navigate to the actionable areas where clinical decision rules are displayed and editable.

- Areas for improvement

  - Make it easier to find the action trigger for editing or providing feedback by changing both the icon images and the size of the icons to make them appear more like buttons and convey their intent.

  - The DSI message saying no source attribute information has been provided should be moved out of the text edit fields and below the message. Color code it to provide more contrast for users to differentiate between instruction text and user entered values.

- Predictive DSI source attribute information should be grouped into headers and the header texts should have more contrast in both size, weight, and color from the user edit fields.

- Saving an entry in the evidence based DSI should show a successfully saved message and skip the edit screens of the rest of the rule workflow.

- Have the dashboard areas by default be fully expanded to see all information on the screen instead of being closed by default requiring users to expand the DSI screen area and scroll down to the action items.

2. INTRODUCTION

The EHRUT tested for this study was the OpenEMR version 7.0.2. Designed to present patient medical information to healthcare providers, the EHRUT consists of a provider facing, open source, electronic health record which is used to manage various aspects of patient care. 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 user centered design in accordance with Safety Enhanced Design certification criteria. To this end, measures of effectiveness, efficiency, and user satisfaction, such as task success and task time, were captured during the usability testing.

3. METHODS

3.1 PARTICIPANTS

A total of 10 participants were tested on the EHRUT. Participants in the test were physicians, administrative staff, and physician assistants. Participants were recruited by OpenEMR community leaders. When participants were recruited, they were informed that the test would take place virtually. Participants were not compensated for their time and they were informed that they could withdraw at any point. In addition, participants had no direct connection to the development of or producing the EHRUT. Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received.

Recruited participants completed a pre-test questionnaire (see Appendix 5.3) which detailed the mix of professional backgrounds and demographic characteristics. The following is a table of participants by characteristics, including demographics, professional experience, EHR experience, number of EHRs used/familiar with, 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. 10 participants were recruited and 10 participated in the usability test. No participants failed to show up for the study. Participants were

scheduled for 15 to 30 minutes sessions which included a debrief by the administrator. A spreadsheet was used to keep track of the schedule and each participant's demographic characteristics.

Part ID	Gender	Age	Education	Occupation	Professional Experience (months)	Computer Experience (months)	Product Experience (months)	Assistive Technology Needs
12	Female	40-49	Doctorate degree (MD,DNP, DMD, PhD)	Physician	240	0	0	None
13	Female	40-49	Master's Degree	Nurse practitioner	144	216	0	None
14	Female	40-49	Doctorate degree (MD,DNP, DMD, PhD)	Physician	36	120	18	None
15	Female	30-39	High School Graduate	Administrative Staff	120	120	27	None
16	Female	60-69	Doctorate degree (MD,DNP, DMD, PhD)	Physician	276	180	24	None
17	Male	60-69	Doctorate degree (MD,DNP, DMD, PhD)	Physician	300	180	0	None
18	Male	50-59	Master's Degree	Physician Assistant	156	240	12	None
19	Male	60-69	Doctorate degree (MD,DNP, DMD, PhD)	Physician	408	144	24	None
20	Female	30-39	Bachelor's Degree	Administrative Staff	108	108	27	None
21	Female	30-39	High School Graduate	Medical Assistant	48	228	27	None

Table 1. Participant Demographics

3.2 STUDY DESIGN

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

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

During the usability test, participants interacted with OpenEMR and each participant 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 Section 3.9 Usability Metrics.

3.3 TASKS

A number of tasks were constructed that are realistic and representative of the activities a user might do with this EHR. Tasks were selected based on their frequency of use, criticality of function, those that may be most troublesome for users, and the tasks were constructed in light of the study objectives. These tasks, stemming from § 170.315(g)(3) Safety Enhanced Design, include:

1. View and update Decision Support Intervention source attribute information.
    a. § 170.315 (b)(11) Decision Support Interventions
2. Provide feedback on incorrect Decision Support Intervention rule usage.
    a. § 170.315 (b)(11) Decision Support Interventions
3. View and update 3rd party Decision Support Intervention source attribute information.
    a. § 170.315 (b)(11) Decision Support Interventions

3.4 PROCEDURE

Upon connecting to the online meeting platform, participants were greeted; their identity was verified and matched with a name on the participant schedule. Participants were then assigned a participant ID. Each participant signed an informed consent and release form (See Appendix 5.2).

One usability testing member participated in each test, the usability administrator. The usability testing staff conducting the test were project administrators of the OpenEMR community.

The administrator moderated the session including administering instructions and tasks. The administrator also monitored task times, obtained post-task rating data, and took notes on participant comments. The administrator recorded each session and reviewed each session recording to take notes on task success,

path deviations, number and type of errors, and comments into a spreadsheet. 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.
- Without using a think aloud technique.

For each task, the participants were sent the task prompt through the Chat box. Task timing began once the administrator finished reading the task. The task time was stopped once the participant indicated they had successfully completed the task. The scores are discussed in the Data Scoring section below. Following the session, the administrator emailed the participant the post-test questionnaire (see Appendix 5.3), and thanked each individual for their participation.

3.5 TEST LOCATION

The testing was conducted via a virtual online meeting platform. Participants used their personal computer for the testing. A link to the scheduled testing was provided to the participant. The participant's screen and audio was recorded.

3.6 TEST ENVIRONMENT

The EHR would typically be used in a healthcare office or facility. In this instance, the testing was conducted remotely via virtual meeting and the participants used their own computer, keyboard and mouse to interact with the EHR. Participants were instructed not to change any of the default system settings (such as font size). The testing environment was set up by OpenEMR according to the documentation describing system set-up and preparation, and used a test database accessed via wireless connection. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation.

3.7 TEST FORMS AND TOOLS

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

- Moderator's Guide (Appendix 5.3)
- Pre-test questionnaire (Appendix 5.3)
- Post-test questionnaire (Appendix 5.3)

These documents can be found in the Appendices referenced above. The Moderator's Guide was devised so as to be able to capture required data. The questionnaires were hosted on Google Forms and sent via email to the participants. The participant's interaction with the EHRUT was captured and recorded with screen capture software on the administrator's computer and verbal comments were recorded with a microphone.

3.8 PARTICIPANT INSTRUCTIONS

The administrator reads the following instructions aloud to each participant (also see the Orientation in the full moderator's guide in Appendix 3):

> *Our session today will last for 15-30 minutes. During training you were provided instructions for logging in, but as a reminder, this info will be provided again in the Chat box if you need it. We are recording the audio and screen of our session today.*
>
> *I will ask you to complete a few tasks using this system and answer some questions afterward. You will be asked to complete these tasks on your own, as quickly as possible. If you have difficulty I am not able to instruct or provide help with anything to do with the system itself. I would like to request that you not talk aloud or verbalize while you are doing the tasks. Please save your detailed comments until the end of a task or the end of the session as a whole when we can discuss freely. I did not have any involvement in its creation, so please be honest with your opinions. All of the information that you provide will be kept confidential and your name will not be associated with your comments at any time. Should you feel it necessary you are able to withdraw at any time during the testing.*
>
> *The product you will be using today is the OpenEMR EHR. Please log into the testing environment.*

Following the procedural instructions, participants were instructed to log-in to the usability testing environment of OpenEMR. After logging in, the administrator gave the following instructions:

> *After presenting the task, I will say "Begin". At that point, please complete the task and note out loud once you are done.*
>
> *Do you have any questions or concerns?*

Participants were then given three tasks to complete. Tasks are listed in the moderator's guide in Appendix 5.3.

3.9 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:

- Effectiveness of OpenEMR measuring participant success rates and errors
- Efficiency of OpenEMR by measuring the average task time and path deviations
- Satisfaction with OpenEMR by measuring ease of use ratings

DATA SCORING

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

Measures	Rationale and Scoring
Effectiveness: Task Success	A task was counted as a "Success" if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis. The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage. Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency. Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target task times used for task times in the Moderator's Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by some factor [e.g., 1.25] that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was [65 seconds] then allotted task time performance was [65 * 1.25 = 81 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 "Failure". 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.[11] This should also be expressed as the mean number of failed tasks per participant. On a qualitative level, an enumeration of errors and error types should be collected.
Efficiency: Task Deviations	The participant's path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation. It is strongly recommended that task deviations be reported. Optimal paths (i.e., procedural steps) should be recorded when constructing tasks.
Efficiency: Task Time	Each task was timed from when the administrator said "Begin" until the participant said, "Done." If he or she failed to say "Done," the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation and standard error) were also calculated.

Satisfaction: Task Rating	Participant's subjective impression of the ease of use of the application was measured by administering both a simple post-task question. After each task, the participant was asked to rate "Overall, this task was:" on a scale of 1 (Very Difficult) to 5 (Very Easy). These data are averaged across participants. Common convention is that average ratings for systems judged easy to use should be 3.3 or above.

Table 2. Details of how observed data were scored.

4. RESULTS

4.1 DATA ANALYSIS AND REPORTING

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. The usability testing results for the EHRUT are detailed below (see Table 3). The results should be seen in light of the objectives and goals outlined in Section 3.2 Study Design.

Measure Task	N	Task Success	Path Deviation	Task Time		Errors	Task Ratings 5=Easy
	#	Mean (SD)	Deviations (Observed / Optimal)	Mean(SD) seconds	Deviations (Observed / Optimal)	Mean (SD)	Mean (SD)
1. View and update Decision Support Intervention source attribute information.	10	90 (32)	10/8	96 (45)	96/123	2.4 (3.2)	4.5 (0.71)
2. Provide feedback on incorrect Decision Support Intervention rule usage.	10	90 (32)	7/6	86 (70)	86/72	0.9 (1.45)	4.1 (1.29)
3. View and update 3rd party Decision Support Intervention source attribute information.	10	90 (32)	8/8	110 (71)	110/102	0.4 (0.7)	4.5 (0.85)

Table 3: Performance Data

4.2 DISCUSSION OF THE FINDINGS

The goal of EHR usability test is for users to interact with the system effectively, efficiently, and with an acceptable level of satisfaction. To measure these parameters, the data was collected after conducting virtual video recordings and analysis: time taken for each task, task successes, path deviations, task errors, and ease of use ratings were analyzed. Each task was analyzed individually.

EFFECTIVENESS

In light of the test findings, the participants were able to complete the tasks with a success rate of 90%.

EFFICIENCY

Based on the observations, OpenEMR is an efficient system to use as a majority of the participants completed the tasks in less than the optimal time. The average time taken for each task was calculated and compared to the optimal task times. Task 2 (Provide feedback on incorrect DSI rule usage) took the least amount of time at 86 seconds and had the least number of observed path deviations. Task 3 (View and update 3rd party Decision Support Intervention source attribute information) took the longest amount of time (110 seconds) and had a high number of observed path deviations (8/8 clicks). Task 1 had a higher number of observed path deviations (10/8 clicks) and was completed in 96 seconds.

SATISFACTION

Participants rated the tasks on the level of ease based on a five point Likert scale, with 1 being difficult and 5 being easy. Satisfaction ratings averaged to 4 or higher which indicates that users did not perceive the tasks as difficult.

MAJOR FINDINGS

Most participants were able to complete tasks within the optimal time range. Nonetheless, there were slight uncertainties which were discovered while testing. Regarding Task 1, some participants struggled to find the right icon to click on as the "?" icon was not intuitive to them in order to edit a rule and the icon was a small font size. When saving the rule participants did not see any success message and instead were taken to the rule interval edit screen. Only upon saving the rule edit screen were they taken back to the rule summary page but still did not see any success message.

While testing Task 2, again some participants struggled initially to click on the "?" icon to provide feedback on the rule's incorrect usage. Also, participants would deviate in their path by clicking on the "Edit" rule button because they could not immediately see the Feedback input box on the screen.   Participants had to discover that they needed to scroll down to the bottom of the source attribute summary screen in order to provide feedback on the rule.

For both Task 1 and Task 3, participants were confused by the default text message in the text edit fields saying "The source attribute value is unknown or the DSI developer did not provide any information for this field". They struggled to know if the text field already had text or if the field was editable given the message. Participants reported needing more contrast between the text field and the default empty message.

For Task 3, some participants struggled to find the 3rd party predictive DSI section as it was closed and hidden from view by default. Participants had to scroll to the bottom of the dashboard screen, expand the "Smart Enabled Apps" section in order to see the predictive DSI attributes.

Overall, the participants noted that despite some of the minor challenges, the tasks were easy to accomplish, the dashboard was easy to navigate and participants were able to find the DSI attribute sections. The general flow of the EHR was easy to follow.

AREAS FOR IMPROVEMENT

Despite the mostly positive comments about OpenEMR, there are a few design aspects which can be improved. Firstly, making it easier to edit or provide feedback on the DSI source attributes for both evidence and predictive DSI by making the icon images to use a larger "gear" icon. This would convey a sense that the DSI rule is being configured or setup and make it easier for users to see and select it.

Next, the Predictive DSI source attribute information should be grouped into headers grouped by purpose. The current list is very long and made it challenging for participants to find the specific field they needed to edit. On both this screen, and the evidence based screen, the default missing source attribute information should be moved out of the text box and have greater contrast to show it is a system message. The contrast could be done via size, weight, or color.

In the Evidence Based DSI edit screen, when launched from the patient demographic's dashboard screen, it should return the user to the demographics screen upon successful completion and show a save message to the user. This will avoid user confusion by skipping past the save interval screen.

Lastly, on the patient demographic's dashboard screen, all of the visible selections should have their contents fully visible and expanded by default instead of many of the sections being collapsed by default. This allows first time users to find the 3rd party Predictive DSI source attributes edit area inside the "Smart Enabled Apps" sections. Users can then have the option to collapse the section on future usages, but will be able to know the area exists, enhancing the learnability and usability of the system.

5. APPENDICES

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

1. Participant Demographics
2. Example Moderator's Guide
    i. Orientation
    ii. Tasks
    iii. Pre-Test Questionnaire
    iv. Post-Test Questionnaire

Appendix 1: PARTICIPANT DEMOGRAPHICS

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

Gender	Count
Men	3
Women	7
Other	0

Occupation	Count
Nurse Practitioner	1
Physician	5
Physician Assistant	1
Admin Staff	3

Years of Experience	Years
EHR Use	0-9 years – 2 participants
	10- 19 years – 7 participants
	20+ years – 1 participant

Appendix 2: INFORMED CONSENT

Informed Consent

OpenEMR Foundation would like to thank you for participating in this study. The purpose of this study is to evaluate an electronic health records system. If you decide to participate, you will be asked to perform several tasks using the prototype and give your feedback. The study will last about *60* minutes. At the conclusion of the test, you will be compensated for your time.

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

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

I understand and agree that the purpose of this study is to make software applications more useful and usable in the future.

I understand and agree that the data collected from this study may be shared with outside of *OpenEMR Foundation and it's* client. I understand and agree that data confidentiality is assured, because only de- identified data – i.e., identification numbers not names – will be used in analysis and reporting of the results.

I agree to immediately raise any concerns or areas of discomfort with the study administrator. I understand that I can leave at any time.

Please check one of the following:

- ⧩ YES, I have read the above statement and agree to be a participant.
- ⧩ NO, I choose not to participate in this study.

Signature:_____   **Date:** _____

Orientation

Thank you for participating in this study.

Can I verify that you took the pre-test survey?

Our session today will last for 15-30 minutes. During training you were provided instructions for logging in, but as a reminder, this info will be provided again in the Chat box if you need it. We are recording the audio and screen of our session today.

I will ask you to complete a few tasks using this system and answer some questions. You will be asked to complete these tasks on your own, as quickly as possible. If you have difficulty I am not able to instruct or provide help with anything to do with the system itself. I would like to request that you not *talk aloud or verbalize while you are doing the tasks. Please save your detailed comments until the end of a task or the end of the session as a whole when we can discuss freely. I did not have any involvement in its creation, so please be honest with your opinions. All of the information that you provide will be kept confidential and your name will not be associated with your comments at any time. Should you feel it necessary you are able to withdraw at any time during the testing.*

The product you will be using today is the OpenEMR EHR. Please log into the testing environment. Some of the data may not make sense as it is placeholder data.

After presenting the task, I will say "Begin". At that point, please complete the task and note out loud once you are done.

Do you have any questions or concerns?

Task 1: View and update Decision Support Intervention source attribute information. (123 Seconds)

Ed Smith is a patient in the user's clinic. In this scenario, the user will update the Prostate Cancer Screening rule to explain the rule's usage of patient's biological birth sex.

Update the Prostate Cancer Screening rule.
1. Change "Rule usage of Patient`s Sex" field to "This rule uses birth sex to determine if the patient should be screened for prostate cancer"

On a scale of 1 to 5, with 5 being easiest to perform, how would you rate this task?

Success:
- ☐ Easily completed
- ☐ Completed with difficulty or help (Describe)
- ☐ Not completed

Task Time: _____ Seconds

Optimal Path: *Enter "Smith" in patient selector at top right and click the search icon ⭢ Click the "Smith, Ed" patient ⭢ Under Clinical Reminders click info icon for "Assessment: Prostate Cancer Screening" ⭢ Click "Edit Rule Source Attributes" button ⭢ Click on "Rule usage of Patient`s Sex" text field ⭢ Type following in "Rule usage of Patient`s Sex" field: "This rule uses birth sex to determine if the patient should be screened for prostate cancer" ⭢ Click "Save" ⭢ Click "Save"*

- ☐ Correct
- ☐ Minor Deviations / Cycles (Describe)
- ☐ Major Deviations (Describe)

Observed Errors and Verbalizations:

Rating:
Overall, this task was: _____

Administrator / Notetaker Comments:

Task 2: Provide feedback on incorrect Decision Support Intervention rule usage. (72 Seconds)

Ed Smith is a patient in the user's clinic. In this scenario, the user will Provide rule feedback on incorrect application of Pap Smear rule for 'Ed Smith' due to incorrect biological sex.

Provide feedback on incorrect application of Pap Smear rule.
1. Type following in "Rule Feedback" field: "Rule should not have flagged Ed Smith for pap smear as Ed's birth sex is male"

On a scale of 1 to 5, with 5 being easiest to perform, how would you rate this task?

Success:
- ☐ Easily completed
- ☐ Completed with difficulty or help (Describe)
- ☐ Not completed

Task Time: _____ Seconds

Optimal Path: *Enter "Smith" in patient selector at top right and click the search icon ▯ Click the "Smith, Ed" patient ▯ Under Clinical Reminders click info icon for "Examination: Pap Smear" ▯ Click on "Rule Feedback" text box ▯ Type following in "Rule Feedback" field: "Rule should not have flagged Ed Smith for pap smear as Ed's birth sex is male" ▯ Click "Submit Feedback" button*

- ☐ Correct
- ☐ Minor Deviations / Cycles (Describe)
- ☐ Major Deviations (Describe)

Observed Errors and Verbalizations:

Rating:
Overall, this task was: ___

Administrator / Notetaker Comments:

Task 3: View and update 3rd party Decision Support Intervention source attribute information. (102 Seconds)

Ed Smith is a patient in the user's clinic. In this scenario, the user will update 3rd party decision support intervention source attribute field information.

Update 3rd party decision support intervention source attribute field information.
1. Type following in "Intended patient population(s) for the intervention`s use" field: "All patients who have had some form of chronic pain condition or diagnosis"

On a scale of 1 to 5, with 5 being easiest to perform, how would you rate this task?

Success:
- □ Easily completed
- □ Completed with difficulty or help (Describe)
- □ Not completed

Task Time:_____Seconds

Optimal Path: *Enter "Smith" in patient selector at top right and click the search icon ⬜ Click the "Smith, Ed" patient ⬜ Expand the SMART Enabled Apps on the patient's Medical Record Dashboard ⬜ Click on the "DSI Source Information" link ⬜ click "Edit" ⬜ Click on "Intended patient population(s) for the intervention`s use" text field ⬜ Type following in "Intended patient population(s) for the intervention`s use" field: "All patients who have had some form of chronic pain condition or diagnosis" ⬜ Click "Save"*

- □ Correct
- □ Minor Deviations / Cycles (Describe)
- □ Major Deviations (Describe)

Observed Errors and Verbalizations:

Rating:
Overall, this task was: _____

Administrator / Notetaker Comments:

This concludes the test. Please take the post-testing survey.

Thank you for your participation!

Pre-Test Questionnaire

1. What is your name? (this will not be shared in the testing report)

2. What is your gender?
   Male
   Female
   Other:

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

4. Do you, or does anyone in your home, work in marketing research, usability research, or web design?
   Yes
   No

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

6. What is your age (in years)?
   0-19
   20-29
   30-39
   40-49
   50-59
   60-69
   70-79
   80+

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

8. Do you require any assistive technologies to use a computer?

9. What is your current position?
   RN
   Physician

Resident
Administrative Staff
Other:

10. What is your current title?

11. How long have you held this position (in years)?

12. What are some of your main responsibilities in this role?

13. What is your work location and environment?
private practice
health system
government
clinic
Other:

14. Which of the following describes your highest level of education?
high school graduate/GED
some college
college graduate (RN, BSN)
postgraduate (MD/PhD)
Other:

15. In the last month, on how many days did you use an electronic health record?

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

17. How many years have you used OpenEMR 7.0?

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

Post- Test Questionnaire

_____

1. What is your name? (this will not be reported)

2. What was your overall impression of this system?

3. What aspects of the system did you like most?

4. What aspects of the system did you like least?

5. Were there any features that you were surprised to see?

6. What features did you expect to encounter but did not see? That is, is there anything that is missing in this application?

7. Compare this system to other systems you have used (if you have used other systems).

8. Would you recommend this system to your colleagues?