EHR Usability Test Report for Redwood EMR

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EHR Usability Test Report of Redwood EMR, Version 5.0

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Redwood EMR, 5.0

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Executive Summary

A usability test of the ambulatory EHR called Redwood EMR, v5.0 was conducted between 4/25/18 and 5/11/18 at Fanno Creek Clinic by FannoTek EMR. 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). The creation and testing of Redwood EMR, v5.0 followed the UCD processes outlined in the "NISTIR 7741 Guide to the Processes Approach for Improving the Usability of Electronic Health Records"[1]. This document provides guidance for those developing electronic health applications that need to know more about the processes of user-centered design (UCD).

During the usability test, 10 healthcare providers matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks. This study collected performance data on 12 tasks typically conducted on an EHR:

- Create and change a medication order
- Create and change a lab order
- Create and change a diagnostic imaging order
- Verify drug-drug contraindication intervention
- Verify drug-allergy contraindication intervention
- Create a new patient and specify demographic information, including name, DOB, birth sex, preferred language, ethnicity, ethnicity details, sexual orientation, and gender identity.
- Access an existing patient's record, enter a new problem, and change the problem
- Access an existing patient's record, prescribe a new medication, and make changes to dosage frequency post-prescription
- Access an existing patient's medication allergy list, create a new medication allergy, then make changes to the medication allergy
- Add implantable devices to a patient record using UDIs with all three potential formats

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[1] United States, Congress, National Institute of Standards and Technology, et al. "NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records." *NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records*, 2010.

- Trigger Clinical Decision Support rules for each of the following attributes: problem list, medication list, medication allergy list, laboratory tests, and a combination of demographics and vital signs
- Review bibliographic and linked referential information for triggered Clinical Decision Support rules
- Trigger Clinical Decision Support rules for medications, medication allergy, and problem list after receiving a transition of care/referral summary and incorporating into the patient's record

During the 60-minute one-on-one usability test, each participant was greeted by the administrator and asked to review and sign an informed consent/release form (included in Appendix 3); they were instructed that they could withdraw at any time. Participants had prior experience with a prior version of the EHR, however they did not have experience with the latest version, including several key features that were being tested for the first time. The administrator introduced the test, and instructed participants to complete a series of tasks (given one at a time) using the EHRUT. During the testing, the administrator timed the test and, along with the data logger(s) recorded user performance on 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 types of data were collected for each participant:

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

All participant data was de-identified – no correspondence could be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants were asked to complete a post-test questionnaire. Participants were not compensated monetarily for their time. Various recommended metrics, in accordance with the example 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 Success	Path Deviation	Task Time		Errors	SUS Ratings
Task	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Mean (SD)
Create and change a medication order	100 (0)	31.5/29	131.8 (19.7)	131.8/110	1.1 (1.1)	92.25 (10.51)
Create and change a lab order	100 (0)	26.7/16	75.6 (22.9)	75.6/41	.4 (.7)	90.5 (14.31)
Create and change a diagnostic imaging order	100 (0)	18.3/16	69.5 (21)	69.5/42	1.0 (.9)	92.75 (10.63)
Verify drug-drug contraindication intervention	100 (0)	9.4/7	54.8 (18.1)	54.8/34	.8 (.7)	92.75 (10.57)
Verify drug-allergy contraindication intervention	100 (0)	7.6/7	52.3 (35)	52.3/20	.4 (.7)	93 (10.71)
Create a new patient and specify demographic information, including name, DOB, birth sex, preferred language, ethnicity, ethnicity details, sexual orientation, and gender identity.	100 (0)	22.9/20	115.4 (28.4)	115.4/86	1.0 (1.3)	94.75 (7.37)
Access an existing patient's record, enter a new problem, and change the problem	100 (0)	13.3/12	73.3 (29.1)	73.3/44	.4 (.5)	91.25 (12.71)
Access an existing patient's record, prescribe a new medication, and make changes to dosage frequency post-prescription	100 (0)	27.3/26	88.5 (19.8)	88.5/65	.7 (.9)	89.75 (15.95)
Access an existing patient's medication allergy list, create a new medication allergy, then make changes to the medication allergy	100 (0)	17.8/17	83.7 (26.4)	83.7/52	.4 (.7)	91.75 (11.73)
Add implantable devices to a patient record using UDIs with all three potential formats	100 (0)	18.8/17	119.2 (36.5)	119.2/71	.8 (.6)	93.5 (8.6)
Trigger Clinical Decision Support rules for each of the following attributes: problem list, medication	100 (0)	9.3/8	138.6 (21.8)	138.6/111	.7 (.9)	91.25 (13.52)

list, medication allergy list, laboratory tests, and a combination of demographics and vital signs						
Review bibliographic and linked referential information for triggered Clinical Decision Support rules	100 (0)	3/3	40.1 (8.3)	40.1/30	0 (0)	93.25 (10.19)
Trigger Clinical Decision Support rules for medications, medication allergy, and problem list after receiving a transition of care/referral summary and incorporating into the patient's record	100 (0)	8.2/8	64.7 (22.9)	64.7/39	.2 (.4)	92.75 (10.63)

Table 1: Summary of Data Collected

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be 92.27[2].

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

- Major findings:
    - Providers were consistently frustrated with 3rd party systems, particularly e-prescribing system through Dr First. The chief complaints were the number of clicks required, the occasional downtime, and the size of text in the Dr First interface.
    - Some providers wished they could personalize the interface to fit their workflows better
    - Overall, providers found system to be easy to use and would recommend it to colleagues
- Areas for improvement:
    - Reducing number of clicks required for certain provider' workflow
    - Integration with Dr First that enables easier workflow
    - Ability to print patient instructions without printing the entire notes
    - More information around which provider created physician visits

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[2] See Tullis, T. & Albert, W. (2008). Measuring the User Experience. Burlington, MA: Morgan Kaufman (p. 149). Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.

o   Mobile compatibility

Introduction

The EHRUT tested for this study was ambulatory EHR called Redwood EMR, v5.0. Designed to present medical information to healthcare providers in outpatient ambulatory clinical settings, the EHRUT consists of a variety of modules serving various specialties to record and manage patient health records. 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 the EHR Under Test (EHRUT). To this end, measures of effectiveness, efficiency, and user satisfaction, such as task successes, path deviations, time on task, errors, and SUS rating were captured during the usability testing.

Method

Participants

A total of 10 participants were tested on the EHRUT. Participants in the test were doctors and nurses. Participants were recruited by Fanno Creek Clinic and were not compensated for their time. In addition, participants had no direct connection to the development of or the organization producing the EHRUT. Participants were not from the testing or supplier organization. Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received. Recruited participants had a mix of backgrounds and demographic characteristics. The following is a table of the participants by characteristics, including demographics, professional experience, computing experience, and user needs for assistive technology. Participant names were replaced with Participant IDs so that an individual's data cannot be tied back to individual identities.

Part ID	Gender	Age	Education	Occupation / Role	Professional Experience	Computer Experience	Product Experience	Assistive Technology Needs
1	Male	50-59	Doctorate Degree	Physician	360 mo	60 mo	60 mo	No
2	Female	40-49	Trade / technical / vocational training	CMA	264 mo	264 mo	60 mo	No
3	Female	50-59	Doctorate Degree	Physician	288 mo	216 mo	7 mo	No
4	Male	60-69	Doctorate Degree	Physician	360 mo	240 mo	60 mo	No
5	Male	50-59	Doctorate Degree	Physician	288 mo	276 mo	48 mo	No
6	Male	70-79	Doctorate Degree	Psychiatrist	504 mo	636 mo	96 mo	No
7	Male	50-59	Doctorate Degree	Physician	360 mo	480 mo	72 mo	No
8	Female	30-39	Trade / technical / vocational training	CMA	60 mo	300 mo	18 mo	No
9	Female	40-49	Doctorate Degree	Physician	300 mo	396 mo	60 mo	No

| 10 | Female | 60-69 | Trade / Technical / vocational training | RN / Nurse Manager | 576 mo | 180 mo | 84 mo | No |

Table 2: Summary of Participant Demographics

Participants were scheduled for 60-minute sessions with 15 minutes in between each session for debrief by the administrator and data logger, and to reset systems to proper test conditions. A spreadsheet was used to keep track of the participant schedule, and included each participant's demographic characteristics.

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

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

Additional information about the various measures can be found in Section 3.9 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 with this EHR, including:

1. Create and change a medication order
2. Create and change a lab order
3. Create and change a diagnostic imaging order
4. Verify drug-drug contraindication intervention
5. Verify drug-allergy contraindication intervention
6. Create a new patient and specify demographic information, including name, DOB, birth sex, preferred language, ethnicity, ethnicity details, sexual orientation, and gender identity.
7. Access an existing patient's record, enter a new problem, and change the problem
8. Access an existing patient's record, prescribe a new medication, and make changes to dosage frequency post-prescription
9. Access an existing patient's medication allergy list, create a new medication allergy, then make changes to the medication allergy
10. Add implantable devices to a patient record using UDIs with all three potential formats
11. Trigger Clinical Decision Support rules for each of the following attributes: problem list, medication list, medication allergy list, laboratory tests, and a combination of demographics and vital signs
12. Review bibliographic and linked referential information for triggered Clinical Decision Support rules
13. Trigger Clinical Decision Support rules for medications, medication allergy, and problem list after receiving a transition of care/referral summary and incorporating into the patient's record

Tasks were selected based on their frequency of use, criticality of function, and those that may be troublesome for some users. Tasks should always be constructed in light of the study objectives.

Procedures

Upon arrival, 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 reviewed and

signed an informed consent and release form (See Appendix 3). A representative from the test team witnessed the participant's signature.

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 also 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
- Without using a think aloud technique

For each task, the participants were given a written copy of the task. Task timing began once the administrator finished reading the question. The task time was completed once the participant indicated they had successfully completed the task. Scoring is discussed below in Section 3.9.

Following the session, the administrator gave the participant the post-test questionnaire (e.g., the System Usability Scale, see Appendix 5), compensated them for their time, and thanked each individual for their participation.

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

Participants were thanked for their time.

Test Location

The test facility included a waiting area and a quiet testing room with a table, computer for the participant, and recording computer for the administrator. Only the participant and administrator were in the test room. All observers and the data logger worked from a separate room where they could see the participant's screen and listen to the audio of the session. To ensure that the environment was comfortable for users, noise levels were kept to a minimum with the ambient temperature within a normal range. All of the safety instructions and evacuation procedures were valid, in place, and visible to the test participants.

Test Environment

The EHRUT would be typically used in a healthcare office or facility. In this case, the testing was conducted in a healthcare facility. For testing, the computer was a Dell Optiplex 390 desktop running Windows 10. The participants used a mouse, keyboard, and external display when interacting with the EHRUT.

The EHRUT used a 21 in display, running at 1920 x 1080 resolution and the color settings were sRGB virtual device model profile, System default (WCS profile for sRGB viewing conditions). The application was set up by the vendor according to the vendor's documentation describing the system set-up and preparation. The application itself was running on a remote server using a test database on a WAN connection. Technically, the system performance (i.e., response time) was representative of what actual users would experience in a field implementation. Additionally, participants were instructed not to change any of the default system settings (such as control of font size).

Test Forms and Tools

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

1. Informed Consent
2. Moderator's Guide
3. Post-Test Questionnaire

Examples of these documents can be found in Appendices 3-5 respectively. The Moderator's Guide was devised so as to be able to capture required data.

The participant's interaction with the EHRUT was captured and recorded digitally with screen capture software running on the test machine. Verbal comments were recorded with a microphone. The test session was later transmitted to a nearby observation room where the data logger observed and recorded the test session.

Participant Instructions

The administrator reads the following aloud to each participant (also see the full moderator's guide in Appendix B4):

> *Thank you for participating in this study. Your input is very important. Our session today will last about 75 minutes.*

I will ask you to complete a few tasks using this system and answer some questions. You should complete the tasks as quickly as possible making as few errors as possible. Please try to complete the tasks on your own following the instructions very closely. Please note that we are not testing you we are testing the system, therefore if you have difficulty all this means is that something needs to be improved in the system. I will be here in case you need specific help, but I am not able to instruct you or provide help in how to use the application.

Overall, we are interested in how easy (or how difficult) this system is to use, what in it would be useful to you, and how we could improve it. All of the information that you provide will be kept confidential and your name will not be associated with your comments at any time. Should you feel it necessary you are able to withdraw at any time during the testing.

Following the procedural instructions, participants were shown the EHR and as their first task, were given 5 minutes to explore the system and make comments. Once the task was complete, the administrator gave the following instructions:

For each task, I will read the description to you and say "Begin." At that point, please perform the task and say "Done" once you believe you have successfully completed the task.

I will ask you your impressions about the task once you are done.

The product you will be using today is in the final stages of development. Some of the data may not make sense as it is placeholder data.

We are recording the audio and screenshots of our session today. All of the information that you provide will be kept confidential and your name will not be associated with your comments at any time.

Do you have any questions or concerns?

Participants were then given 12 tasks to complete. Tasks are listed in the moderator's guide in Appendix B4.

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 Redwood EMR by measuring participant success rates and errors
2. Efficiency of Redwood EMR by measuring the average task time and path deviations
3. Satisfaction with Redwood EMR by measuring the 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 [x] seconds then allotted task time performance was [x * 1.25] 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. 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:	The participant's path (i.e., steps) through the application was

Task Deviations	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 their agreement with statements describing the tasks, from 1 (Strongly Disagree) to 5 (Strongly Agree). These data are averaged across participants.[3] Common convention is that average ratings for systems judged easy to use should be 3.3 or above. To measure participants' confidence in and likeability of the [EHRUT] overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, "I think I would like to use this system frequently," "I thought the system was easy to use," and "I would imagine that most people would learn to use this system very quickly." See full System Usability Score questionnaire in Appendix 5.13[4]

Table 3: Details of how observed data were scored.

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[3] See Tedesco and Tullis (2006) for a comparison of post-task ratings for usability tests. Tedesco, D. & Tullis, T. (2006) A comparison of methods for eliciting post-task subjective ratings in usability testing. Usability Professionals association Conference, June 12 – 16, Broomfield, CO.

[4] The SUS survey yields a single number that represents a composite measure of the overall perceived usability of the system. SUS scores have a range of 0 to 100 and the score is a relative benchmark that is used against other iterations of the system.

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, however no such observation of participants failing to follow instructions occurred.

The usability testing results for the EHRUT are detailed below (see table 4). The results should be seen in light of the objectives and goals outlined in Section 3.2 Study Design. The data should yield actionable results that, if corrected, yield material, positive impact on user performance. Furthermore, the data should be presented in forms such as the table below so that the tasks can be easily identified and their performance results examined and compared.

Measure	Task Success	Path Deviation	Task Time		Errors	SUS Ratings
Task	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Mean (SD)
Create and change a medication order	100 (0)	31.5/29	131.8 (19.7)	131.8/110	1.1 (1.1)	92.25 (10.51)
Create and change a lab order	100 (0)	26.7/16	75.6 (22.9)	75.6/41	.4 (.7)	90.5 (14.31)
Create and change a diagnostic imaging order	100 (0)	18.3/16	69.5 (21)	69.5/42	1.0 (.9)	92.75 (10.63)
Verify drug-drug contraindication intervention	100 (0)	9.4/7	54.8 (18.1)	54.8/34	.8 (.7)	92.75 (10.57)
Verify drug-allergy contraindication intervention	100 (0)	7.6/7	52.3 (35)	52.3/20	.4 (.7)	93 (10.71)
Create a new patient and specify demographic information, including name, DOB, birth sex, preferred language, ethnicity, ethnicity details, sexual orientation, and gender identity.	100 (0)	22.9/20	115.4 (28.4)	115.4/86	1.0 (1.3)	94.75 (7.37)
Access an existing patient's record, enter a new	100 (0)	13.3/12	73.3 (29.1)	73.3/44	.4 (.5)	91.25 (12.71)

problem, and change the problem						
Access an existing patient's record, prescribe a new medication, and make changes to dosage frequency post-prescription	100 (0)	27.3/26	88.5 (19.8)	88.5/65	.7 (.9)	89.75 (15.95)
Access an existing patient's medication allergy list, create a new medication allergy, then make changes to the medication allergy	100 (0)	17.8/17	83.7 (26.4)	83.7/52	.4 (.7)	91.75 (11.73)
Add implantable devices to a patient record using UDIs with all three potential formats	100 (0)	18.8/17	119.2 (36.5)	119.2/71	.8 (.6)	93.5 (8.6)
Trigger Clinical Decision Support rules for each of the following attributes: problem list, medication list, medication allergy list, laboratory tests, and a combination of demographics and vital signs	100 (0)	9.3/8	138.6 (21.8)	138.6/111	.7 (.9)	91.25 (13.52)
Review bibliographic and linked referential information for triggered Clinical Decision Support rules	100 (0)	3/3	40.1 (8.3)	40.1/30	0 (0)	93.25 (10.19)
Trigger Clinical Decision Support rules for medications, medication allergy, and problem list after receiving a transition of care/referral summary and incorporating into the patient's record	100 (0)	8.2/8	64.7 (22.9)	64.7/39	.2 (.4)	92.75 (10.63)

Table 4: Usability Testing Results

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be 92.27. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.[5]

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[5] See Tullis, T. & Albert, W. (2008). Measuring the User Experience. Burlington, MA: Morgan Kaufman (p. 149).

Discussion of Findings

This section provides a narrative discussion of each of the major areas in light of the findings.

Effectiveness

Based on the success, failure, and path deviation data, the overall system is relatively easy to use and provides its users with a straightforward interface to accomplish their goals. There were relatively few failures and sub-optimal path deviations. When they did occur, all users were able to get back on track and accomplish the tasks without assistance from the moderator. This indicates that even an inexperienced user would likely be able to effectively use the system without aid.

Efficiency

Based on the observations of the task time and deviation data, there is a relatively wide range in task efficiencies across users. This is to be expected, as different providers had significantly different levels of comfortability and skill with using an electronic system on a computer. Based on the data and qualitative observations during the test, efficiency deviations were not highly related to the system itself, but rather to the users skills with computers.

Satisfaction

Based on the task ratings and the SUS results data, users were highly satisfied with the system. There was one test participant who was a significant outlier in this regard, however the overall consensus was one of great satisfaction, reflected by a very high average SUS rating with a relatively low standard deviation.

Major Findings

Based on the quantitative findings, verbal report of the participants, and observations from the administrators and data loggers, providers were consistently frustrated with 3rd party systems, particularly e-prescribing through Dr First. The chief complaints were the number of clicks required to create and change a medication order, the occasional downtime, and the readability of the text in the Dr First interface. Some providers wished they could create templates for physician visits and personalize the system to fit their workflows better. Overall, providers found the system to be easy to use and would recommend it to their colleagues.

Areas for Improvement:

Based on the quantitative findings, verbal report of the participants, and observations from the administrators and data loggers, the key areas of improvement are reducing the number of clicks

required for certain providers' workflows, integration with Dr First that enables easier workflow through a reduced number of clicks and a more readable interface, the ability to print patient instructions without printing their entire notes, and the addition of mobile compatibility so that providers can access the EMR through mobile devices.

Appendices

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

1. Sample Recruiting Screener
2. Participant Demographics
3. Non-Disclosure Agreement (NDA) and Informed Consent Form
4. Example Moderator's Guide
5. System Usability Scale Questionnaire

Appendix 1: Sample Recruiting Screener

Recruiting Script for Recruiting Firm

Hello, my name is _____, calling from [Insert name of recruiting firm]. We are recruiting individuals to participate in a usability study for an electronic health record. We would like to ask you a few questions to see if you qualify and if would like to participate. This should only take a few minutes of your time. This is strictly for research purposes. If you are interested and qualify for the study, you will be paid to participate. Can I ask you a few questions?

1. [If not obvious] Are you male or female?
2. Have you participated in a focus group or usability test in the past xx months?
3. Do you, or does anyone in your home, work in marketing research, usability research, web design […etc.]?
4. Do you, or does anyone in your home, have a commercial or research interest in an electronic health record software or consulting company?
5. Which of the following best describes your age? [23 to 39; 40 to 59; 60 - to 74; 75 and older]
6. Which of the following best describes your race or ethnic group? [e.g., Caucasian, Asian, Black/African-American, Latino/a or Hispanic, etc.]
7. Do you require any assistive technologies to use a computer? [if so, please describe]

Professional Demographics:

8. What is your current position and title?
    a. RN: Specialty _____
    b. Physician: Specialty _____
    c. Resident: Specialty _____
    d. Administrative Staff
    e. Other
9. How long have you held this position?
10. Describe your work location (or affiliation) and environment? [e.g., private practice, health system, government clinic, etc.]

11. Which of the following describes your highest level of education? [e.g., high school graduate/GED, some college, college graduate (RN, BSN), postgraduate (MD/PhD), other (explain)]

Computer Experience

12. Besides reading email, what professional activities do you do on the computer? [e.g., access EHR, research; reading news; shopping/banking; digital pictures; programming/word processing, etc.]

13. About how many hours per week do you spend on the computer? [Recruit according to the demographics of the intended users, e.g., 0 to 10, 11 to 25, 26+ hours per week]

14. What computer platform do you usually use? [e.g., Mac, Windows, etc.]

15. What Internet browser(s) do you usually use? [e.g., Firefox, IE, AOL, etc.]

16. In the last month, how often have you used an electronic health record?

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

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

19. How does your work environment patient records?

    a. On paper

    b. Some paper, some electronic

    c. All electronic

Contact Information

These are all the questions I have for you. Your background matches the people we're looking for. Would you be able to participate on [date, time]?

May I get your contact information?

- Name of participant
- Address
- City, State, Zip
- Daytime phone number
- Evening phone number
- Alternate phone number
- Email address

Before your session starts, we will ask you to sign a release form allowing us to videotape and screen record your session. The videotape will only be used internally for further study if needed. Will you consent to these recordings?

This study will take place at Fanno Creek Clinic. I will confirm your appointment ac couple of days before your session and provide you with directions to our office. What time is best to reach you?

Appendix 2: Participant Demographics

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

Gender

Men:

Women:

Total (participants):

Occupation/Role

RN/BSN:

Physician:

Admin Staff:

Total (participants):

Years of Experience

Years experience:

Facility Use of EHR

All paper:

Some paper, some electronic:

All electronic:

Total (participants):

Non-Disclosure Agreement

THIS AGREEMENT is entered into as of _____, 2018, between _____ ("the Participant") and the testing organization *FannoTek Inc* located at *2400 SW Vermont St Portland, OR 97219.*

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 FannoTek Inc, 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 FannoTek Inc 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

FannoTek Inc 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.

Agreement

I understand and agree that as a voluntary participant in the present study conducted by FannoTek Inc. 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 FannoTek Inc.

I understand and consent to the use and release of the screen capture by FannoTek Inc. I understand that the information and screen capture 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 screen capture and understand the screen capture may be copied and used by FannoTek Inc 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 FannoTek Inc and FannoTek Inc'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 4: Example Moderator's Guide

Only one task is presented here for illustration.

EHRUT **Usability Test Guide**

Moderator's Guide

Administrator _____

Data Logger _____

Date _____ Time _____

Participant # _____

Location _____

Prior to testing

- • Confirm schedule with Participants
- • Ensure EHRUT lab environment is running properly
- • Ensure lab and data recording equipment is running properly

Prior to each participant

- • Reset application
- • Start session recordings

Prior to each task

- • Reset application to starting point for next task

After each participant

- • End session recordings

After all testing

- • Back up all video and data files

Orientation (10 minutes)

Thank you for participating in this study. Our session today will last roughly 75 minutes. During that time you will take a look at an electronic health record system.

I will ask you to complete a few tasks using this system and answer some questions. You should complete the tasks as quickly as possible making as few errors as possible. Please try to complete the tasks on your own following the instructions very closely. Please note that we are not testing you we are testing the system, therefore if you have difficulty all this means is that something needs to be improved in the system. I will be here in case you need specific help, but I am not able to instruct you or provide help in how to use the application.

Overall, we are interested in how easy (or how difficult) this system is to use, what in it would be useful to you, and how we could improve it. 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.

For each task, I will read the description to you and say "Begin." At that point, please perform the task and say "Done" once you believe you have successfully completed the task.

I will ask you your impressions about the task once you are done.

The product you will be using today is in the final stages of development. Some of the data may not make sense as it is placeholder data.

We are recording the audio and screenshots of our session today. All of the information that you provide will be kept confidential and your name will not be associated with your comments at any time.

Do you have any questions or concerns?

Preliminary Questions (5 minutes)

What is your job title?

How long have you been working in this role?

What are some of your main responsibilities?

Tell me about your experience with electronic health records.

This is the application you will be working with it. Have you heard of it? If so, tell me what you know about it.

Show test participant the EHRUT

Please don't click anything just yet. What do you notice? What are you able to do here? Please be specific.

Task 1: Patient Summary Screen

Take the participant to the starting point for the task.

Before going into the exam room, you want to review *Patient's* chief complaint, history, and vitals. Find this information.

Success:

- ☐ Easily completed
- ☐ Completed with difficulty or help (describe below)
- ☐ Not completed
- • Comments:

Task Time: _____ seconds

Optimal Path: *Screen A -> Screen B -> Drop down B -> "OK" Button -> Screen X…*

- ☐ Correct
- ☐ Minor Deviations / Cycles (describe below)
- ☐ Major Deviations / Cycles (describe below)
- ☐ Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

State each question under SUS and record responses.

Administrator / Notetaker Comments:

Final Questions (10 minutes)

What was your overall impression of this system?

What aspects of the system did you like most?

What aspects of the system did you like least?

Were there any features that you were surprised to see?

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

Compare this system to other systems you have used. Would you recommend this system to your colleagues?

Appendix 5: 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. 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, 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 this 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*