EHR Usability Test Report of SRS EHR 10.x


SRS EHR v10.x

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EXECUTIVE SUMMARY

A usability test of SRS EHR v10.x Ambulatory EHR was conducted on 12/7/17 in the offices of Princeton Orthopaedic Associates, P.A. at 11 Center Drive Monroe Twp, NJ 09931 by SRSHealth. The purpose of this test was to test and validate the usability of the current user interface, and provide evidence of usability in the SRS EHR, the EHR Under Test (EHRUT). During the usability test, 10 clinical and practice staff matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks.

This study collected performance data on one task typically conducted on an EHR:

§ 170.315(a)(9) Clinical Decision Support

During the 15 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. Some participants had prior experience with the EHR. The administrator introduced the test, and instructed participants to complete a series of tasks (given one at a time) using the EHRUT. During the testing, the administrator timed the test and, 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 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. 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 SRS EHR.
<table>
<thead>
<tr>
<th>Task</th>
<th>N</th>
<th>Task Success</th>
<th>Deviations (Observed / Optimal)</th>
<th>Path Deviation</th>
<th>Task Time</th>
<th>Task Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Decision Support Measures Configuration</td>
<td>10</td>
<td>100%</td>
<td>1.12</td>
<td>1.00</td>
<td>73.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Clinical Decision Support using TOC/DDR</td>
<td>10</td>
<td>90%</td>
<td>0.97</td>
<td>1.03</td>
<td>63.6</td>
<td>2.1</td>
</tr>
<tr>
<td>CDS Medication List</td>
<td>10</td>
<td>100%</td>
<td>0.96</td>
<td>1.00</td>
<td>62.5</td>
<td>1.3</td>
</tr>
<tr>
<td>CDS Problem List and Medication Allergy List</td>
<td>10</td>
<td>70%</td>
<td>0.96</td>
<td>1.02</td>
<td>218.1</td>
<td>2.2</td>
</tr>
<tr>
<td>CDS Lab tests and values/results</td>
<td>10</td>
<td>90%</td>
<td>0.91</td>
<td>1.02</td>
<td>91</td>
<td>1.5</td>
</tr>
<tr>
<td>Linked Referential CDS and CDS Vitals Signs</td>
<td>10</td>
<td>80%</td>
<td>0.91</td>
<td>1.06</td>
<td>165.3</td>
<td>1.7</td>
</tr>
</tbody>
</table>

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 85.5

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

- Major findings

The test participants were also happy to see that that clinical decision support rules were more medically relevant and tied directly to clinical quality measures. This linkage will lead to more meaningful alerts appearing inside the EHR which in turn will make physicians more likely to review them. The participants believed the inclusion of the new linked referential information would prove to be useful while reviewing the patient chart. In addition, the users believed the automatic triggering of the CDS alerts upon importing key clinical data into the patient chart was extremely valuable especially in cases where alert was displayed based on clinical data from a different specialty.

- Areas for improvement

The EHR supports a number of CDS alerts and on the admin screen a more apparent visual differentiation between the selected vs. unselected CDS alerts would be useful in progressing quickly through the selection process.

INTRODUCTION

The EHRUT tested for this study was SRS EHR v10.x. It is designed to present medical information to healthcare providers in an outpatient ambulatory environment. The SRS EHR consists of various modules and interfaces design to capture, display, and modify patient clinical data. 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 time on task, user satisfaction, and deviation from optimal paths, were captured during the usability testing.

METHOD

**SRS User Centered Design Process**

SRSsoft designed and implemented its own UCD process based upon the ISO 9241-210 industry standard. The SRS UCD process follows the same principles of human-centered design and fits in to our overall quality management system (QMS). The system involves users in the overall design and software development process. The design team includes individuals with skills spanning across multiple disciplines and with different perspectives. The team works to address the entire user experience through a deep understanding of the tasks and workflows required by end users. The process is iterative and requirements are continually updated to better address the context of use, increase usability, and reduce user error.

The main steps of the process are:

- Understanding/stating the context of use for the function or module
  - Business requirements are gathered from internal and client stakeholders. These stakeholders are kept up to date with product developments through “Feature team” meetings.
- Creating design solutions
  - Business Analysis works with “Feature teams” to design several possible solutions and through further analysis with stakeholders the solution is refined.
- Creating user requirements
  - Business analysis creates full requirements documents based on feedback from “Feature teams”
- Evaluating the solution
  - Solution prototypes are created and vetted against the original understanding of the context of use.
- Performing user centered evaluations
  - Formal summative user testing is performed and the analysis is sent back to the “feature teams”. The results are then used to drive future iterations of the product.

The following tasks and modules were developed based on the SRS UCD design process:

§ 170.315(a)(9) (Clinical decision support)
PARTICIPANTS

The testing methods were in accordance with the SRS User Centered Design Process. A total of 10 participants were tested on the EHRUT(s). Participants in the study included technicians, managers and PT staff from the orthopaedic specialties. In addition, participants had no direct connection to the development of or organization producing the EHRUT(s). Participants were not from the testing or supplier organization. Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received.

For the test purposes, end-user characteristics were identified and translated into a recruitment screener used to solicit potential participants; an example of a screener is provided in Appendix 1.

Recruited participants had a mix of backgrounds and demographic characteristics conforming to the recruitment screener. The following is a table of participants by characteristics, including demographics, professional experience, computing experience and user needs for assistive technology. Participant names were replaced with Participant IDs randomly generated from the demographics collection tool so that an individual’s data cannot be tied back to individual identities.

<table>
<thead>
<tr>
<th>ID</th>
<th>Gender</th>
<th>Age</th>
<th>Occupation/Role</th>
<th>EHR Experience (Years)</th>
<th>CDS Module Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>188980004</td>
<td>Female</td>
<td>50-59</td>
<td>Manager</td>
<td>10</td>
<td>Beginner</td>
</tr>
<tr>
<td>189157620</td>
<td>Female</td>
<td>70-79</td>
<td>Clerical</td>
<td>2</td>
<td>Beginner</td>
</tr>
<tr>
<td>189157638</td>
<td>Female</td>
<td>20-29</td>
<td>Billing Rep</td>
<td>1</td>
<td>Beginner</td>
</tr>
<tr>
<td>189158003</td>
<td>Female</td>
<td>50-59</td>
<td>Billing Office</td>
<td>7</td>
<td>Beginner</td>
</tr>
<tr>
<td>189183182</td>
<td>Female</td>
<td>50-59</td>
<td>PT Aide</td>
<td>2</td>
<td>Beginner</td>
</tr>
<tr>
<td>189240589</td>
<td>Female</td>
<td>30-39</td>
<td>Physical Therapy Front Desk Coordinator</td>
<td>10</td>
<td>Beginner</td>
</tr>
<tr>
<td>189242966</td>
<td>Male</td>
<td>30-39</td>
<td>IT Systems Specialist</td>
<td>0</td>
<td>Beginner</td>
</tr>
<tr>
<td>189253210</td>
<td>Female</td>
<td>50-59</td>
<td>Manager</td>
<td>2</td>
<td>Beginner</td>
</tr>
<tr>
<td>189258674</td>
<td>Female</td>
<td>40-49</td>
<td>Biller</td>
<td>10</td>
<td>Beginner</td>
</tr>
<tr>
<td>189680942</td>
<td>Male</td>
<td>40-49</td>
<td>Technician</td>
<td>2</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

Ten participants (matching the demographics in the section on Participants) were recruited and ten participated in the usability test.

Participants were scheduled for 15 minute sessions with 5 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 participants, 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 test, participants interacted with one EHR. Each participant used the system in the same room of the two testing locations, 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. Clinical Decision Support:
   a. Clinical Decision Support Measures Configuration
   b. Clinical Decision Support using TOC/DDR
   c. CDS Medication List
   d. CDS Problem List and Medication Allergy List
   e. CDS Lab tests and values/results
   f. Linked Referential CDS and CDS Vitals Signs

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users.

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.

To ensure that the test ran smoothly, two staff members participated in this test, the usability administrator and the data logger.

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. A second person served as the data logger and took notes on task success, path deviations, number and type of errors, and comments.
Participants were instructed to perform the tasks (see specific instructions below):

- As quickly as possible making as few errors
- 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 stopped 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 (the System Usability Scale, see Appendix 5) 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.

**TEST LOCATION**

The tests were performed in the exam room where the EHRUT would typically be deployed and used in production. Only the participant, the administrator and the data logger were in the test room. 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 instruction and evacuation procedures were valid, in place, and visible to the participants.

**TEST ENVIRONMENT**

The EHRUT would be typically be used in a healthcare office or facility. In this instance, the testing was conducted in an examination room on a computer where interactions with the EHRUT would typically take place in real world office scenarios. For testing, the computer used a Windows PC running windows 7 with a standard mouse and keyboard.

The SRS EHR v10.x system was viewed on a 22 inch vertical monitor in portrait mode. The application was set up by the SRSSoSoft according to standard operating procedure for client/server installation. The application itself was running on a Windows 2008 Server using a Demo/Training SQL database on a LAN connection. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation. Additionally, participants 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 goto meeting screen capture software running on the test machine.
**PARTICIPANT INSTRUCTIONS**

The administrator reads the following instructions aloud to the each participant (also see the full moderator's guide in Appendix 4):

Thank you for participating in this study. Our session today will last about 20 minutes. During that time you will take a look at an early prototype of SRS EHR v10.x.

I will ask you to complete a few tasks using this system and answer some questions. 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. You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Please do not do anything more than asked. If you get lost or have difficulty I cannot answer help you with anything to do with the system.

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. Since this is a test system some of the data may not make sense as it is placeholder data. We are recording the screen of our session today for our internal use only.

Do you have any questions or concerns?

Following the procedural instructions, participants were shown the EHR. Once this 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 would like to request that you not talk aloud or verbalize while you are doing the tasks. I will ask you your impressions about the task once you are done.*

Participants were then given ten tasks to complete. Tasks are listed in the moderator’s guide in Appendix 4.

**USABILITY METRICS**

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

1. Effectiveness of SRS EHR v10.x by measuring participant success rates and errors
2. Efficiency of SRS EHR v10.x by measuring the average task time and path deviations
3. Satisfaction with SRS EHR v10.x by measuring ease of use ratings

**DATA SCORING**

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

<table>
<thead>
<tr>
<th>Measures</th>
<th>Rationale and Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effectiveness:</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Task Success</strong></td>
<td>The total number of successes were calculated for each task and then divided by</td>
</tr>
</tbody>
</table>
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 and was recorded.

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 were defined by taking multiple measures of optimal performance and multiplying each time by a factor of 1.5. This factor allows some time buffer, as participants are presumably not trained to expert performance. Thus, if expert performance on a task was \( x \) seconds then optimal task time performance was \( x \times 1.5 \) seconds. The ratio of reported time to optimal time was aggregated across tasks and reported with mean.

| Effectiveness: Task Failures | If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as a “Failures.” No task times were taken for errors. On a qualitative level, an enumeration of errors and error types was collected and is described in the narrative section below. |
| Efficiency: Task Deviations | The participant’s path through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, opened an incorrect module, 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. Optimal paths were recorded in the moderator guide. Task deviations are discussed further in the qualitative sections. |
| 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. |
| 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 Easy) to 5 (Very Difficult). These data are averaged across participants. Common convention is that average ratings for systems judged easy to use should be 3.3 or below. To measure participants’ confidence in and likeability of the SRS EHR v10.x overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, “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. |

Table 1. Details of how observed data were scored.
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.

There were a few minor issues which may have affected data collection. The task descriptions and the terminology used could have contributed to some hesitation on the part of the user when completing tasks. Efforts were made to use descriptions and terminology which would be familiar to users; however, some users still may have experienced some confusion.

The usability testing results for the EHRUT are detailed below (see Table 2).

<table>
<thead>
<tr>
<th>Measure</th>
<th>Effectiveness</th>
<th>Efficiency</th>
<th>Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Task Success</td>
<td>Task Time</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>(Observed / Optimal)</td>
<td>(Observed / Optimal)</td>
</tr>
<tr>
<td>Clinical Decision Support Measures Configuration</td>
<td>10</td>
<td>100%</td>
<td>1.12</td>
</tr>
<tr>
<td>Clinical Decision Support using TOC/DDR</td>
<td>10</td>
<td>90%</td>
<td>0.97</td>
</tr>
<tr>
<td>CDS Medication List</td>
<td>10</td>
<td>100%</td>
<td>0.96</td>
</tr>
<tr>
<td>CDS Problem List and Medication Allergy List</td>
<td>10</td>
<td>70%</td>
<td>0.96</td>
</tr>
<tr>
<td>CDS Lab tests and values/results</td>
<td>10</td>
<td>90%</td>
<td>0.91</td>
</tr>
<tr>
<td>Linked Referential CDS and CDS Vitals Signs</td>
<td>10</td>
<td>80%</td>
<td>0.91</td>
</tr>
</tbody>
</table>

Table 2. 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: 85.5. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.¹

DISCUSSION OF THE FINDINGS

EFFECTIVENESS

Based on the findings, most users were quite effective at using the EHRUT. The average number of failures per task was 1.1, but the "errors" were primarily due to the user timing out before the task could be completed. Some users spent additional time making sure that they reviewed the alert and information on the popped out hyperlink which contributed to timing out on the task, and ultimately, failure on the task. However, making certain that data is entered correctly contributes to an overall goal of this project - patient safety.

Most test participants were quite effective and showed very few, if any path deviations. The duration taken to complete the task can be attributed to the fact that this is a feature on the application on which the test participants were not trained. It would be interesting to measure effectiveness once again after training has been completed once the EHRUT has been deployed to the customers and to observe if users continue to follow an optimal path.

Risk Prone Errors

When discussing errors, it is important to note which tasks are more likely to result in errors and what types of errors are most likely to cause patient safety issues. Tasks which do not alter the patient’s record but simply display information to the user are less likely to lead to errors.

Below is a prioritized list of tasks in the order of the associated risk and with a rating of the risk (1-3, where 1 is a low risk and 3 is a high risk)

<table>
<thead>
<tr>
<th>Task</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDS Problem List and Medication Allergy List</td>
<td>3</td>
</tr>
<tr>
<td>Clinical Decision Support using TOC/DDR</td>
<td>2</td>
</tr>
<tr>
<td>CDS Lab tests and values/results</td>
<td>2</td>
</tr>
<tr>
<td>Clinical Decision Support Measures Config</td>
<td>1</td>
</tr>
<tr>
<td>CDS Medication List</td>
<td>1</td>
</tr>
<tr>
<td>Linked Referential CDS and CDS Vitals Signs</td>
<td>1</td>
</tr>
</tbody>
</table>

**EFFICIENCY**

A few users were unable to complete the tasks in what was deemed a "reasonable" amount of time. Users who failed to complete the task within the maximum amount of time, as determined for each task prior to testing, had their data excluded for efficiency measures.

The average deviations ratios (observed path / optimal path) in the group tested were close to 1.0 for users who could complete the task. Even users who were unable to complete a task in time were generally on the correct path and rarely deviated into a different area of the software. Thus, we conclude that users were relatively efficient when completing the tasks set before them.

**SATISFACTION**

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be: 85.5. Verbal feedback as well as task ratings conclude that
there is a high level of comfort and overall satisfaction with the system. Specifically, users stated that the system is “simple and intuitive,” “user friendly,” and “organized logically.” These statements, along with other participant verbalizations, suggest a high level of usability within the system.

There are of course some areas of improvement, which are discussed below, but even so the average task ease of use rating was between 1.0 and 2.2 for each task. As set forth in the data scoring section, average ratings for systems judged easy to use should be 3.3 or below. Hence, a major finding of this testing was that the modules tested are very easy to use.

**MAJOR FINDINGS**

The test participants were also happy to see that that clinical decision support rules were more medically relevant and tied directly to CQM measures. This link will lead to more meaningful alerts appearing inside the EHR, which in turn will make physicians more likely to review them. The participants believed the inclusion of the new linked referential information would prove to be useful while reviewing the patient chart.
**AREAS FOR IMPROVEMENT**

Generally, the feedback was very positive, but there are some areas where usability could be improved. One major takeaway from this process is that gathering user feedback earlier in the development process as well as working with less advanced/beginner users rather than super users could improve usability and overall safety.

Users noted they would also benefit from a clear listing of the patient data which caused a clinical decision message to appear. No user wanted the system to immediately generate a popup and interrupt their work every time a new alert was generated. The EHR supports a number of CDS alerts and on the admin screen a more apparent visual differentiation between the selected vs. unselected CDS alerts would be useful in progressing quickly through the selection process.
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: Moderator’s Guide
5: System Usability Scale Questionnaire
Appendix 1: SAMPLE RECRUITING SCREENER

The purpose of a screener to ensure that the participants selected represent the target user population as closely as possible. Rather than reaching out to individual participants, SRS opted to target the Practice Administrator and rely upon them to select qualified participants based on the functionality being tested.

Recruiting Scripts:

Hello, my name is _______, and I am calling from SRSHealth. We are recruiting participants for a usability study on the SRS EHR. Would you be willing to participate, along with staff members? This is strictly for research purposes. We will primarily be conducting tests on the usability of the new clinical decision support. Could you identify users in the practice such as physicians, medical assistants, and technicians who use this module? Once you have identified those users, please send them a demographics questionnaire.

Would you be able to participate between December 4 and December 8? The test will take place at your office.

Thank you, and we appreciate your time.

Participants then filled out an online demographics survey at https://srssoft.polldaddy.com/s/participant-demographics-survey-1
Appendix 2: PARTICIPANT DEMOGRAPHICS

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

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>2</td>
</tr>
<tr>
<td>Women</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total (participants)</strong></td>
<td>10</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>18-25</td>
<td>0</td>
</tr>
<tr>
<td>25-39</td>
<td>3</td>
</tr>
<tr>
<td>40-59</td>
<td>6</td>
</tr>
<tr>
<td>60+</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total (participants)</strong></td>
<td>10</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>6</td>
</tr>
<tr>
<td>Asian</td>
<td>1</td>
</tr>
<tr>
<td>Black/African-American</td>
<td>1</td>
</tr>
<tr>
<td>Latino/a or Hispanic</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total (participants)</strong></td>
<td>10</td>
</tr>
<tr>
<td><strong>Occupation/Role</strong></td>
<td></td>
</tr>
<tr>
<td>Physician</td>
<td>0</td>
</tr>
<tr>
<td>Medical Assistant</td>
<td>0</td>
</tr>
<tr>
<td>Technician</td>
<td>1</td>
</tr>
<tr>
<td>Manager</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total (participants)</strong></td>
<td>10</td>
</tr>
<tr>
<td><strong>Years of Experience</strong></td>
<td></td>
</tr>
<tr>
<td>0-2</td>
<td>6</td>
</tr>
<tr>
<td>3-5</td>
<td>0</td>
</tr>
<tr>
<td>6-9</td>
<td>1</td>
</tr>
<tr>
<td>10+</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total (participants)</strong></td>
<td>10</td>
</tr>
</tbody>
</table>
Following is a full participant breakdown:

<table>
<thead>
<tr>
<th>ID</th>
<th>Gender</th>
<th>Age</th>
<th>Occupation/Role</th>
<th>EHR Experience (Years)</th>
<th>CDS Module Experience</th>
<th>Assistive Tech Needs</th>
<th>Race/Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1188980004</td>
<td>Female</td>
<td>50-59</td>
<td>Manager</td>
<td>10</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>2189157620</td>
<td>Female</td>
<td>70-79</td>
<td>Clerical</td>
<td>2</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>3189157638</td>
<td>Female</td>
<td>20-29</td>
<td>Billing Rep</td>
<td>1</td>
<td>Beginner</td>
<td>N/A</td>
<td>Asian</td>
</tr>
<tr>
<td>4189158003</td>
<td>Female</td>
<td>50-59</td>
<td>Billing Office</td>
<td>7</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>5189183182</td>
<td>Female</td>
<td>50-59</td>
<td>PT Aide</td>
<td>2</td>
<td>Beginner</td>
<td>N/A</td>
<td>Other</td>
</tr>
<tr>
<td>6189240589</td>
<td>Female</td>
<td>30-39</td>
<td>Physical Therapy Front Desk Coordinator</td>
<td>10</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>7189242966</td>
<td>Male</td>
<td>30-39</td>
<td>IT Systems Specialist</td>
<td>0</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>8189253210</td>
<td>Female</td>
<td>50-59</td>
<td>Manager</td>
<td>2</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>9189258674</td>
<td>Female</td>
<td>40-49</td>
<td>Biller</td>
<td>10</td>
<td>Beginner</td>
<td>N/A</td>
<td>Black/African-American</td>
</tr>
<tr>
<td>10189680942</td>
<td>Male</td>
<td>40-49</td>
<td>Technician</td>
<td>2</td>
<td>Moderate</td>
<td>N/A</td>
<td>Latino/a or Hispanic</td>
</tr>
</tbody>
</table>
Appendix 3: NON-DISCLOSURE AGREEMENT AND INFORMED CONSENT FORM

Non-Disclosure Agreement

THIS AGREEMENT is entered into as of December 7, 2017, between ___________________________ (“the Participant”) and the testing organization SRSHealth located at 155 Chestnut Ridge Road, Montvale, New Jersey, 07645.

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 SRSHealth, 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 SRSHealth 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 not disclose this confidential information obtained today to anyone else or any other organizations.

Participant’s printed name: ________________________________
Signature: ________________________________
Date: ________________________________
Informed Consent

*SRSHealth* 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 30 minutes.

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

I understand and consent to the use and release of the recording by *SRSHealth*. I understand that the information and recording 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 recording and understand the recording may be copied and used by *SRSHealth* 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 *SRSHealth* and *SRSHealth*’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

SRS EHR Usability Test
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 with Goto Meeting

Prior to each task:
☐ Reset application to starting point for next task

After each participant:
☐ End session recordings with Goto Meeting

After all testing
☐ Back up all video and data files

Orientation

Thank you for participating in this study. Our session today will last about 15 minutes. During that time you will take a look at an early prototype of SRS EHR v10.x.

I will ask you to complete a few tasks using this system and answer some questions. 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.

You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Please do not do anything more than asked. If you get lost or have difficulty I cannot answer help you with anything to do with the system itself.

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. Since this is a test system some of the data may not make sense as it is placeholder data. We are recording the screen of our session today for our internal use only.

Do you have any questions or concerns?
Participant Name:

Task 1: Clinical decision support measures configuration

(Optimal Time: 43 seconds; Maximum Time: 65 seconds)

Please use the CQM CDS Admin PowerTab to configure the CDS measures

Success:
- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:
Task Time: ________ Seconds

Optimal Path
1) User is logged in as a system administrator
2) User is viewing the Interoperability Dashboard
3) Search for a patient
4) User clicks on CQM/CDS Admin Power tab
5) User selects 2017 from the reporting year drop down
6) User selects “Providers not in a group” on the drop down
7) User selects provider for whom to activate for clinical decision support rules
8) Activate the CDS Rules for the following CQMs: 52, 65, 90, 122, 123, 135, 143, 144, 145, 153, 158

Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Notetaker Comments:
Task 2: Clinical decision support using TOC/DDR

(Optimal Time: 43 seconds; Maximum Time: 65 seconds)

Clinical decision support using TOC/DDR

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

Comments:
Task Time: ________ Seconds

Optimal Path
1) Now login as the doctor who is tracking CMS 144
2) Now import the TOC type CCD file in input folder (Path is defined while creating polling folder.
   Input folder location - C:\SRSServer\Integration\DDI\Default Import\In) through DDR/DDI
3) Test patient data is imported successfully for patient
4) User is on the Desktop Interoperability Dashboard. Refresh the patient.
5) CDS alert should be displayed for “Beta-Blocker Therapy for Left Ventricular Systolic Dysfunction”
6) Click on CDS Alert to view diagnosis and Medication allergy with info button
7) Click on diagnosis hyperlink
8) Diagnosis information should be displayed
9) Now click on medication allergy hyperlink
10) Medication allergy information should be displayed in the new window

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)
Administrator / Notetaker Comments:

Task 3: CDS Medication List

(Optimal Time: 43 seconds; Maximum Time: 65 seconds)

Please use the Rx Module to create a Medication Order for a patient and verify the corresponding CDS alert

Success:
- [ ] Easily completed
- [ ] Completed with difficulty or help :: Describe below
- [ ] Not completed

Comments:
Task Time: ________ Seconds

Optimal Path
1) User is on the Interoperability Dashboard
2) Patient is between 16 and 23 years old and gender should be Female
3) Patient has an encounter during the calendar year 2017 with an office Visit encounter type (CPT code 99201), enter this data using the Visit Type App
4) Then prescribe an active medication of “Levonorgestrel 0.75 MG Oral Tablet (Rx norm – 259218)” for that encounter and fill out Prescription instructions such as quantity, route, frequency, and days using the Rx Module
5) CDS alert should appear for “Chlamydia Screening for Women”
6) Click on CDS Alert to view medication
7) Click on medication hyperlink
8) Medication information should be displayed in the new window

- [ ] Correct
- [ ] Minor Deviations / Cycles :: Describe below
- [ ] Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Notetaker Comments:

Task 4: CDS Problem List and Medication allergy list

(Optimal Time: 150 seconds; Maximum Time: 225 seconds)

Please use the Rx module and Diagnosis App to capture clinical data for the patient and then verify the corresponding CDS alert displayed.

Success:
- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:
Task Time: __________ Seconds

Optimal Path
1) User is on the Interoperability Dashboard
2) Patient is greater than 18 years old
3) Patient has a minimum of two encounter of office visit during the calendar year 2017 (CPT code 99201,99202), enter this data using the Visit Type App
4) Add a diagnosis of Heart Failure which overlaps to the first encounter (from step 3) (Snomed Code - 84114007 - Heart failure (disorder)) using the Diagnosis App
5) Add one more diagnosis of Moderate or Severe LVSD starts before the first encounter (from step 4) (Snomed Code - 981000124106- Moderate left ventricular systolic dysfunction (disorder) using the Diagnosis App
6) Add an Medication allergy of Beta Blocker Therapy by prescribing first medication with instruction such as quantity, route, frequency, and days and then right click on it and select intolerance for that encounter (Rx norm - 854901: Bisoprolol Fumarate 10 MG Oral Tablet) using the Rx Module
7) CDS alert should appear for “Beta-Blocker Therapy for Left Ventricular Systolic Dysfunction”
8) Click on CDS Alert to view diagnosis and Medication allergy with info button
9) Click on medication allergy hyperlink
10) Medication allergy information should be displayed in the new window
11) Click on diagnosis hyperlink
12) Diagnosis information should be displayed in the new window

Correct
- Minor Deviations / Cycles :: Describe below
- Major Deviations :: Describe below

Comments:
Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Notetaker Comments:

Task 5: CDS Laboratory tests and values/results

(Optimal Time: 67 seconds; Maximum Time: 100 seconds)

Please use CPOE Labs to generate a lab order for the patient and verify the corresponding CDS alert displayed

Success:
- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:
Task Time: ________ Seconds

Optimal Path
1) User is on the Interoperability Dashboard
2) Patient is between 16 and 23 years old
3) Ensure patient gender is Female
4) Patient has an encounter during the calendar year 2017 with an office Visit encounter type (CPT code 99201), enter this data using the Visit Type App
5) Add a Lab order of Pregnancy Test during the measurement period (Code - 19080-1: Choriogonadotropin [Units/volume] in Serum or Plasma)
6) CDS alert should appear for “Chlamydia Screening for Women”
7) Click on CDS Alert to view lab results with hyperlink
8) Click on lab results hyperlink
9) Lab results information should be displayed in the new window

□ Correct
□ Minor Deviations / Cycles :: Describe below
□ Major Deviations :: Describe below

Comments:
Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Notetaker Comments:

Task 6: Linked Referential CDS and CDS Vitals Signs

Please add patient vital signs and verify the corresponding CDS alert displayed
(Optimal Time: 120 seconds; Maximum Time: 180 seconds)

Success:
- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: ________ Seconds

Optimal Path
1) User is on the Interoperability Dashboard
2) Patient is between 18 and 84 years old
3) Patient has an encounter within 6 month from start of the calendar year 2017 with an office visit encounter type (CPT code 99201) entered using the Visit Type app
4) Patient has a diagnosis of Essential Hypertension that starts during this encounter (Code - Essential hypertension (disorder) - 59621000) using the Diagnosis App
5) Patient gets his systolic blood pressure taken during the encounter (from step 3) which must be greater than or equal to 140mmhg entered using the Vitals App
   a. While entering the data within the Vitals App use the date and time controls to select the date and time of the encounter from step 3
6) CDS alert should appear for “Blood Pressure Improvement”
7) Click on CDS Alert to view Diagnosis and Vitals information
8) Click on Vitals hyperlink
9) Vitals for blood pressure information should be displayed in the new window.
10) Click on CDS Alert to view vital and diagnosis information along with below information
• Description about the Bibliographic citation of Intervention
• Developer information
• Funding Source information
• Release and Revision Date

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Notetaker Comments:
**Appendix 5: SYSTEM USABILITY SCALE QUESTIONNAIRE**

This questionnaire was adapted from John Brooke's "SUS: a "quick and dirty" usability scale" at Digital Equipment Corporation in the UK. Participants completed the questionnaire on paper.

<table>
<thead>
<tr>
<th>System Usability Scale</th>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I think that I would like to use this system frequently</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>2. I found the system unnecessarily complex</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>3. I thought the system was easy to use</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>4. I think that I would need the support of a technical person to be able to use this system</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>5. I found the various functions in this system were well integrated</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>6. I thought there was too much inconsistency in this system</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>7. I would imagine that most people would learn to use this system very quickly</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>8. I found the system very cumbersome to use</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>9. I felt very confident using the system</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>10. I needed to learn a lot of things before I could get going with this system</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

---

EHR Usability Test Report of SRS EHR 10.x


SRS EHR 9.13

Date of Usability Test: 12/7/2017
Date of Report: 12/7/2017
Report Prepared By: Sumitra Rangarajan, Product Owner, SRS Health
201-802-1300
srangarajan@srs-health.com
155 Chestnut Ridge Road, Montvale NJ, 07645

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EXECUTIVE SUMMARY

A usability test of SRS EHR 9.13 Ambulatory EHR was conducted on 12/7/2017 in the offices of Princeton Orthopaedic Associates, P.A. at 11 Center Drive Monroe Twp, NJ 09931 by SRSHealth. The purpose of this test was to test and validate the usability of the current user interface, and provide evidence of usability in the SRS EHR, the EHR Under Test (EHRUT). During the usability test, 10 clinical staff and technicians matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks.

This study collected performance data on two tasks typically conducted on an EHR:

- 170.315(a)(1) CPOE Medications
- 170.315(a)(7) Medication List
- 170.315(a)(8) Medication Allergy List
- 170.315(a)(4) Drug-drug, drug-allergy interaction checks

During the 30 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 the EHR. The administrator introduced the test, and instructed participants to complete a series of tasks (given one at a time) using the EHRUT. During the testing, the administrator timed the test and, 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 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. 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 SRS EHR.
<table>
<thead>
<tr>
<th>Measure</th>
<th>N</th>
<th>Task Success</th>
<th>Effectiveness</th>
<th>Efficiency</th>
<th>Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronically Record Patient Active Medication List</td>
<td>10</td>
<td>100</td>
<td>0.97</td>
<td>1.04</td>
<td>38.9</td>
</tr>
<tr>
<td>Electronically Change Patient Active Medication List</td>
<td>10</td>
<td>100</td>
<td>1.04</td>
<td>1</td>
<td>26.2</td>
</tr>
<tr>
<td>Electronically Access Patient Active Medication List</td>
<td>10</td>
<td>100</td>
<td>0.84</td>
<td>1</td>
<td>12.6</td>
</tr>
<tr>
<td>Electronically Record Patient Active Medication Allergy List</td>
<td>10</td>
<td>100</td>
<td>1.2</td>
<td>1</td>
<td>90.7</td>
</tr>
<tr>
<td>Electronically Change Active Medication Allergy List</td>
<td>10</td>
<td>100</td>
<td>0.98</td>
<td>1</td>
<td>17.6</td>
</tr>
<tr>
<td>Electronically Access Active Medication Allergy List</td>
<td>10</td>
<td>100</td>
<td>0.98</td>
<td>1</td>
<td>12.7</td>
</tr>
<tr>
<td>Automatically and Electronically Indicate Drug-drug and Drug-allergy Interventions</td>
<td>10</td>
<td>100</td>
<td>1.07</td>
<td>1.01</td>
<td>53.7</td>
</tr>
</tbody>
</table>

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 94.

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

- **Major findings**

  Overall, the system was well received and considered very usable and intuitive by almost all participants. The areas that tested most positively were related to updating and maintaining the drug list. Almost all users were able to perform these tasks with minimal deviation from the ideal workflow.

  Users responded generally well to having many options available to them in one place. This allowed for even the most complicated workflow to be completed with only a few steps. Some users noted that they were impressed that so much functionality was available with so few steps/clicks. Some prescribers commented that would like to see the module expanded to include the ability to ePrescribe multiple drugs at once or to automatically ePrescribe drugs based on common practices. From a patient safety standpoint it does not seem prudent to ePrescribe anything without an EP’s approval.

- **Areas for improvement**

  Providers commented that the system should allow them to send more than one script at a time. When questioned about the patient safety concerns of batch prescriptions they agreed that a final approval screen would help to ensure that all drugs had the right instructions, refills, and notes. Doing a process quickly does not necessarily mean that is done safely. In an effort to improve both safety and efficiently, the system could display more clinically relevant data on the screen during the ePrescribing process.

**INTRODUCTION**

The EHRUT tested for this study was SRS EHR 10.x. It is designed to present medical information to healthcare providers in an outpatient ambulatory environment. The SRS EHR consists of various modules.
and interfaces design to capture, display, and modify patient clinical data. 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 time on task, user satisfaction, and deviation from optimal paths, were captured during the usability testing.

METHOD

SRS User Centered Design Process
SRSHealth designed and implemented its own UCD process based upon the ISO 9241-210 industry standard. The SRS UCD process follows the same principles of human-centered design and fits in to our overall quality management system (QMS). The system involves users in the overall design and software development process. The design team includes individuals with skills spanning across multiple disciplines and with different perspectives. The team works to address the entire user experience through a deep understanding of the tasks and workflows required by end users. The process is iterative and requirements are continually updated to better address the context of use, increase usability, and reduce user error.

The main steps of the process are:

- Understanding/stating the context of use for the function or module
  - Business requirements are gathered from internal and client stakeholders. These stakeholders are kept up to date with product developments through “Feature team” meetings.
- Creating design solutions
  - Business Analysis work with “Feature teams” to design several possible solutions and through further analysis with stakeholders the solution is refined.
- Creating user requirements
  - Business analysis creates full requirements documents based on feedback from “Feature teams”
- Evaluating the solution
  - Solution prototypes are created and vetted against the original understanding of the context of use.
- Performing user centered evaluations
  - Formal summative user testing is performed and the analysis is sent back to the “feature teams”. The results are then used to drive future iterations of the product.

The following tasks and modules were developed based on the SRS UCD design process:

- 170.315(a)(1) CPOE Medications
- 170.315(a)(7) Medication List
- 170.315(a)(8) Medication Allergy List
- 170.315(a)(4) Drug-drug, drug-allergy interaction checks
PARTICIPANTS

The testing methods were in accordance with the SRS User Centered Design Process. A total of 10 participants were tested on the EHRUT(s). Participants in the study included medical assistants, and technicians from the orthopedic and ophthalmology specialties. In addition, participants had no direct connection to the development of or organization producing the EHRUT(s). Participants were not from the testing or supplier organization. Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received.

For the test purposes, end-user characteristics were identified and translated into a recruitment screener used to solicit potential participants; an example of a screener is provided in Appendix 1.

Recruited participants had a mix of backgrounds and demographic characteristics conforming to the recruitment screener. The following is a table of participants by characteristics, including demographics, professional experience, computing experience and user needs for assistive technology. Participant names were replaced with Participant IDs randomly generated from the demographics collection tool so that an individual’s data cannot be tied back to individual identities.

<table>
<thead>
<tr>
<th>ID</th>
<th>Gender</th>
<th>Age Range</th>
<th>Occupation/Role</th>
<th>EHR Experience (Years)</th>
<th>CDS Module Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Female</td>
<td>50-59</td>
<td>Manager</td>
<td>10</td>
<td>Beginner</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>70-79</td>
<td>Clerical</td>
<td>2</td>
<td>Beginner</td>
</tr>
<tr>
<td>3</td>
<td>Female</td>
<td>20-29</td>
<td>Billing Rep</td>
<td>1</td>
<td>Beginner</td>
</tr>
<tr>
<td>4</td>
<td>Female</td>
<td>50-59</td>
<td>Billing Office</td>
<td>7</td>
<td>Beginner</td>
</tr>
<tr>
<td>5</td>
<td>Female</td>
<td>50-59</td>
<td>PT Aide</td>
<td>2</td>
<td>Beginner</td>
</tr>
<tr>
<td>6</td>
<td>Female</td>
<td>30-39</td>
<td>Physical Therapy Front Desk Coordinator</td>
<td>10</td>
<td>Beginner</td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>30-39</td>
<td>IT Systems Specialist</td>
<td>0</td>
<td>Beginner</td>
</tr>
<tr>
<td>8</td>
<td>Female</td>
<td>50-59</td>
<td>Manager</td>
<td>2</td>
<td>Beginner</td>
</tr>
<tr>
<td>9</td>
<td>Female</td>
<td>40-49</td>
<td>Biller</td>
<td>10</td>
<td>Beginner</td>
</tr>
</tbody>
</table>
Ten participants (matching the demographics in the section on Participants) were recruited and 10 participated in the usability test.

Participants were scheduled for 15 minute sessions with 5 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 participants, 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 test, participants interacted with one EHR. Each participant used the system in the same room of the two testing locations, 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. **Rx:**
   - Electronically Record Patient Active Medication List
   - Electronically Change Patient Active Medication List
   - Electronically Access Patient Active Medication List
   - Electronically Record Patient Active Medication Allergy List
   - Electronically Change Active Medication Allergy List
   - Electronically Access Active Medication Allergy List
   - Automatically and Electronically Indicate Drug-drug and Drug-allergy Interventions

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users.
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.

To ensure that the test ran smoothly, two staff members participated in this test, the usability administrator and the data logger.

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. A second person served as the data logger and took notes on task success, path deviations, number and type of errors, and comments.

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

• As quickly as possible making as few errors
• 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 stopped 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 (the System Usability Scale, see Appendix 5) 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.

TEST LOCATION

The tests were performed in the exam room where the EHRUT would typically be deployed and used in production. Only the participant, the administrator and the data logger were in the test room. 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 instruction and evacuation procedures were valid, in place, and visible to the participants.

TEST ENVIRONMENT

The EHRUT would be typically be used in a healthcare office or facility. In this instance, the testing was conducted in an examination room on a computer where interactions with the EHRUT would typically take place in real world office scenarios. For testing, the computer used a Windows PC running Windows 10 with a standard mouse and keyboard.

The SRS EHR 10.x system was viewed on a 22/14 inch monitor. The application was set up by the SRSHealth according to standard operating procedure for client/server installation. The application itself was running on a Windows 2008 Server using a Demo/Training SQL database on a LAN connection. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation. Additionally, participants 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 GotoMeeting and GotToraining screen capture software running on the test machine.

PARTICIPANT INSTRUCTIONS
The administrator reads the following instructions aloud to the each participant (also see the full moderator’s guide in Appendix 4):

Thank you for participating in this study. Our session today will last about 10 minutes. During that time you will take a look at an early prototype of SRS EHR v10.x.

I will ask you to complete a few tasks using this system and answer some questions. 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. You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Please do not do anything more than asked. If you get lost or have difficulty I cannot answer help you with anything to do with the system.

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. Since this is a test system some of the data may not make sense as it is placeholder data. We are recording the screen of our session today for our internal use only.

Do you have any questions or concerns?

Following the procedural instructions, participants were shown the EHR. Once this 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 would like to request that you not talk aloud or verbalize while you are doing the tasks. I will ask you your impressions about the task once you are done.

Participants were then given six tasks to complete. Tasks are listed in the moderator’s guide in Appendix 4.

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

1. Effectiveness of SRS EHR v10.x by measuring participant success rates and errors
2. Efficiency of SRS EHR v10.x by measuring the average task time and path deviations
3. Satisfaction with SRS EHR v10.x by measuring ease of use ratings
**DATA SCORING**

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

<table>
<thead>
<tr>
<th>Measures</th>
<th>Rationale and Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effectiveness:</strong></td>
<td></td>
</tr>
<tr>
<td>Task Success</td>
<td>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 and was recorded. 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 were defined by taking multiple measures of optimal performance and multiplying each time by a factor of 1.5. This factor allows some time buffer, as participants are presumably not trained to expert performance. Thus, if expert performance on a task was ([x]) seconds then optimal task time performance was ([x \times 1.5]) seconds. The ratio of reported time to optimal time was aggregated across tasks and reported with mean.</td>
</tr>
<tr>
<td>Task Failures</td>
<td>If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as a “Failures.” No task times were taken for errors. On a qualitative level, an enumeration of errors and error types was collected and is described in the narrative section below.</td>
</tr>
<tr>
<td><strong>Efficiency:</strong></td>
<td></td>
</tr>
<tr>
<td>Task Deviations</td>
<td>The participant’s path through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, opened an incorrect module, 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. Optimal paths were recorded in the moderator guide. Task deviations are discussed further in the qualitative sections.</td>
</tr>
<tr>
<td>Task Time</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Satisfaction:</strong></td>
<td></td>
</tr>
<tr>
<td>Task Rating</td>
<td>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 Easy) to 5 (Very Difficult). These data are averaged across participants.</td>
</tr>
</tbody>
</table>
Common convention is that average ratings for systems judged easy to use should be 3.3 or below.

To measure participants' confidence in and likeability of the SRS EHR v9.13 overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, "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.

<table>
<thead>
<tr>
<th>Task</th>
<th>N</th>
<th>Success</th>
<th>% of success</th>
<th>Deviations (Observed / Optimal)</th>
<th>Deviations (Observed / Optimal)</th>
<th>Time (Seconds)</th>
<th>Rating (1=EASY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronically Record Patient Active Medication List</td>
<td>10</td>
<td>100</td>
<td>0.97</td>
<td>1.04</td>
<td>38.9</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Electronically Change Patient Active Medication List</td>
<td>10</td>
<td>100</td>
<td>1.04</td>
<td>1</td>
<td>26.2</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Electronically Access Patient Active Medication List</td>
<td>10</td>
<td>100</td>
<td>0.84</td>
<td>1</td>
<td>12.6</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Electronically Record Patient Active Medication Allergy List</td>
<td>10</td>
<td>100</td>
<td>1.2</td>
<td>1</td>
<td>90.7</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>Electronically Change Active Medication Allergy List</td>
<td>10</td>
<td>100</td>
<td>0.98</td>
<td>1</td>
<td>17.6</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Electronically Access Active Medication Allergy List</td>
<td>10</td>
<td>100</td>
<td>0.98</td>
<td>1</td>
<td>12.7</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Automatically and Electronically Indicate Drug-drug and Drug-allergy Interventions</td>
<td>10</td>
<td>100</td>
<td>1.07</td>
<td>1.01</td>
<td>53.7</td>
<td>1.75</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Details of how observed data were scored.

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.

There were a few minor issues which may have affected data collection. The task descriptions and the terminology used could have contributed to some hesitation on the part of the user when completing tasks. Efforts were made to use descriptions and terminology which would be familiar to users; however, some users still may have experienced some confusion.

As part of testing, users were presented with existing data entry screens. Test participants had never used some parts of the screens to create and update lab and radiology orders, so it is understandable that users would have some initial difficulty navigating unfamiliar screens.

The usability testing results for the EHRUT are detailed below (see Table 2).
Table 2. 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: 94. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.¹

**DISCUSSION OF THE FINDINGS**

**EFFECTIVENESS**

Based on the findings, most users were quite effective at using the EHRUT. Most test participants were quite effective and showed very few, if any path deviations. This finding could be partially attributed to the testing circumstances.

**Risk Prone Errors**

When discussing errors, it is important to note which tasks are more likely to result in errors and what types of errors are most likely to cause patient safety issues. Tasks which do not alter the patient’s record but simply display information to the user are less likely to lead to errors. Viewing order details does not involve the user entering or alerting data, so the chance of error is very low. The system will only allow an order to be generated when all medically necessary information has been entered, so there is no chance of an incomplete order being sent to the lab or radiologist.

Tasks which require the user to enter data are more prone to error. To that end every effort should be made to ensure that the user can clearly discern what has been selected on the screen and that they are given an opportunity to double check and “cancel” actions before they are committed.

Below is a prioritized list of tasks in the order of the associated risk and with a rating of the risk (1-3, where 1 is a low risk and 3 is a high risk)

<table>
<thead>
<tr>
<th>Task</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronically Record Patient Active Medication List</td>
<td>2</td>
</tr>
<tr>
<td>Electronically Change Patient Active Medication List</td>
<td>2</td>
</tr>
<tr>
<td>Electronically Access Patient Active Medication List</td>
<td>1</td>
</tr>
<tr>
<td>Electronically Record Patient Active Medication Allergy List</td>
<td>2</td>
</tr>
<tr>
<td>Electronically Change Active Medication Allergy List</td>
<td>2</td>
</tr>
<tr>
<td>Electronically Access Active Medication Allergy List</td>
<td>1</td>
</tr>
<tr>
<td>Automatically and Electronically Indicate Drug-drug and Drug-allergy Interventions</td>
<td>1</td>
</tr>
</tbody>
</table>

**EFFICIENCY**

A few users were unable to complete the tasks in what was deemed a “reasonable” amount of time. Users who failed to complete the task within the maximum amount of time, as determined for each task prior to testing, had their data excluded for efficiency measures.

The average deviations ratios (observed path / optimal path) in the group tested were close to 0.2 for users who could complete the task. Even users who were unable to complete a task in time were generally on the correct path and rarely deviated into a different area of the software. Thus, we conclude that users were relatively efficient when completing the tasks set before them.

SATISFACTION
The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be: 94. Verbal feedback as well as task ratings conclude that there is a high level of comfort and overall satisfaction with the system. Specifically, users stated that the system is “simple and intuitive,” “user friendly,” and “organized logically.” These statements, along with other participant verbalizations, suggest a high level of usability within the system.

There are of course some areas of improvement, which are discussed below, but even so the average task ease of use rating was between 1.0 and 2.0 for each task. As set forth in the data scoring section, average ratings for systems judged easy to use should be 3.3 or below. Hence, a major finding of this testing was that the modules tested are very easy to use.

MAJOR FINDINGS
Most of the participants were familiar with the ePrescribing function of the Rx module so very few users had difficulty with those tasks. Most users agreed that the system as a whole was well integrated and that they found that they rarely had trouble using the module. They would like to see the module expanded to include the ability to ePrescribe multiple drugs at once or to automatically ePrescribe drugs based on common practices. From a patient safety standpoint it does not seem prudent to ePrescribe anything without an EP’s approval. Usability may seem to suffer when a user is required to perform a manual task but that manual process ensures that the correct action is being performed. There is a fine line between assisting a user with a task and doing the task for the user.

AREAS FOR IMPROVEMENT
Generally, the feedback was very positive, but there are some areas where usability could be improved. One major takeaway from this process is that gathering user feedback earlier in the development process as well as working with less advanced/beginner users rather than super users could improve usability and overall safety.

Providers commented that the system should allow them to send more than one script at a time. When questioned about the patient safety concerns of batch prescriptions they agreed that a final approval screen would help to ensure that all drugs had the right instructions, refills, and notes. They also said that they would like to see more relevant data on the screen during the ePrescribing process. Age, sex, vitals, current conditions, etc could alter which drugs they choose for the patient or change the dosage or refills. This data is available to them in the chart but they need to leave the ePrescribing screen to view it. Viewing the data without leaving the ePrescribing module would make the system easier to use and could reduce errors by allowing the user to concentrate on the prescription rather than seeking out data.

Further development of the tested features will incorporate the key findings and areas for improvement from this test.

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: Moderator’s Guide
Appendix 1: SAMPLE RECRUITING SCREENER

The purpose of a screener to ensure that the participants selected represent the target user population as closely as possible. Rather than reaching out to individual participants, SRS opted to target the Practice Administrator and rely upon them to select qualified participants based on the functionality being tested.

Recruiting Scripts:

Hello, my name is ________, and I am calling from SRSHealth. We are recruiting participants for a usability study on the SRS EHR. Would you be willing to participate, along with staff members? This is strictly for research purposes. We will primarily be conducting tests on the usability of computerized physician order entry. Could you identify users in the practice such as physicians, medical assistants, and technicians who use this module? Once you have identified those users, please send them a demographics questionnaire.

Would you be able to participate between December 4th and December 7th? The test will take place at your office.

Thank you, and we appreciate your time.

Participants then filled out an online demographics survey at

https://srssoft.poll daddy.com/s/participant-demographics-survey-1
Appendix 2: PARTICIPANT DEMOGRAPHICS

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

**Gender**
- Men: 2
- Women: 8
- Total (participants): 10

**Age**
- 18-25: 0
- 25-39: 3
- 40-59: 6
- 60+: 1
- Total (participants): 10

**Race/Ethnicity**
- Caucasian: 6
- Asian: 1
- Black/African-American: 1
- Latino/a or Hispanic: 1
- Other: 1
- Total (participants): 10

**Occupation/Role**
- Physician: 0
- Medical Assistant: 0
- Technician: 1
- Manager: 2
- Other: 7
- Total (participants): 10

**Years of Experience**
- 0-2: 6
- 3-5: 0
- 6-9: 1
- 10+: 3
- Total (participants): 10

Following is a full participant breakdown:

<table>
<thead>
<tr>
<th>ID</th>
<th>Gender</th>
<th>Age</th>
<th>Occupation/Role</th>
<th>EHR Experience (Years)</th>
<th>CDS Module Experience</th>
<th>Assistive Tech Needs</th>
<th>Race/Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>188980004</td>
<td>Female</td>
<td>50-59</td>
<td>Manager</td>
<td>10</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>189157620</td>
<td>Female</td>
<td>70-79</td>
<td>Clerical</td>
<td>2</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
</tbody>
</table>
Appendix 3: NON-DISCLOSURE AGREEMENT AND INFORMED CONSENT FORM

Non-Disclosure Agreement

THIS AGREEMENT is entered into as of December 7th 2017, between ______________________ ("the Participant") and the testing organization SRSHealth located at 155 Chestnut Ridge Road, Montvale, New Jersey, 07645.

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 SRSHealth, 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 SRSHealth 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 not disclose this confidential information obtained today to anyone else or any other organizations.

Participant’s printed name: ______________________________________________________
Signature: _____________________________________________
Date: ____________________
Informed Consent

SRSHealth 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 30 minutes.

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

I understand and consent to the use and release of the recording by SRSHealth. I understand that the information and recording 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 recording and understand the recording may be copied and used by SRSHealth 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 SRSHealth and SRSHealth’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

SRS EHR Usability Test
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 with Gotomeeting
Prior to each task:
☐ Reset application to starting point for next task

After each participant:
☐ End session recordings with Gotomeeting

Orientation

Thank you for participating in this study. Our session today will last about 20 minutes. During that time you will take a look at an early prototype of SRS EHR v9.

I will ask you to complete a few tasks using this system and answer some questions. 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.

You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Please do not do anything more than asked. If you get lost or have difficulty I cannot answer help you with anything to do with the system itself.

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. Since this is a test system some of the data may not make sense as it is placeholder data. We are recording the screen of our session today for our internal use only.

Do you have any questions or concerns?
Task 1: Electronically Record Patient Active Medication List

(Optional Time: 40 seconds)

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

Comments:
Task Time: ________ Seconds

Optimal Path

Scenario 1

- User is on the Desktop Clinical Summary
- User selects a patient from the appointment list
- User clicks on Rx
- User searches for a drug (such as Celebrex)
- User adds the active non-controlled drug () with SIG, quantity, unit, refills

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______

☐ Very Easy
☐ Easy
☐ Neutral
☐ Difficult
☐ Very Difficult

Administrator / Notetaker Comments:
Task 2: Electronically Change Patient Active Medication List

(Optimal Time: 25 seconds)

Success:
- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:
Task Time: ________ Seconds

Optimal Path
1) User is on the Desktop Clinical Summary
2) User selects a patient from the appointment list with an active drug
3) User clicks on Rx
4) User right-clicks a drug and marks it as “Discontinued” or “Intolerant”

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
- Very Easy
- Easy
- Neutral
- Difficult
- Very Difficult

Administrator / Notetaker Comments:
Task 3: Electronically Access Patient Active Medication List

(Optimal Time: 15 seconds)

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

Comments:
Task Time: ________ Seconds

Optimal Path
1. User is on the Desktop Clinical Summary
2. User selects a patient from the appointment list with medication history
3. User clicks on Rx
4. User can access the patient for active, discontinued and deleted medications

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
☐ Very Easy
☐ Easy
☐ Neutral
☐ Difficult
☐ Very Difficult

Administrator / Notetaker Comments:
Task 4: Electronically Record Patient Active Medication Allergy List

(Optimal Time: 75 seconds)

Success:
- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:
Task Time: ________ Seconds

Optimal Path
1) User is on the Desktop Clinical Summary
2) User selects a patient from the appointment list
3) User clicks on Rx
4) User searches for a drug (such as Celebrex)
5) User adds the active non-controlled drug () with SIG, quantity, unit, refills
6) User right clicks on the drug and marks it as “Intolerant” and selects the severity and reaction

☐ Correct
☐ Minor Deviations / Cycles: Describe below
☐ Major Deviations: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
- Very Easy
- Easy
- Neutral
- Difficult
- Very Difficult

Administrator / Notetaker Comments:
Task 5: Electronically Change Active Medication Allergy List

(Optimal Time: 18 seconds)

Success:
- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:
Task Time: _________ Seconds

Optimal Path
1) User is on the Desktop Clinical Summary
2) User selects a patient from the appointment list with an intolerant drug
3) User clicks on Rx
4) User right-clicks the intolerant drug and selects “Delete” to delete the drug from the patient’s history

Correct
Minor Deviations / Cycles :: Describe below
Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: _______
- Very Easy
- Easy
- Neutral
- Difficult
- Very Difficult

Administrator / Notetaker Comments:
Task 6: Electronically Access Active Medication Allergy List

(Optimal Time: 13 seconds)

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

Comments:
Task Time: ________ Seconds

Optimal Path

1. User is on the Desktop Clinical Summary
2. User selects a patient from the appointment list with medication history
3. User clicks on Rx
4. User can access the patient for intolerant and deleted prescriptions

☐ Correct
☐ Minor Deviations / Cycles: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
☐ Very Easy
☐ Easy
☐ Neutral
☐ Difficult
☐ Very Difficult

Administrator / Notetaker Comments:
Task 7: Automatically and Electronically Indicate Drug-drug and Drug-allergy Interventions

(Optimal Time: 50 seconds)

Success:
- Easily completed
- Completed with difficulty or help: Describe below
- Not completed

Comments:
Task Time: _______ Seconds

Optimal Path
1. User is on the Desktop Clinical Summary
2. User selects a patient from the appointment list with previous medication history
3. User clicks on Rx
4. User searches for a drug
5. The system automatically checks for intolerant and interaction alerts
6. User can view the drug-drug checks by clicking “View Alerts” near the bottom right hand corner

Correct
- Minor Deviations / Cycles: Describe below
- Major Deviations: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:
Overall, this task was: _______
- Very Easy
- Easy
- Neutral
- Difficult
- Very Difficult

Administrator / Notetaker Comments:
Appendix 5: SYSTEM USABILITY SCALE QUESTIONNAIRE

This questionnaire was adapted from John Brooke’s “SUS: a “quick and dirty” usability scale” at Digital Equipment Corporation in the UK. Participants completed the questionnaire online at http://SRSHealth.poll daddy.com/s/rx-system-usability-scale-questionnaire

<table>
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<th>System Usability Scale</th>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I think that I would like to use this system frequently</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I found the system unnecessarily complex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I thought the system was easy to use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I think that I would need the support of a technical person to be able to use this system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I found the various functions in this system were well integrated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I thought there was too much inconsistency in this system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I would imagine that most people would learn to use this system very quickly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I found the system very cumbersome to use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. I felt very confident using the system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. I needed to learn a lot of things before I could get going with this system</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

# EHR Usability Test Report of SRS EHR v9.13


SRS EHR 9.13

Date of Usability Test: 12/07/2017  
Date of Report: 12/07/2017  
Report Prepared By: Vani Chitturi, Product Owner, SRS Health  
201-746-7991  
vchitturi@srs-health.com  
155 Chestnut Ridge Road, Montvale NJ, 07645

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<td>EFFICIENCY</td>
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EXECUTIVE SUMMARY

A usability test of SRS EHR V10.x Ambulatory EHR was conducted on 7th December 2017 in the offices of Princeton Orthopedic Associates, P.A. located at 11 Center Drive, Monroe Township, NJ by SRSHealth. The purpose of this test was to test and validate the usability of the current user interface, and provide evidence of usability in the SRS EHR, the EHR under Test (EHRUT). During the usability test, 10 clinical staff matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks.

This study collected performance data on two tasks typically conducted on an EHR:

- § 170.315(b)(2) Clinical Information Reconciliation

During the 15 minutes 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 the EHR. The administrator introduced the test, and instructed participants to complete a series of tasks (given one at a time) using the EHRUT. During the testing, the administrator timed the test and, 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 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. 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 SRS EHR.
#### INTRODUCTION

The EHRUT tested for this study was SRS EHR v10.x. It is designed to present medical information to healthcare providers in an outpatient ambulatory environment. The SRS EHR consists of various modules and interfaces design to capture, display, and modify patient clinical data. 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 time on task, user satisfaction, and deviation from optimal paths, were captured during the usability testing.

<table>
<thead>
<tr>
<th>Task</th>
<th>Measure</th>
<th>Effectiveness</th>
<th>Efficiency</th>
<th>Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>View Problems, Rx and Rx allergies data received</td>
<td>N: 10, % of success: 100, Task Time: 1.02, Deviations: 1.02 (Observed / Optimal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create a single reconciled list of Problems, Rx and Rx Allergies</td>
<td>N: 10, % of success: 100, Task Time: 0.96, Deviations: 1.01 (Observed / Optimal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review and incorporate Problems, Rx and Rx Allergies data</td>
<td>N: 10, % of success: 100, Task Time: 0.94, Deviations: 1.02 (Observed / Optimal)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 94

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

- **Major findings**

  The data reconciliation feature was well received and considered by almost all users to be straightforward and easy to use. There were some suggestions made to improve the ergonomics of the system such as adding a “save” button to the top and the bottom of the screen to reduce the amount of mouse travel. There was also some confusion about what would happen to data left in a “pending” state. The screen could make it more apparent to the user that they do not need to reconcile all data simultaneously.

- **Areas for improvement**

  The reconciliation process should be more tightly integrated with the rest of the system to improve overall usability. Some comments were made that the “preview” process should be mandatory rather than optional. Allowing the user accept the new data directly from the “preview” screen would also improve the overall workflow although this might lead to the user accidentally adding data if what they see on the preview screen is incorrect.
SRS User Centered Design Process

SRSHealth designed and implemented its own UCD process based upon the ISO 9241-210 industry standard. The SRS UCD process follows the same principles of human-centered design and fits in to our overall quality management system (QMS). The system involves users in the overall design and software development process. The design team includes individuals with skills spanning across multiple disciplines and with different perspectives. The team works to address the entire user experience through a deep understanding of the tasks and workflows required by end users. The process is iterative and requirements are continually updated to better address the context of use, increase usability, and reduce user error.

The main steps of the process are:

- Understanding/stating the context of use for the function or module
  - Business requirements are gathered from internal and client stakeholders. These stakeholders are kept up to date with product developments through “Feature team” meetings.
- Creating design solutions
  - Business Analysis work with “Feature teams” to design several possible solutions and through further analysis with stakeholders the solution is refined.
- Creating user requirements
  - Business analysis creates full requirements documents based on feedback from “Feature teams”
- Evaluating the solution
  - Solution prototypes are created and vetted against the original understanding of the context of use.
- Performing user centered evaluations
  - Formal summative user testing is performed and the analysis is sent back to the “feature teams”. The results are then used to drive future iterations of the product.

The following tasks and modules were developed based on the SRS UCD design process:

- § 170.315(b)(2) Clinical Information Reconciliation
PARTICIPANTS

The testing methods were in accordance with the SRS User Centered Design Process. A total of 10 participants were tested on the EHRUT(s). Participants in the study included medical assistants, and technicians from the orthopedic and ophthalmology specialties. In addition, participants had no direct connection to the development of or organization producing the EHRUT(s). Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received.

For the test purposes, end-user characteristics were identified and translated into a recruitment screener used to solicit potential participants; an example of a screener is provided in Appendix 1.

Recruited participants had a mix of backgrounds and demographic characteristics conforming to the recruitment screener. The following is a table of participants by characteristics, including demographics, professional experience, computing experience and user needs for assistive technology. Participant names were replaced with Participant IDs randomly generated from the demographics collection tool so that an individual's data cannot be tied back to individual identities.

<table>
<thead>
<tr>
<th>ID</th>
<th>Gender</th>
<th>Age</th>
<th>Occupation/Role</th>
<th>EHR Experience (Years)</th>
<th>CDS Module Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 188980004</td>
<td>Female</td>
<td>50-59</td>
<td>Manager</td>
<td>10</td>
<td>Beginner</td>
</tr>
<tr>
<td>2 189157620</td>
<td>Female</td>
<td>70-79</td>
<td>Clerical</td>
<td>2</td>
<td>Beginner</td>
</tr>
<tr>
<td>3 189157638</td>
<td>Female</td>
<td>20-29</td>
<td>Billing Rep</td>
<td>1</td>
<td>Beginner</td>
</tr>
<tr>
<td>4 189158003</td>
<td>Female</td>
<td>50-59</td>
<td>Billing Office</td>
<td>7</td>
<td>Beginner</td>
</tr>
<tr>
<td>5 189183182</td>
<td>Female</td>
<td>50-59</td>
<td>PT Aide</td>
<td>2</td>
<td>Beginner</td>
</tr>
<tr>
<td>6 189240589</td>
<td>Female</td>
<td>30-39</td>
<td>Physical Therapy Front Desk Coordinator</td>
<td>10</td>
<td>Beginner</td>
</tr>
<tr>
<td>7 189242966</td>
<td>Male</td>
<td>30-39</td>
<td>IT Systems Specialist</td>
<td>0</td>
<td>Beginner</td>
</tr>
<tr>
<td>8 189253210</td>
<td>Female</td>
<td>50-59</td>
<td>Manager</td>
<td>2</td>
<td>Beginner</td>
</tr>
<tr>
<td>9 189258674</td>
<td>Female</td>
<td>40-49</td>
<td>Biller</td>
<td>10</td>
<td>Beginner</td>
</tr>
<tr>
<td>10 189680942</td>
<td>Male</td>
<td>40-49</td>
<td>Technician</td>
<td>2</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

Ten participants (matching the demographics in the section on Participants) were recruited and 10 participated in the usability test.

Participants were scheduled for 5 minute sessions with a 2 minutes 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 participants, 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 test, participants interacted with one EHR. Each participant used the system in the same room of the two testing locations, 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. Clinical Information Reconciliation:
   a. View Problems, Rx and Rx allergies data received
   b. Create a single reconciled list of Problems, Rx and Rx Allergies
   c. Review and incorporate Problems, Rx and Rx Allergies data

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users.

**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.

To ensure that the test ran smoothly, two staff members participated in this test, the usability administrator and the data logger.

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. A second person served as the data logger and took notes on task success, path deviations, number and type of errors, and comments.

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

- As quickly as possible making as few errors
- 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 stopped 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 (the System Usability Scale, see Appendix 5) 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.

**TEST LOCATION**

The tests were performed in the exam room where the EHRUT would typically be deployed and used in production. Only the participant, the administrator and the data logger were in the test room. 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 instruction and evacuation procedures were valid, in place, and visible to the participants.

**TEST ENVIRONMENT**

The EHRUT would be typically be used in a healthcare office or facility. In this instance, the testing was conducted in an examination room on a computer where interactions with the EHRUT would typically take place in real world office scenarios. For testing, the computer used a Windows PC running windows 10 with a standard mouse and keyboard.

The SRS EHR V10.x system was viewed on a 22/14 inch monitor. The application was set up by the SRSHealth according to standard operating procedure for client/server installation. The application itself was running on a Windows 2008 Server using a Demo/Training SQL database on a LAN connection. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation. Additionally, participants 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 Goto Meeting and Goto Training software running on the test machine.

**PARTICIPANT INSTRUCTIONS**

The administrator reads the following instructions aloud to the each participant (also see the full moderator’s guide in Appendix 4):
Thank you for participating in this study. Our session today will last about 5 minutes. During that time you will take a look at an early prototype of SRS EHR v10.x

I will ask you to complete a few tasks using this system and answer some questions. 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. You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Please do not do anything more than asked. If you get lost or have difficulty I cannot answer or help you with anything to do with the system.

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. Since this is a test system some of the data may not make sense as it is placeholder data. We are recording the screen of our session today for our internal use only.

Do you have any questions or concerns?

Following the procedural instructions, participants were shown the EHR. Once this 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 would like to request that you not talk aloud or verbalize while you are doing the tasks. I will ask you your impressions about the task once you are done.

Participants were then given three tasks to complete. Tasks are listed in the moderator’s guide in Appendix 4.

**USABILITY METRICS**

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

1. Effectiveness of SRS EHR v10.x by measuring participant success rates and errors
2. Efficiency of SRS EHR v10.x by measuring the average task time and path deviations
3. Satisfaction with SRS EHR v10.x by measuring ease of use ratings

**DATA SCORING**

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

<table>
<thead>
<tr>
<th>Measures</th>
<th>Rationale and Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effectiveness:</strong></td>
<td>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.</td>
</tr>
<tr>
<td>Task Success</td>
<td>Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency and was recorded.</td>
</tr>
</tbody>
</table>
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 were defined by taking multiple measures of optimal performance and multiplying each time by a factor of 1.5. This factor allows some time buffer, as participants are presumably not trained to expert performance. Thus, if expert performance on a task was \([x]\) seconds then optimal task time performance was \([x \times 1.5]\) seconds. The ratio of reported time to optimal time was aggregated across tasks and reported with mean.

**Effectiveness:**

**Task Failures**

If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as a “Failures.” No task times were taken for errors.

On a qualitative level, an enumeration of errors and error types was collected and is described in the narrative section below.

**Efficiency:**

**Task Deviations**

The participant’s path through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, opened an incorrect module, 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.

Optimal paths were recorded in the moderator guide. Task deviations are discussed further in the qualitative sections.

**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.

**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 Easy) to 5 (Very Difficult). These data are averaged across participants.

Common convention is that average ratings for systems judged easy to use should be 3.3 or below.

To measure participants’ confidence in and likeability of the SRS EHR v10.x overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, “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.

Table 1. Details of how observed data were scored.
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.

There were a few minor issues which may have affected data collection. The task descriptions and the terminology used could have contributed to some hesitation on the part of the user when completing tasks. Efforts were made to use descriptions and terminology which would be familiar to users; however, some users still may have experienced some confusion.

As part of testing, users were presented with entirely new data entry screens. Test participants had never used these screens to add, change or access problem list. So it is understandable that users would have some initial difficulty navigating unfamiliar screens.

The usability testing results for the EHRUT are detailed below (see Table 2).

<table>
<thead>
<tr>
<th>Measure</th>
<th>Effectiveness</th>
<th>Efficiency</th>
<th>Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Task Success</td>
<td>Task Time</td>
<td>Path Deviation</td>
</tr>
<tr>
<td>View Problems, Rx and Rx allergies data received</td>
<td>10</td>
<td>100</td>
<td>1.02</td>
</tr>
<tr>
<td>Create a single reconciled list of Problems, Rx and Rx Allergies</td>
<td>10</td>
<td>100</td>
<td>0.96</td>
</tr>
<tr>
<td>Review and incorporate Problems, Rx and Rx Allergies data</td>
<td>10</td>
<td>100</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Table 2. 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: 94. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.¹

DISCUSSION OF THE FINDINGS

EFFECTIVENESS

Based on the findings, most users were quite effective at using the EHRUT. The average number of failures per task was 1.5, but the “errors” were primarily due to the user timing out before the task could be completed. Some users spent additional time making sure that they had typed information correctly, which contributed to timing out on the task, and ultimately, failure on the task. However, making certain that data is entered correctly contributes to an overall goal of this project - patient safety.

Most test participants were quite effective and showed very few, if any path deviations. This finding could be partially attributed to the testing circumstances. Specifically, users had been recently trained on how to use the modules. Subsequent testing would it would be interesting to measure effectiveness once again after training decay has set in to see if users continue to follow an optimal path.

**Risk Prone Errors**

When discussing errors, it is important to note which tasks are more likely to result in errors and what types of errors are most likely to cause patient safety issues. Tasks which do not alter the patient's record but simply display information to the user are less likely to lead to errors. Viewing order details and reviewing the patient's prescription history does not involve the user entering or alerting data, so the chance of error is very low. The system will only allow an order to be generated when all medically necessary information has been entered, so there is no chance of an incomplete order being sent to the lab.

Tasks which require the user to enter data are more prone to error. To that end every effort should be made to ensure that the user can clearly discern what has been selected on the screen and that they are given an opportunity to double check and “cancel” actions before they are committed.

Below is a prioritized list of tasks in the order of the associated risk and with a rating of the risk (1-3, where 1 is a low risk and 3 is a high risk)

<table>
<thead>
<tr>
<th>Task</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>View Problems, Rx and Rx allergies data received</td>
<td>1</td>
</tr>
<tr>
<td>Create a single reconciled list of Problems, Rx and Rx Allergies</td>
<td>1</td>
</tr>
<tr>
<td>Review and incorporate Problems, Rx and Rx Allergies data</td>
<td>2</td>
</tr>
</tbody>
</table>

**EFFICIENCY**

A few users were unable to complete the tasks in what was deemed a “reasonable” amount of time. Users who failed to complete the task within the maximum amount of time, as determined for each task prior to testing, had their data excluded for efficiency measures.

The average deviations ratios (observed path / optimal path) in the group tested were close to 1.0 for users who could complete the task. Even users who were unable to complete a task in time were generally on the correct path and rarely deviated into a different area of the software. Thus, we conclude that users were relatively efficient when completing the tasks set before them.

**SATISFACTION**

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be: 94. Verbal feedback as well as task ratings conclude that there is a high level of comfort and overall satisfaction with the system. Specifically, users stated that the system is “simple and intuitive,” “user friendly,” and “organized logically.” These statements, along with other participant verbalizations, suggest a high level of usability within the system.

There are of course some areas of improvement, which are discussed below, but even so the average task ease of use rating was between 1.0 and 2.0 for each task. As set forth in the data scoring section,
average ratings for systems judged easy to use should be 3.3 or below. Hence, a major finding of this testing was that the modules tested are very easy to use.

MAJOR FINDINGS

The data reconciliation feature was also well received and considered by almost all users to be straightforward and easy to use. There were some suggestions made to improve the ergonomics of the system and to make it more apparent to the user that they did not need to reconcile all data simultaneously. The fact that the only indication that there is data to be reconciled is available on the patient’s Interoperability Dashboard (desktop) screen seemed to be an issue. Integrating reconciliation into other modules (or simply adding an omnipresent indicator denoting data needing reconciliation) would improve usability and patient safety by reminding the user to update the chart and incorporate new clinically relevant data. Any piece of relevant data left unincorporated could lead to an incorrect diagnosis or missed allergy.

AREAS FOR IMPROVEMENT
Generally, the feedback was very positive, but there are some areas where usability could be improved. One major takeaway from this process is that gathering user feedback earlier in the development process as well as working with less advanced/beginner users rather than super users could improve usability and overall safety.

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: Moderator’s Guide
5: System Usability Scale Questionnaire
Appendix 1: SAMPLE RECRUITING SCREENER

The purpose of a screener to ensure that the participants selected represent the target user population as closely as possible. Rather than reaching out to individual participants, SRS opted to target the Practice Administrator and rely upon them to select qualified participants based on the functionality being tested.

Recruiting Scripts:

Hello, my name is _______, and I am calling from SRSHealth. We are recruiting participants for a usability study on the SRS EHR. Would you be willing to participate, along with staff members? This is strictly for research purposes. We will primarily be conducting tests on the usability of the new clinical decision support and computerized physician order entry. Could you identify users in the practice such as physicians, medical assistants, and technicians who use this module? Once you have identified those users, please send them a demographics questionnaire.

Would you be able to participate between December 4 and December 8? The test will take place at your office.

Thank you, and we appreciate your time.

Participants then filled out an online demographics survey at https://srssoft.polldaddy.com/s/participant-demographics-survey-1
## Appendix 2: PARTICIPANT DEMOGRAPHICS

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

### Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Total (participants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>2</td>
</tr>
<tr>
<td>Women</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

### Age

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Total (participants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-25</td>
<td>0</td>
</tr>
<tr>
<td>25-39</td>
<td>3</td>
</tr>
<tr>
<td>40-59</td>
<td>6</td>
</tr>
<tr>
<td>60+</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

### Race/Ethnicity

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Total (participants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>6</td>
</tr>
<tr>
<td>Asian</td>
<td>1</td>
</tr>
<tr>
<td>Black/African-American</td>
<td>1</td>
</tr>
<tr>
<td>Latino/a or Hispanic</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

### Occupation/Role

<table>
<thead>
<tr>
<th>Occupation/Role</th>
<th>Total (participants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician</td>
<td>0</td>
</tr>
<tr>
<td>Medical Assistant</td>
<td>0</td>
</tr>
<tr>
<td>Technician</td>
<td>1</td>
</tr>
<tr>
<td>Manager</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

### Years of Experience

<table>
<thead>
<tr>
<th>Years of Experience</th>
<th>Total (participants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>6</td>
</tr>
<tr>
<td>3-5</td>
<td>0</td>
</tr>
<tr>
<td>6-9</td>
<td>1</td>
</tr>
<tr>
<td>10+</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>
Following is a full participant breakdown:

<table>
<thead>
<tr>
<th>ID</th>
<th>Gender</th>
<th>Age</th>
<th>Occupation/Role</th>
<th>EHR Experience (Years)</th>
<th>CDS Module Experience</th>
<th>Assistive Tech Needs</th>
<th>Race/Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Female</td>
<td>50-59</td>
<td>Manager</td>
<td>10</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>70-79</td>
<td>Clerical</td>
<td>2</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>3</td>
<td>Female</td>
<td>20-29</td>
<td>Billing Rep</td>
<td>1</td>
<td>Beginner</td>
<td>N/A</td>
<td>Asian</td>
</tr>
<tr>
<td>4</td>
<td>Female</td>
<td>50-59</td>
<td>Billing Office</td>
<td>7</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>5</td>
<td>Female</td>
<td>50-59</td>
<td>PT Aide</td>
<td>2</td>
<td>Beginner</td>
<td>N/A</td>
<td>Other</td>
</tr>
<tr>
<td>6</td>
<td>Female</td>
<td>30-39</td>
<td>Physical Therapy Front Desk Coordinator</td>
<td>10</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>30-39</td>
<td>IT Systems Specialist</td>
<td>0</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>8</td>
<td>Female</td>
<td>50-59</td>
<td>Manager</td>
<td>2</td>
<td>Beginner</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>9</td>
<td>Female</td>
<td>40-49</td>
<td>Biller</td>
<td>10</td>
<td>Beginner</td>
<td>N/A</td>
<td>Black/African-American</td>
</tr>
<tr>
<td>10</td>
<td>Male</td>
<td>40-49</td>
<td>Technician</td>
<td>2</td>
<td>Moderate</td>
<td>N/A</td>
<td>Latino/a or Hispanic</td>
</tr>
</tbody>
</table>
Non-Disclosure Agreement

THIS AGREEMENT is entered into as of December 7th 2017, between ___________________________ ("the Participant") and the testing organization SRSHealth located at 155 Chestnut Ridge Road, Montvale, New Jersey, 07645.

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 SRSHealth, 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 SRSHealth 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 not disclose this confidential information obtained today to anyone else or any other organizations.

Participant’s printed name: ___________________________________________
Signature: _____________________________________
Date: ____________________
Informed Consent

SRSHealth 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 30 minutes.

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

I understand and consent to the use and release of the recording by SRSHealth. I understand that the information and recording 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 recording and understand the recording may be copied and used by SRSHealth 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 SRSHealth and SRSHealth’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

SRS EHR Usability Test
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 with Goto Meeting

Prior to each task:
☐ Reset application to starting point for next task

After each participant:
☐ End session recordings with Goto Meeting

After all testing
☐ Back up all video and data files

Orientation

Thank you for participating in this study. Our session today will last about 20 minutes. During that time you will take a look at an early prototype of SRS EHR v10.x

I will ask you to complete a few tasks using this system and answer some questions. 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.

You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Please do not do anything more than asked. If you get lost or have difficulty I cannot answer help you with anything to do with the system itself.

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. Since this is a test system some of the data may not make sense as it is placeholder data. We are recording the screen of our session today for our internal use only.

Do you have any questions or concerns?
Participant Name:

Task 1: View Problems, Rx and Rx allergies data received
Optimal: 18 seconds

Please use ‘Discrete Data Reconciliation’ app on Interoperability Dashboard to view problems, medications and medication allergies data.

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

Comments:
Task Time: ________ Seconds

Optimal Path
1) User is on the Desktop Interoperability Dashboard
2) User selects a patient with multiple problem, medications and medication allergies to be reconciled (ex. Brown, Paul)
3) User clicks on the Alert – ‘Reconcile new data’
4) User can view the problems, medications and medication allergies list data in a single view under ‘Medications’

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______

Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Note taker Comments:
Task 2: Create a single reconciled list of Problems, Rx and Rx Allergies

Optimal: 50 seconds

Please use ‘Discrete Data Reconciliation’ app on Interoperability Dashboard to create a single reconciled list of Problems, Rx and Rx Allergies

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

Comments:
Task Time: ________ Seconds

Optimal Path
1) User is on the Desktop Interoperability Dashboard
2) User selects a patient with multiple problem, medications and medication allergies to be reconciled received from multiple sources (ex. Brown, Paul)
3) User clicks on the Alert – ‘Reconcile new data’
4) User can view the problem list data in a single view under ‘Diagnoses’
5) User can view the medication list data in a single view under ‘Medications’
6) User can view the medication allergy list data in a single view under ‘Allergies’
7) User selects problem, medications and medication allergies from different sources to add/reconcile into patient’s chart
8) User clicks ‘Preview’ button to view a single reconciled problems, medications and medication allergies under ‘Diagnoses’, ‘Medications’ and ‘Allergies’ respectively

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:
Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Note taker Comments:
Task 3: Review and incorporate Problems, Rx and Rx Allergies data

Optimal: 45 seconds

Please use ‘Discrete Data Reconciliation’ app on Interoperability Dashboard to review and incorporate Problems, Rx and Rx Allergies data

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

Comments:
Task Time: ________ Seconds

Optimal Path
1) User is on the Desktop Interoperability Dashboard
2) User selects a patient with multiple problem, medications and medication allergies to be reconciled received from multiple sources (ex. Brown, Paul)
3) User clicks on the Alert – ‘Reconcile new data’
4) User selects problems, medications and medication allergies from different sources to add/reconcile into patient’s chart
5) User clicks ‘Preview’ button to view and review data to be reconciled
6) User clicks on ‘Save & Close’ to confirm and submit the final list
7) Selected problems, medications and medication allergies are added to the patient’s chart and are displayed in the patient’s Interoperability Dashboard under ‘Diagnoses’ and ‘Rx History’

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Notetaker Comments:
Appendix 5: SYSTEM USABILITY SCALE QUESTIONNAIRE

This questionnaire was adapted from John Brooke’s “SUS: a “quick and dirty” usability scale” at Digital Equipment Corporation in the UK.\(^2\) Participants completed the questionnaire online at http://SRSHealth.polladddy.com/s/rx-system-usability-scale-questionnaire.

<table>
<thead>
<tr>
<th>System Usability Scale</th>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I think that I would like to use this system frequently</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I found the system unnecessarily complex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I thought the system was easy to use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I think that I would need the support of a technical person to be able to use this system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I found the various functions in this system were well integrated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I thought there was too much inconsistency in this system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I would imagine that most people would learn to use this system very quickly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I found the system very cumbersome to use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. I felt very confident using the system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. I needed to learn a lot of things before I could get going with this system</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EHR Usability Test Report of SRS EHR v10


SRS EHR v10

Date of Usability Test: 5/18/2017
Date of Report: 5/26/2017
Report Prepared By: Harika Prabhakar, Product Owner, SRS Health
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hprabhakar@srs-health.com
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EXECUTIVE SUMMARY

A usability test of SRS EHR v10 Ambulatory EHR was conducted on 18th May 2017 in the offices of Princeton Eye Group, 419 North Harrison Street, Princeton, NJ and Orthopedic Institute of Central Jersey, 2315 Route 34 S Manasquan, NJ by SRSHealth. The purpose of this test was to test and validate the usability of the current user interface, and provide evidence of usability in the SRS EHR, the EHR under Test (EHRUT). During the usability test, 10 clinical staff matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks.

This study collected performance data on one task typically conducted on an EHR:

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

During the 10 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 the EHR. The administrator introduced the test, and instructed participants to complete a series of tasks (given one at a time) using the EHRUT. During the testing, the administrator timed the test and, 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 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. 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 SRS EHR.
<table>
<thead>
<tr>
<th>Task</th>
<th>Effectiveness</th>
<th>Efficiency</th>
<th>Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Task Success</td>
<td>Task Time</td>
</tr>
<tr>
<td>Searching for Implantable Device of UDI format “HIBCC”</td>
<td>10</td>
<td>80%</td>
<td>0.58</td>
</tr>
<tr>
<td>Adding Implantable Device through Save&amp;Close (UDI format “HIBCC”)</td>
<td>10</td>
<td>80%</td>
<td>0.53</td>
</tr>
<tr>
<td>Viewing Implantable Device Activity</td>
<td>10</td>
<td>70%</td>
<td>0.36</td>
</tr>
<tr>
<td>Editing Implantable Device</td>
<td>10</td>
<td>80%</td>
<td>0.55</td>
</tr>
<tr>
<td>Reset Implantable Device</td>
<td>10</td>
<td>80%</td>
<td>0.61</td>
</tr>
<tr>
<td>Adding activity to Existing Implantable Device</td>
<td>10</td>
<td>80%</td>
<td>0.61</td>
</tr>
</tbody>
</table>

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 71.11

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

- Major findings

Most participants found it easy to view and update the Implantable Device list information. There were minor issues with the initial searching of the device. But as users progressed through the task they found the feature easy to use and completed tasks with ease. From a usability perspective the screen would benefit from trimming extra spaces before and after the device UDI to avoid running into errors. In addition the screen would benefit from having the necessary interfaces to automatically pre-populate the screen with the device data. Lastly visual cues to alert the user as to which data elements are missing and why the user is not able to continue with the device entry/update.

- Areas for improvement

As stated above, the order entry UI contains some design elements which hindered usability. For example, when saving a device the user is required to enter the state & date. From a usability standpoint these fields should have a visual indicator following a standard UI paradigm to indicate required fields. Making the Implantable Device List interoperable to reduce data entry would improve usability.

**INTRODUCTION**

The EHRUT tested for this study was SRS EHR v10. It is designed to present medical information to healthcare providers in an outpatient ambulatory environment. The SRS EHR consists of various modules
and interfaces design to capture, display, and modify patient clinical data. 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 time on task, user satisfaction, and deviation from optimal paths, were captured during the usability testing.

**METHOD**

**SRS User Centered Design Process**

SRS Health designed and implemented its own UCD process based upon the ISO 9241-210 industry standard. The SRS UCD process follows the same principles of human-centered design and fits in to our overall quality management system (QMS). The system involves users in the overall design and software development process. The design team includes individuals with skills spanning across multiple disciplines and with different perspectives. The team works to address the entire user experience through a deep understanding of the tasks and workflows required by end users. The process is iterative and requirements are continually updated to better address the context of use, increase usability, and reduce user error.

The main steps of the process are:

- Understanding/stating the context of use for the function or module
  - Business requirements are gathered from internal and client stakeholders. These stakeholders are kept up to date with product developments through “Feature team” meetings.
- Creating design solutions
  - Business Analysis work with “Feature teams” to design several possible solutions and through further analysis with stakeholders the solution is refined.
- Creating user requirements
  - Business analysis creates full requirements documents based on feedback from “Feature teams”
- Evaluating the solution
  - Solution prototypes are created and vetted against the original understanding of the context of use.
- Performing user centered evaluations
  - Formal summative user testing is performed and the analysis is sent back to the “feature teams”. The results are then used to drive future iterations of the product.

The following tasks and modules were developed based on the SRS UCD design process:

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

The testing methods were in accordance with the SRS User Centered Design Process. A total of 10 participants were tested on the EHRUT(s). Participants in the study included medical assistants, and technicians from the orthopedic and ophthalmology specialties. In addition, participants had no direct connection to the development of or organization producing the EHRUT(s). Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received.

For the test purposes, end-user characteristics were identified and translated into a recruitment screener used to solicit potential participants; an example of a screener is provided in Appendix 1.

Recruited participants had a mix of backgrounds and demographic characteristics conforming to the recruitment screener. The following is a table of participants by characteristics, including demographics, professional experience, computing experience and user needs for assistive technology. Participant names were replaced with Participant IDs randomly generated from the demographics collection tool so that an individual’s data cannot be tied back to individual identities.

<table>
<thead>
<tr>
<th>ID</th>
<th>Gender</th>
<th>Age</th>
<th>Occupation/Role</th>
<th>EHR Experience (Years)</th>
<th>IDL Module Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Female</td>
<td>40-59</td>
<td>Technician</td>
<td>10+</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>40-59</td>
<td>Manager</td>
<td>10+</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>Female</td>
<td>25-39</td>
<td>Technician</td>
<td>3-5</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>Female</td>
<td>25-39</td>
<td>Technician</td>
<td>6-9</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>Female</td>
<td>40-59</td>
<td>Medical Assistant</td>
<td>10+</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>Female</td>
<td>25-39</td>
<td>Medical Assistant</td>
<td>3-5</td>
<td>None</td>
</tr>
<tr>
<td>7</td>
<td>Female</td>
<td>25-39</td>
<td>Medical Assistant</td>
<td>6-9</td>
<td>None</td>
</tr>
<tr>
<td>8</td>
<td>Female</td>
<td>25-39</td>
<td>Medical Assistant</td>
<td>3-5</td>
<td>None</td>
</tr>
<tr>
<td>9</td>
<td>Female</td>
<td>25-39</td>
<td>X-Ray Technician</td>
<td>3-5</td>
<td>None</td>
</tr>
<tr>
<td>10</td>
<td>Male</td>
<td>40-59</td>
<td>Medical Assistant</td>
<td>6-9</td>
<td>None</td>
</tr>
</tbody>
</table>

Ten participants (matching the demographics in the section on Participants) were recruited and 10 participated in the usability test.

Participants were scheduled for 10 minute sessions with a 5 minutes 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 participants, 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 test, participants interacted with one EHR. Each participant used the system in the same room at the two testing locations, 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. Implantable Device List:
   a. Searching for Implantable Device of UDI format “HIBCC”
   b. Adding Implantable Device through Save&Close (UDI format “HIBCC”)
   c. Viewing Implantable Device Activity
   d. Editing Implantable Device
   e. Reset Implantable Device
   f. Adding activity to existing Implantable Device

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users.

**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.

To ensure that the test ran smoothly, two staff members participated in this test, the usability administrator and the data logger.

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. A second person served as the data logger and took notes on task success, path deviations, number and type of errors, and comments.

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

- As quickly as possible making as few errors
• 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 stopped 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 (the System Usability Scale, see Appendix 5) 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.

TEST LOCATION

The tests were performed in the exam room where the EHRUT would typically be deployed and used in production. Only the participant, the administrator and the data logger were in the test room. 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 instruction and evacuation procedures were valid, in place, and visible to the participants.

TEST ENVIRONMENT

The EHRUT would be typically be used in a healthcare office or facility. In this instance, the testing was conducted in an examination room on a computer where interactions with the EHRUT would typically take place in real world office scenarios. For testing, the computer used a Windows PC running windows 10 with a standard mouse and keyboard.

The SRS EHR v10 system was viewed on a 22/14 inch monitor. The application was set up by the SRSHhealth according to standard operating procedure for client/server installation. The application itself was running on a Windows 2008 Server using a Demo/Training SQL database on a LAN connection. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation. Additionally, participants 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 Goto Meeting and Goto Training software running on the test machine.
PARTICIPANT INSTRUCTIONS

The administrator reads the following instructions aloud to the each participant (also see the full moderator’s guide in Appendix 4):

Thank you for participating in this study. Our session today will last about 10 minutes. During that time you will take a look at an early prototype of SRS EHR v10.

I will ask you to complete a few tasks using this system and answer some questions. 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. You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Please do not do anything more than asked. If you get lost or have difficulty I cannot answer help you with anything to do with the system.

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. Since this is a test system some of the data may not make sense as it is placeholder data. We are recording the screen of our session today for our internal use only.

Do you have any questions or concerns?

Following the procedural instructions, participants were shown the EHR. Once this 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 would like to request that you not talk aloud or verbalize while you are doing the tasks. I will ask you your impressions about the task once you are done.*

Participants were then given six tasks to complete. Tasks are listed in the moderator’s guide in Appendix 4.

USABILITY METRICS

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

1. Effectiveness of SRS EHR v10 by measuring participant success rates and errors
2. Efficiency of SRS EHR v10 by measuring the average task time and path deviations
3. Satisfaction with SRS EHR v10 by measuring ease of use ratings

DATA SCORING

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

<table>
<thead>
<tr>
<th>Measures</th>
<th>Rationale and Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effectiveness:</strong> Task Success</td>
<td>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.</td>
</tr>
</tbody>
</table>
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 and was recorded.

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 were defined by taking multiple measures of optimal performance and multiplying each time by a factor of 1.5. This factor allows some time buffer, as participants are presumably not trained to expert performance. Thus, if expert performance on a task was \([x]\) seconds then optimal task time performance was \([x \times 1.5]\) seconds. The ratio of reported time to optimal time was aggregated across tasks and reported with mean.

<table>
<thead>
<tr>
<th>Effectiveness:</th>
<th>Task Failures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as a “Failures.” No task times were taken for errors. On a qualitative level, an enumeration of errors and error types was collected and is described in the narrative section below.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Efficiency:</th>
<th>Task Deviations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The participant's path through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, opened an incorrect module, 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. Optimal paths were recorded in the moderator guide. Task deviations are discussed further in the qualitative sections.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Efficiency:</th>
<th>Task Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Satisfaction:</th>
<th>Task Rating:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>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 Easy) to 5 (Very Difficult). These data are averaged across participants. Common convention is that average ratings for systems judged easy to use should be 3.3 or below. To measure participants’ confidence in and likeability of the SRS EHR vv10 overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, “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.</td>
</tr>
</tbody>
</table>
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.

There were a few minor issues which may have affected data collection. The task descriptions and the terminology used could have contributed to some hesitation on the part of the user when completing tasks. Efforts were made to use descriptions and terminology which would be familiar to users; however, some users still may have experienced some confusion.

As part of testing, users were presented with entirely new data entry screens. Test participants had never used these screens to create and update implantable device list information, so it is understandable that users would have some initial difficulty navigating unfamiliar screens.

The usability testing results for the EHRUT are detailed below (see Table 2).

<table>
<thead>
<tr>
<th>Measure</th>
<th>Effectiveness</th>
<th>Efficiency</th>
<th>Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Task Success</td>
<td>Task Time</td>
</tr>
<tr>
<td>Searching for Implantable Device of UDI format “HIBCC”</td>
<td>10</td>
<td>80%</td>
<td>0.58</td>
</tr>
<tr>
<td>Adding Implantable Device through Save &amp; Close (UDI format “HIBCC”)</td>
<td>10</td>
<td>80%</td>
<td>0.53</td>
</tr>
<tr>
<td>Viewing Implantable Device Activity</td>
<td>10</td>
<td>70%</td>
<td>0.36</td>
</tr>
<tr>
<td>Editing Implantable Device</td>
<td>10</td>
<td>80%</td>
<td>0.55</td>
</tr>
<tr>
<td>Reset Implantable Device</td>
<td>10</td>
<td>80%</td>
<td>0.61</td>
</tr>
<tr>
<td>Adding activity to Existing Implantable Device</td>
<td>10</td>
<td>80%</td>
<td>0.61</td>
</tr>
</tbody>
</table>

Table 2. 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: 71.11. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.¹

**DISCUSSION OF THE FINDINGS**

**EFFECTIVENESS**

Based on the findings, most users were quite effective at using the EHRUT. The average number of failures per task was 2, but the “errors” were primarily due to the user timing out before the task could be completed. Some users spent additional time making sure that they had typed information correctly, which contributed to timing out on the task, other users verified they had completed all intended steps before completing the last step of the task and ultimately, failure on the task. However, making certain that data is entered correctly contributes to an overall goal of this project - patient safety.

Most test participants were effective and showed very few, if any path deviations. The duration taken to complete the task can be attributed to the fact that this is a new feature on the application on which no one has been trained. It would be interesting to measure effectiveness once again after training has been completed once the EHRUT has been deployed to the customers and to observe if users continue to follow an optimal path.

**Risk Prone Errors**

When discussing errors, it is important to note which tasks are more likely to result in errors and what types of errors are most likely to cause patient safety issues. Tasks which do not alter the patient’s record but simply display information to the user are less likely to lead to errors. Viewing device details and reviewing the patient’s device history does not involve the user entering or alerting data, so the chance of error is very low. The system will only allow ancillary information associated with the device to be updated. The actual device information itself cannot be altered and is saved as retrieved from the FDA database. So there is no chance of an incorrect device being attached with a patient record.

Tasks which require the user to enter data are more prone to error. To that end every effort should be made to ensure that the user can clearly discern what has been selected on the screen and that they are given an opportunity to double check and “cancel’/”reset” actions before they are committed.

Below is a prioritized list of tasks in the order of the associated risk and with a rating of the risk (1-3, where 1 is a low risk and 3 is a high risk)

<table>
<thead>
<tr>
<th>Task</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Searching for Implantable Device of UDI format “HIBCC”</td>
<td>3</td>
</tr>
<tr>
<td>Adding Implantable Device through Save&amp;Close (UDI format “HIBCC”)</td>
<td>1</td>
</tr>
<tr>
<td>Viewing Implantable Device Activity</td>
<td>1</td>
</tr>
<tr>
<td>Editing Implantable Device</td>
<td>1</td>
</tr>
<tr>
<td>Reset Implantable Device</td>
<td>1</td>
</tr>
<tr>
<td>Adding activity to Existing Added Implantable Device</td>
<td>1</td>
</tr>
</tbody>
</table>

EFFICIENCY

A few users were unable to complete the tasks in what was deemed a “reasonable” amount of time. Users who failed to complete the task within the maximum amount of time, as determined for each task prior to testing, had their data excluded for efficiency measures.

The average deviations ratios (observed path / optimal path) in the group tested were close to 1.0 for users who could complete the task. Even users who were unable to complete a task in time were generally on the correct path and rarely deviated into a different area of the software. Thus, we conclude that users were relatively efficient when completing the tasks set before them.

SATISFACTION

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be: 71.11. Verbal feedback as well as task ratings conclude that there is a high level of comfort and overall satisfaction with the system. Specifically, users stated that the system is “simple and intuitive,” “user friendly,” and “organized logically.” These statements, along with other participant verbalizations, suggest a high level of usability within the system.

There are of course some areas of improvement, which are discussed below, but even so the average task ease of use rating was between 1.8 and 2.3 for each task. As set forth in the data scoring section, average ratings for systems judged easy to use should be 3.3 or below. Hence, a major finding of this testing was that the modules tested are very easy to use.

MAJOR FINDINGS

Most of the participants were very familiar with the EHRUT so very few users had difficulty with those tasks. Most users agreed that they found that they rarely had trouble using the module.

Most participants found it easy to view and update the Implantable Device list information. There were minor issues with the initial searching of the device. But as users progressed through the task they found the feature easy to use and completed tasks with ease. From a usability perspective the screen would benefit from making the visual cues to alert the user as to which data elements are missing any why the user is not able to continue with the device entry/update.
AREAS FOR IMPROVEMENT

Generally, the feedback was very positive, but there are some areas where usability could be improved. One major takeaway from this process is that gathering user feedback earlier in the development process as well as working with less advanced/beginner users rather than super users could improve usability and overall safety.

As stated above, the order entry UI contains some design elements which hindered usability. For example, when saving an order the user is required to enter the state & date. From a usability standpoint these fields should have a visual indicator following a standard UI paradigm to indicate required fields. Making the Implantable Device List interoperable to reduce data entry would improve usability.
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: Moderator’s Guide
5: System Usability Scale Questionnaire
Appendix 1: SAMPLE RECRUITING SCREENER

The purpose of a screener to ensure that the participants selected represent the target user population as closely as possible. Rather than reaching out to individual participants, SRS opted to target the Practice Administrator and rely upon them to select qualified participants based on the functionality being tested.

Recruiting Scripts:

Hello, my name is ________, and I am calling from SRSHealth. We are recruiting participants for a usability study on the SRS EHR. Would you be willing to participate, along with staff members? This is strictly for research purposes. We will primarily be conducting tests on the usability of the new implantable device list. Could you identify users in the practice such as physicians, medical assistants, and technicians who use this module? Once you have identified those users, please send them a demographics questionnaire.

Would you be able to participate between May 15th and May 20th? The test will take place at your office.

Thank you, and we appreciate your time.

Participants then filled out an online demographics survey at

http://srssoft.poldaddy.com/s/participant-demographics-survey
Appendix 2: PARTICIPANT DEMOGRAPHICS

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

### Gender

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
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</tr>
<tr>
<td>Women</td>
<td>9</td>
</tr>
<tr>
<td>Total (participants)</td>
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### Age

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<td>25-39</td>
<td>6</td>
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<td>40-59</td>
<td>4</td>
</tr>
<tr>
<td>60+</td>
<td>0</td>
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<tr>
<td>Total (participants)</td>
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### Race/Ethnicity

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</thead>
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<tr>
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<tr>
<td>Black/African-American</td>
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<tr>
<td>Latino/a or Hispanic</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
</tr>
<tr>
<td>Total (participants)</td>
<td>10</td>
</tr>
</tbody>
</table>

### Occupation/Role

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Physician</td>
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</tr>
<tr>
<td>Medical Assistant</td>
<td>5</td>
</tr>
<tr>
<td>Technician</td>
<td>4</td>
</tr>
<tr>
<td>Manager</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
</tr>
<tr>
<td>Total (participants)</td>
<td>10</td>
</tr>
</tbody>
</table>

### Years of Experience

<p>| | |</p>
<table>
<thead>
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<th></th>
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<tr>
<td>3-5</td>
<td>4</td>
</tr>
<tr>
<td>6-9</td>
<td>3</td>
</tr>
<tr>
<td>10+</td>
<td>3</td>
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<tr>
<td>Total (participants)</td>
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Following is a full participant breakdown:

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<thead>
<tr>
<th>ID</th>
<th>Gender</th>
<th>Age</th>
<th>Occupation/Role</th>
<th>EHR Experience (Years)</th>
<th>IDL Module Experience</th>
<th>Assistive Tech Needs</th>
<th>Race/Ethnicity</th>
</tr>
</thead>
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<td>177949577</td>
<td>Female</td>
<td>40-59</td>
<td>Technician</td>
<td>10+</td>
<td>None</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>177954502</td>
<td>Female</td>
<td>40-59</td>
<td>Manager</td>
<td>10+</td>
<td>None</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>177964860</td>
<td>Female</td>
<td>25-39</td>
<td>Technician</td>
<td>3-5</td>
<td>None</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>177966158</td>
<td>Female</td>
<td>25-39</td>
<td>Technician</td>
<td>6-9</td>
<td>None</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>178098724</td>
<td>Female</td>
<td>40-59</td>
<td>Medical Assistant</td>
<td>10+</td>
<td>None</td>
<td>N/A</td>
<td>Black/African-American</td>
</tr>
<tr>
<td>178098953</td>
<td>Female</td>
<td>25-39</td>
<td>Medical Assistant</td>
<td>3-5</td>
<td>None</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>178099038</td>
<td>Female</td>
<td>25-39</td>
<td>Medical Assistant</td>
<td>6-9</td>
<td>None</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>178099052</td>
<td>Female</td>
<td>25-39</td>
<td>Medical Assistant</td>
<td>3-5</td>
<td>None</td>
<td>N/A</td>
<td>Latino/a or Hispanic</td>
</tr>
<tr>
<td>178099136</td>
<td>Female</td>
<td>25-39</td>
<td>X-Ray Technician</td>
<td>3-5</td>
<td>None</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
<tr>
<td>178099491</td>
<td>Male</td>
<td>40-59</td>
<td>Medical Assistant</td>
<td>6-9</td>
<td>None</td>
<td>N/A</td>
<td>Caucasian</td>
</tr>
</tbody>
</table>
Non-Disclosure Agreement

THIS AGREEMENT is entered into as of May 18th, 2017, between
________________________________________ (“the Participant”) and the testing organization
SRSHealth located at 155 Chestnut Ridge Road, Montvale, New Jersey, 07645.

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 SRSHealth, 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 SRSHealth 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 not disclose this confidential information obtained today to anyone else or any other organizations.

Participant’s printed name: ___________________________________________
Signature: __________________________________________________________
Date: __________________


Informed Consent

SRSHealth 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 30 minutes.

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

I understand and consent to the use and release of the recording by SRSHealth. I understand that the information and recording 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 recording and understand the recording may be copied and used by SRSHealth 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 SRSHealth and SRSHealth’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

SRS EHR Usability Test

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 with Goto Meeting
Prior to each task:
☐ Reset application to starting point for next task

After each participant:
☐ End session recordings with Goto Meeting

After all testing
☐ Back up all video and data files

Orientation

Thank you for participating in this study. Our session today will last about 10 minutes. During that time you will take a look at an early prototype of SRS EHR v10.

I will ask you to complete a few tasks using this system and answer some questions. 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.

You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Please do not do anything more than asked. If you get lost or have difficulty I cannot answer help you with anything to do with the system itself.

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. Since this is a test system some of the data may not make sense as it is placeholder data. We are recording the screen of our session today for our internal use only.

Do you have any questions or concerns?
Participant Name:

Task 1: Searching for Implantable Device of UDI format “HIBCC”

(Optimal Time: 60.75 Secs)

Searching for Implantable Device of UDI format “HIBCC”

Success:
- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:

Task Time: __________ Seconds

Optimal Path

1) User is logged into SRS
2) User selects a patient with appointment
3) User opens the Implantable Device List app on the Interoperability Dashboard by clicking on the green “+” icon
4) Enter with valid UDI format (of type HIBCC) in Search box like +B066000325011NS1/$$420020216LOT123456789012345/SXYZ456789012345678/16D20130202C1 then Press Enter Key
5) User can see the below Implantable Device information on the screen with respect to search

GMDN PT: "Cardiopulmonary bypass system filter, arterial blood line"
SNOMED:

Brand Name: "CAP, NON-VENTED FEMALE: BLUE NON-STERILE"
Version/Model: 000325-011NS
Company: "NOVOSCI CORP"
Lot/Batch No: LOT123456789012345
Serial No: XYZ456789012345678
MRI: "Labeling does not contain MRI Safety Information"
Contains Natural Rubber: false
Expiration Date: 02/02/2020
Manufactured Date: 02/02/2013
HCT/P: false

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Notetaker Comments:

Task 2: Adding Implantable Device through Save&Close (UDI format “HIBCC”)
(Optimal Time: 93.15 Secs)

Adding Implantable Device through Save&Close (UDI format “HIBCC”)

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

Comments:
Task Time: ________ Seconds

Optimal Path

1) User is logged into SRS
2) User selects a patient with appointment
3) User opens the Implantable Device List app on the Interoperability Dashboard by clicking on the green “+” icon
4) Enter with valid UDI format (of type HIBCC) in Search box like
   +B066000325011NS1/5$420020216LOT123456789012345/SXYZ456789012345678/16D2013
   0202C1 then Press Enter Key
5) User can see the below Implantable Device information on the screen with respect to search

GMDN PT: "Cardiopulmonary bypass system filter, arterial blood line"
SNOMED:
Brand Name: "CAP, NON-VENTED FEMALE: BLUE NON-Sterile"
Version/Model: 000325-011NS
Company: "NOVOSCI CORP"
Lot/Batch No: LOT123456789012345
Serial No: XYZ456789012345678
MRI: "Labeling does not contain MRI Safety Information"
Contains Natural Rubber: false
Expiration Date: 02/02/2020
Manufactured Date: 02/02/2013
HCT/P: false

6) User can see the below labeled with text boxes under Expanded layout grid

   Friendly Name: Text Box
   Status: Dropdown
   Date: Text box(Calendar)
   Notes: Text Box
   Reset and Save & Close

7) User enter the Data (Free text) in the above test box Like below
   **Example** -
   Friendly Name: HIBCC Device
   Status: Active
   Date: 01/01/2017
   Notes: Saving the Device

8) User click on Save & Close button
9) User should able to save Implantable Device successfully and screen also closed
10) User should be see the added Implantable Device on the Interoperability Dashboard
11) Now user again opens the Implantable Device List app on the Interoperability Dashboard by clicking on the green “+” icon
12) User should able to see the saved Implantable Device in the Bottom grid and information should be displayed under columns (i.e. GMDN Pt Name, Status, Date, Brand and Notes)

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Notetaker Comments:

Task 3: Viewing Implantable Device Activity.
(Optimal Time: 22.35 Secs)

Viewing Implantable Device Activity

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

Comments:
Task Time: ________ Seconds

Optimal Path

1) User is logged into SRS
2) User selects a patient with appointment
3) User opens the Implantable Device List app on the Interoperability Dashboard by clicking on the green “+” icon
4) User already added Implantable device data to the Bottom grid
5) User click on “+” icon left to saved Implantable device in the Bottom grid
6) User should able to see the information

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Notetaker Comments:
Task 4: Editing Implantable Device

Editing Implantable Device

(Optimal Time: 55.5 Secs)

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

Comments:
Task Time: ________ Seconds

Optimal Path

1) User is logged into SRS
2) User selects a patient with appointment
3) User opens the Implantable Device List app on the Interoperability Dashboard by clicking on the green “+” icon
4) User already added Implantable device data to the Bottom grid
5) User click on Edit icon right side to saved Implantable device in the Bottom grid
6) User enter the updated information in the columns friendly name, date and Notes and click on save/&close
7) User should able to update successfully the columns (friendly name, status date and Notes)
8) User again click on Edit icon right side to saved Implantable device in the Bottom grid (Step – 4)
9) Now user should able to see the Updated information

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)
Task 5: Reset Implantable Device

(Optimal Time: 48.75 Secs)

Reset Implantable Device

Success:
- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:
Task Time: ________ Seconds

Optimal Path

1) User is logged into SRS
2) User selects a patient with appointment
3) User opens the Implantable Device List app on the Interoperability Dashboard by clicking on the green “+” icon
4) User already added Implantable device data to the Bottom grid
5) User click on Edit icon right side to saved Implantable device in the Bottom grid
6) User enter the new information in the columns for friendly name, status, date and Notes and do not click on save/ & close
7) User click on Reset Button
8) User should able to reset to previous information

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Notetaker Comments:

Task 6: Adding activity to Existing Implantable Device

(Optimal Time: 38.25 Secs)

Adding activity to Existing Implantable Device

Success:
- Easily completed
- Completed with difficulty or help :: Describe below
- Not completed

Comments:
Task Time: ________ Seconds

Optimal Path

1) User is logged into SRS
2) User selects a patient with appointment
3) User opens the Implantable Device List app on the Interoperability Dashboard by clicking on the green “+” icon
4) User already added Active Implantable device data to the Bottom grid
5) User click on Edit icon right side to saved Implantable device in the Bottom grid
6) User change the status to inactive and click on save/&Close button
7) Now user again opens the Implantable Device List app on the Interoperability Dashboard by clicking on the green “+” icon
8) User click on “+” icon left to saved Implantable device in the Bottom grid
   User should able to see the Activity by click on “+” icon left to it

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below

Comments:

Observed Errors and Verbalizations:
Comments:

Rating:

Overall, this task was: ______
Show participant written scale: “Very Easy” (1) to “Very Difficult” (5)

Administrator / Notetaker Comments:
Appendix 5: SYSTEM USABILITY SCALE QUESTIONNAIRE

This questionnaire was adapted from John Brooke’s “SUS: a “quick and dirty” usability scale” at Digital Equipment Corporation in the UK.\(^2\) Participants completed the questionnaire on paper.

<table>
<thead>
<tr>
<th>System Usability Scale</th>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I think that I would like to use this system frequently</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I found the system unnecessarily complex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I thought the system was easy to use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I think that I would need the support of a technical person to be able to use this system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I found the various functions in this system were well integrated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I thought there was too much inconsistency in this system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I would imagine that most people would learn to use this system very quickly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I found the system very cumbersome to use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. I felt very confident using the system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. I needed to learn a lot of things before I could get going with this system</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>