IHS RESOURCE AND PATIENT MANAGEMENT SYSTEM
SUMMATIVE USABILITY TESTING FINAL REPORT

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8/12/2022	2.1	Shannon Hurley	Updated date to reflect review of (b)(2) criteria for 2015 Edition Cures Update; no updates or changes to the criteria were made.

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1.0 Executive Summary

Summative usability testing (hereinafter referred to as “usability testing”) of the Resource and Patient Management System (RPMS) Electronic Heath Record (EHR) application was conducted during 2019 - 2020 as part of the 2015 Certified Health IT (g)(3) Safety-Enhanced Design criterion. The purpose of this test was to evaluate and validate the usability of the current user interface, and provide evidence of user-centered design (UCD) practices in the application.

During the usability test, healthcare providers and other users matching the target demographic criteria participated in summative usability testing for each safety-enhanced design criterion and the associated capabilities.

This study collected performance data on the top tasks as identified by the owners of the criteria to be tested.

The criteria included in this test report are:

- 170.315(a)(1) Computerized provider order entry—medications
- 170.315(a)(2) Computerized provider order entry—laboratory
- 170.315(a)(3) Computerized provider order entry—diagnostic imaging
- 170.315(a)(4) Drug-drug, drug-allergy interaction checks
- 170.315(a)(5) Demographics
- 170.315(a)(9) Clinical decision support
- 170.315(a)(14) Implantable Device List (IDL)
- 170.315(b)(2) Clinical Information Reconciliation and Incorporation (CIR)

These criteria were broken down into 3 test groups (A, B, and C).

During the approximately 60-minute one-on-one usability test sessions, each participant was greeted by the administrator who introduced the test. Participants were asked to share their prior EHR experience.

During each test session, the administrator timed the test and recorded user performance data. Participant screens and audio were also recorded for subsequent analysis.

The following types of data were collected for each participant:

- Demographic data
- Number of tasks successfully completed
- Time to complete the tasks
- Number and types of errors
- Path deviations
- Participant's verbalizations (comments)
- Participant's satisfaction ratings of the system

All participant data was de-identified so that no correspondence could be made from the identity of the participant to the data collected.

The test method and metrics were based on the National Institute of Standards and Technology (NIST) Guide to the Processes Approach for Improving the Usability of Electronic Health Records (NISTIR 7741). Modifications were made where necessary to better evaluate the application against the contract goals and requirements. Following the conclusion of the test, participants were asked to complete a post-test questionnaire and were thanked for their participation.

The Task Satisfaction Rating is based on the following pre-defined scale:

- 1 (Very Difficult) – 5 (Very Easy).

1.1 Major Findings

Based on the score of the Task Satisfaction Rating, the participants found the EHR easy to use. Participants did state that the initial learning curve is steep and training is necessary. However, once they learned to use the application, participants completed tasks with great efficiency and effectiveness.

Criteria	Task Success Rate Mean %	Task Satisfaction Rating (Scale 1-5) 1(Very Difficult)-5(Very Easy)
170.315(a)(1) Computerized provider order entry—medications	100%	4.67
170.315(a)(2) Computerized provider order entry—laboratory	100%	4.83
170.315(a)(3) Computerized provider order entry—diagnostic imaging	92%	4.67
170.315(a)(4) Drug-drug, drug-allergy interaction checks	100%	4.67
170.315(a)(5) Demographics	100%	4.91
170.315(a)(9) Clinical decision support	100%	5
170.315(a)(14) Implantable Device List (IDL)	88%	4.21
170.315(b)(2) Clinical Information Reconciliation and Incorporation (CIR)	98%	4.68

Table 1: Criteria Success and Satisfaction Rating Summary

1.2 Recommendations

Group A

Criteria/Module	Findings
(a)(1) CPOE – medications	Clinical Indication box under Medication Order -- if a provider has not already added a diagnosis to the problem list and they search for it here, it does not also save to the problem list; this causes some providers frustration. Participants did not like that if POV is not added for acute visit, they have to go to dropdown menu and select what the medicine is treating.
(a)(2) CPOE – laboratory	'Order a Lab Test' screen – when a provider is searching a 'clinical indication' but has not added it to the problem list, there is no additional option to add it to the problem list from this screen.
(a)(3) CPOE – diagnostic imaging	Fix tab order of form fields. Improve form field labeling.
(a)(4) Drug-drug, drug-allergy interaction checks for CPOE	Would like to see a hard stop for alerts, something interactive that providers would have to read and acknowledge they have done before continuing. Better configuration for alerts to reduce alert fatigue.
(a)(9) Clinical decision support	Better training available on demand. Better documentation and training on troubleshooting procedures. Nurses have commented that they would like the capability to complete the note/dialogue associated with the reminder from the "Available Reminders" pop up box. Needs to be more flexible of configurable. Ability to set reminders as "Do not remind" or "No longer relevant".

Table 2: Areas for Improvement – Group A

Group B

Criteria/Module	Findings
(a)(5) Demographics	Fix consistency of design and functionality for form input fields. Not all drop-down menus look or function the same. Error messaging is too far from the input field. First "Remove" link for Ethnicity and Race is disabled but should be removed. Better instructions for form inputs. SO/GI checkbox groups should instruct user if it is single or multi-select.

Table 3: Areas for Improvement – Group B

Group C

Criteria/Module	Findings
(a)(14) Implantable device list	Make form inputs more consistent with similar inputs in the EHR or with industry standards. Most participants had trouble with the Imprecise Date Picker. Any form input that required the use of a dialog or widget was troublesome. For Imprecise Date Picker, participants wanted to type directly into the input without having to launch the date picker. Layout of the Add Implant Event form was confusing. Form labels were underneath the inputs which is not consistent with other forms in the EHR. Drop-down Menus do not have a function to clear the selection. Placement of tooltips hid menu options. Improve navigation of the CCDA review view. When user checks or unchecks a section, they are taken to the top of the CCDA preview.
(b)(2) Clinical information reconciliation and incorporation	Form inputs are not consistent in labeling or functionality. Liked the addition of a "reviewed" indicator and a Set All Reviewed button. Much faster and more usable than before. It was unusable before the updates. Looking forward to using. CCDA document can be too long and tricky to navigate

Table 4: Areas for Improvement – Group C

2.0 Introduction

The Office of the National Coordinator for Health Information Technology (ONC) Health IT Certification Program is a voluntary certification program established by the Office of the National Coordinator for Health IT to provide for the certification of health IT.

The Indian Health Service (IHS) Office of Information Technology (OIT) has requested that the Resource and Patient Management System Electronic Health Record (RPMS EHR) achieve ONC 2015 Health IT Certification. As part of the certification criteria, (g)(3) Safety-Enhanced Design requires that summative usability testing be performed on specific criteria and the test data be provided as part of a final test report. The test report will follow the National Institute of Standards and Technology (NIST) Customized Common Industry Format Template for Electronic Health Record Usability Testing (NISTIR 7742).

Summative usability testing is a task-based evaluation that measures the ease of use of a completed product. The results are analyzed and compared to the usability requirements to determine if those requirements have been met. Summative usability testing was conducted on RPMS Suite (BCER) v4.0. The intended users for this software include medical providers, nursing staff, health information management staff, pharmacy staff, and imaging and laboratory personnel at clinics and hospitals.

2.1 Purpose

The purpose of this test was to evaluate and validate each safety-enhanced design criterion and the associated capabilities. The test ensures that the completed product meets the 2015 CHIT certification requirements concerning user-centered design.

2.2 Scope

The scope of usability testing is limited to testing user-involved tasks. Automated tasks or tasks without user interaction are not covered in this test. Functional testing is not covered in detail. Functionality is only tested as it pertains to the usability of the product or feature being tested.

The test was limited in scope to the following criteria:

- 170.315(a)(1) Computerized provider order entry—medications
- 170.315(a)(2) Computerized provider order entry—laboratory
- 170.315(a)(3) Computerized provider order entry—diagnostic imaging
- 170.315(a)(4) Drug-drug, drug-allergy interaction checks

- 170.315 (a)(5) Demographics
- 170.315(a)(9) Clinical decision support
- 170.315(a)(14) Implantable Device List (IDL)
- 170.315(b)(2) Clinical Information Reconciliation and Incorporation (CIR)

3.0 Method

See Appendix A for Participant and Test data.

The test method and metrics were based on the NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records (NISTIR 7741). Modifications were made where necessary to better evaluate the application against the contract goals and requirements.

The objective of this test was to uncover areas where the application performed well and areas where the application failed to meet the usability 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 capability and/or comparison with other EHR capabilities provided the same tasks are used. This testing serves as both a means to record or benchmark current usability and to identify areas where improvements must be made.

The application was evaluated for effectiveness, efficiency and satisfaction as defined by measures collected and analyzed for each participant:

- Number of tasks successfully completed
- Time to complete the tasks
- Number and types of errors
- Path deviations
- Participant's verbalizations (comments)
- Participant's satisfaction ratings of the system (Task Satisfaction Rating)
    - 1 (Very Difficult) – 5 (Very Easy)

Testing for the criteria was broken down into 3 separate test groups as follows:

1. Test Group A – Existing Functionality
    - 170.315(a)(1) Computerized provider order entry—medications
    - 170.315(a)(2) Computerized provider order entry—laboratory
    - 170.315(a)(3) Computerized provider order entry—diagnostic imaging
    - 170.315(a)(4) Drug-drug, drug-allergy interaction checks

- 170.315(a)(9) Clinical decision support

2. Test Group B – New Functionality
    - 170.315(a)(5) Demographics
3. Test Group C – New Functionality
    - 170.315(a)(14) Implantable Device List (IDL)
    - 170.315(b)(2) Clinical Information Reconciliation and Incorporation (CIR)

3.1 Roles and Responsibilities

Role/Function	Responsibilities
Project Manager/Criteria Owner	Responsible for the management, monitoring and tracking of the project and oversees all areas.
Usability Test Lead / Test Administrator	• Ensures that usability testing is conducted successfully and meets all usability testing deadlines. • Provides application systems analysis for application testing activities. • Prepares required documentation at the program level for testing activities. • Monitors and escalates risks or concerns about achieving goals or meeting schedules to program leadership. • Prepares all testing instructions, scripts and materials for use in the testing session. • Performs analysis of testing results, prepares and delivers test report. • Moderates the test • Collects test data

Role/Function	Responsibilities
Test Observers	• Provide any needed training or support • Monitor the testing session
Test Participants	• Complete the assigned tasks • Provide honest feedback on their experience

Table 5: Roles and Responsibilities

3.1.1 Test Participants

The total number of test participants per round of testing is listed below:

1. Test Group A – (a)(1)-(4) & (a)(9)
    - 12 Test Participants
2. Test Group B – (a)(5)
    - 11 Test Participants
3. Test Group C – (a)(14) & (b)(2)
    - 11 Test Participants

Participants in the test were:

- typical end-users such as physicians and medical providers
- trained to use the application prior to usability testing
- recruited by the 2015 CHIT project team and IHS criteria owners
- not compensated for participation
- had no direct connection to the development of the application
- given the same orientation and level of training as the actual end users
- assigned a participant ID initially based on scheduling order

Once participants were identified, they were scheduled for 60-minute one-on-one web conferencing (Skype, Adobe Connect) sessions. A calendar was used to keep track of the participants' schedule and a spreadsheet tracked participants' location (site) and contact information.

3.2 Test Location

The test was conducted remotely via the use of video conferencing and desktop sharing software (Microsoft Skype for Business, Adobe Connect).

3.3 Test Environment

The test participants were:

- physically located at their normal duty stations;
- logged into the RPMS EHR platform connected to a test database;
- utilizing their assigned workstation computers with a Windows operating system, a modern computer screen, a minimum screen resolution of 1024x768, and default color settings;
- interacting with the application with a mouse and keyboard; and
- connected to the video conferencing software via a Wide Area Network (WAN).

The test administrator and observers were also physically distributed and connected via video conferencing software.

For Test Group A, the test participants shared their screens and were the only desktops visible during testing. For Test Groups B and C, the test administrator shared his screen and participants were given control of the test application through the test administrator's screen.

In the case of Test Group B and C, the technical system performance (i.e., response time) was not representative to what actual users would experience in a field implementation, as they were working through the test administrator's workstation and not their own.

3.4 Test Tools

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

1. Demographic Questionnaire
2. Moderator's Guide
3. Post-test Questionnaire

The Moderator's Guide was devised so as to capture the required data.

Video conferencing software (MS Skype, Adobe Connect) was used to connect participants, the administrator and observers. This software was also used to record the video and audio of test sessions.

3.5 Tasks

The testing scenarios and tasks were constructed to be realistic and representative of the kinds of activities a user would perform using the capabilities being tested. Tasks were chosen with the test objectives in mind to ensure that participants provided the most meaningful data possible. The tasks were arranged to simulate a normal patient visit.

The following is the order in which the tasks were administered:

- 170.315(a)(9) Clinical decision support
    1. Access Clinical Reminders List.
    2. Select a reminder and view details.
    3. Resolve the reminder.
    4. Refresh the Clinical Reminders list and confirm that the reminder has been resolved.

- 170.315(a)(1) Computerized provider order entry—medications, 170.315(a)(4) Drug-drug, drug-allergy interaction checks
    1. Access the patient's Orders List.
    2. Place order for Warfarin. Accept and sign the order. Refresh the list and view that the order has been added. (Successful order test.)
    3. Place order for Penicillin. Accept but do not sign the order. Confirm that the order has been added. (Test trigger for a drug-allergy alert.)
    4. Change the Penicillin order to Erythromycin. (Test trigger for drug-drug interaction alert.)
    5. Accept and sign order. Confirm that the order has been added. (Test justification for bypassing the alert.)

- 170.315(a)(2) Computerized provider order entry—laboratory
    1. Access the patient's Orders List.
    2. Place HgbA1c lab order. Accept but do not sign the order. Confirm that the order has been added.
    3. Change the collection date of the HgbA1c order. Accept and sign the order.

- 170.315(a)(3) Computerized provider order entry—diagnostic imaging
    1. Access patient's Orders List.
    2. Place order for x-ray of left ankle. Accept but do not sign the order. Confirm that the order has been added.
    3. Change the Transport method to Stretcher. Accept and sign the order.

- 170.315(a)(5) Demographics
    1. Register New Patient
    2. Add Preferred Language to Existing Patient
    3. Edit Patient Information
    4. Add SO/GI Information

5. Edit SO/GI Information
6. Update Preliminary Cause of Death

- 170.315(a)(14) Implantable Device List
  1. Add New Implantable Device
  2. Access and change UDI and Status
  3. Preview a list that contains UDIs, description, and method to access UDIs

- 170.315(b)(2) Clinical Information Reconciliation and Incorporation
  1. Reconcile CCDA Problems
  2. Reconcile CCDA Adverse Reactions
  3. Reconcile CCDA Medications
  4. Preview new CCDA with reconciled data

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

3.6 Procedure

Upon arrival, each participant was greeted by the administrator and matched to a name on the participant schedule. The participant was then assigned a participant ID.

The test administrator moderated the test session including administering instructions and tasks. The administrator also monitored task times, obtained post-task rating data, and took notes on participant comments.

Each participant was instructed to perform the tasks:

- As quickly as possible making as few errors and deviations as possible.

- Without assistance; administrators were allowed to give immaterial guidance and clarification on tasks, but not instructions on use.

Testing for the criteria was broken down into 3 separate test groups as follows:

1. Test Group A – Existing Functionality (a)(1)-(4); (a)(9)

2. Test Group B – New Functionality – (a)(5) Demographics

3. Test Group C – New Functionality – (a)(14) Implantable Device List (IDL) and (b)(2) Clinical Information Reconciliation and Incorporation (CIR)

Each participant per Test Group used the same application version and was provided with the same set of instructions.

For Test Group A, the administrator instructed participants to log into the application as specific user types. For Test Groups B and C, the administrator logged into the test environment and then instructed the user to request control. After log in, the user was instructed to complete a series of tasks (given one at a time) using the application.

Task timing began once the administrator finished reading the question. The task time was stopped once the participant indicated that the task was successfully completed.

Scoring is discussed in Section 3.7 Usability Metrics.

After completion of the testing tasks, the administrator gave the participant a post-test questionnaire (System Usability Scale), asked if they had any questions, and thanked them for their participation.

Each participant's demographic information, task success rate, time on task, errors, deviations, verbal responses, and post-test questionnaire ratings were recorded into the participant spreadsheet.

Following each test session, the video recordings were reviewed and checked against the data logged in the participant spreadsheet. The participant spreadsheet was updated with any edits or additional information such as verbalizations.

3.7 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 by measuring participant success rates and errors
2. Efficiency by measuring the average task time and path deviations
3. Satisfaction by measuring task satisfaction ratings and SUS scores

3.7.1 Data Scoring

The following table (Table 6) details how tasks were scored, errors evaluated, and the time data analyzed.

Measures	Rationale and Scoring
Effectiveness: Task Success	A task was counted as a "Success" if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis. The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage. Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency. Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target task times used for task times in the Moderator's Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by some factor [e.g., 1.25] that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was [x] seconds then allotted task time performance was [x * 1.25] seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.
Effectiveness: Task Failures	If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as a "Failures." No task times were taken for errors. The total number of errors was calculated for each task and then divided by the total number of times that task was attempted. Not all deviations would be counted as errors.[11] This should also be expressed as the mean number of failed tasks per participant. On a qualitative level, an enumeration of errors and error types should be collected.
Efficiency: Task Deviations	The participant's path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.

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

Table 6: Measure Scoring

4.0 Results

4.1 Data Analysis and Reporting

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above.

Participants who failed to follow session and task instructions had their data excluded from the analyses.

4.2 Discussion of Findings

Based on the score of the Task Satisfaction Rating, the participants found the EHR easy to use. Participants did state that the initial learning curve is steep and training is necessary. However, once they learned to use the application, participants completed tasks with great efficiency and effectiveness.

The path taken to complete the tasks differed from participant to participant. This was influenced by the differing configuration of the test sites' EHR UIs. In spite of the varied paths to complete tasks, time per task was minimal and consistent, and errors were virtually non-existent.

All test participants felt the components were consistent and functioned as expected. The majority found the RPMS EHR to be an effective tool for completing their work tasks. Most said they would recommend this EHR to their colleagues.

The top issues the test participants remarked on were:

- Training
    - More training is needed.
    - Better training is needed.
    - Training should be updated and offered on a more consistent basis.
- UI Configuration
    - All felt the ability to customize the EHR UI to be a strength and that many issues they had with the system could be resolved with configuration updates.
    - Participants wanted more input on how the EHR UI is configured. Users felt locked into their current EHR configuration.

- While some liked the many ways to complete a given task and others did not, most agreed that it was unnecessarily redundant and added to confusion.

- Form Instructions and Elements
  - All participants liked the overall consistency of the EHR UI.
  - Better guidance on required fields in the ordering process.
  - Interface and interface elements are cramped, especially if the view port cannot be resized.
  - The default sizing of many windows, panels and lists does not allow the information they contain to be seen. This renders them useless until being resized, which leads to repeatedly having to adjust displays in order to use them.
  - Windows, panels and lists were inconsistent in their ability to be resized. Participants felt that all displays should allow resizing and should retain any adjustments made to them.

4.2.1 Effectiveness

4.2.1.1 Group A

- 170.315 (a)(1) Computerized provider order entry—medications
- 170.315 (a)(2) Computerized provider order entry—laboratory
- 170.315 (a)(3) Computerized provider order entry—diagnostic imaging
- 170.315 (a)(4) Drug-drug, drug-allergy interaction checks
- 170.315 (a)(9) Clinical decision support

#	Tasks - Group A	# Participants	Task Success Rate - Mean %	Task Success Rate - Std Dev %	Task Errors Mean %	Task Errors Std Dev %
	170.315(a)(9) Clinical decision support					
1	Access Clinical Reminders List.	12	100%	0%	0%	0%
2	Select a reminder and view details.	12	100%	0%	0%	0%
3	Resolve the reminder.	12	100%	0%	0%	0%
4	Refresh the Clinical Reminders list and confirm that the reminder has been resolved.	12	100%	0%	0%	0%
	170.315(a)(1) Computerized provider order entry—medications & 170.315(a)(4) Drug-drug, drug-allergy interaction checks					
5	Access the patient's Orders List.	12	100%	0%	0%	0%
6	Place order for Warfarin. Accept and sign the order. Refresh the list and view that the order has been added. (Successful order test)	12	100%	0%	0%	0%
7	Place order for Penicillin. Accept but do not sign the order. Confirm that the order has been added. (Test trigger for a drug-allergy alert)	12	100%	0%	0%	0%
8	Change the Penicillin order for to Erythromycin. (Test trigger for drug-drug interaction alert)	12	100%	0%	0%	0%
9	Accept and sign order. Confirm that the order has been added. (Test justification for bypassing the alert)	12	100%	0%	0%	0%
	170.315(a)(2) Computerized provider order entry—laboratory					
10	Access the patient's Orders List.	12	100%	0%	0%	0%
11	Place HgbA1c lab order. Accept but do not sign the order. Confirm that the order has been added.	12	100%	0%	0%	0%
12	Change the collection date of the HgbA1c order. Accept and sign the order.	12	100%	0%	0%	0%
	170.315(a)(3) Computerized provider order entry—diagnostic imaging					
13	Access patient's Orders List.	12	92%	29%	0%	0%
14	Place order for x-ray of left ankle. Accept but do not sign the order. Confirm that the order has been added.	12	92%	29%	0%	0%
15	Change the Transport method to Stretcher. Accept and sign the order.	12	92%	29%	0%	0%

Table 7: Effectiveness – Group A

4.2.1.2 Group B

- 170.315(a)(5) Demographics

#	Tasks - Group B	# Participants	Task Success Rate - Mean %	Task Success Rate - Std Dev %	Task Errors Mean %	Task Errors Std Dev %
	170.315(a)(5) Demographics					
1	Register New Patient	11	100%	0%	0%	0%
2	Add Preferred Language to Existing Patient	11	100%	0%	0%	0%
3	Edit Patient Information	11	100%	0%	9%	30%
4	Add SO/GI Information	11	100%	0%	0%	0%
5	Edit SO/GI Information	11	100%	0%	0%	0%
6	Update Preliminary Cause of Death	11	100%	0%	0%	0%

Table 8: Effectiveness – Group B

4.2.1.3 Group C

- 170.315(a)(14) Implantable Device List (IDL)
- 170.315(b)(2) Clinical Information Reconciliation and Incorporation (CIR)

#	Tasks - Group C	# Participants	Task Success Rate - Mean %	Task Success Rate - Std Dev %	Task Errors Mean %	Task Errors Std Dev %
	170.315(a)(14) IDL					
1	Add New Implantable Device	11	91%	30%	0%	0%
2	Access and change UDI and Status	11	82%	40%	0%	0%
3	Preview a list that contains UDIs, description and method to access UDIs	11	91%	30%	0%	0%
	170.315(b)(2) CIR					
4	Reconcile CCDA Problems	11	100%	0%	9%	30%
5	Reconcile CCDA Adverse Reactions	11	100%	0%	9%	30%
6	Reconcile CCDA Medications	11	100%	0%	0%	0%
7	Preview new CCDA with reconciled data	11	91%	30%	0%	0%

Table 9: Effectiveness – Group C

4.2.2 Efficiency

4.2.2.1 Group A

#	Tasks - Group A	Observed # Steps	Optimal # Steps	Task Time Observed Mean (seconds)	Task Time Std Dev (seconds)	Task Time Optimal (seconds)
	170.315(a)(9) Clinical decision support					
1	Access Clinical Reminders List.	2	2	7	4	13
2	Select a reminder and view details.	3	3	12	4	20
3	Resolve the reminder.	4	4	46	21	83
4	Refresh the Clinical Reminders list and confirm that the reminder has been resolved.	2	2	7	5	15
	170.315(a)(1) Computerized provider order entry—medications & 170.315(a)(4) Drug-drug, drug-allergy interaction checks					
5	Access the patient's Orders List.	2	2	5	1	7
6	Place order for Warfarin. Accept and sign the order. Refresh the list and view that the order has been added. (Successful order test)	12	12	71	31	127
7	Place order for Penicillin. Accept but do not sign the order. Confirm that the order has been added. (Test trigger for a drug-allergy alert)	14	14	45	6	63
8	Change the Penicillin order for to Erythromycin. (Test trigger for drug-drug interaction alert)	14	14	55	10	81
9	Accept and sign order. Confirm that the order has been added. (Test justification for bypassing the alert)	5	5	35	11	57
	170.315(a)(2) Computerized provider order entry—laboratory					
10	Access the patient's Orders List.	2	2	4	2	7
11	Place HgbA1c lab order. Accept but do not sign the order. Confirm that the order has been added.	6	6	47	8	68
12	Change the collection date of the HgbA1c order. Accept and sign the order.	5	5	38	7	56

#	Tasks - Group A	Observed # Steps	Optimal # Steps	Task Time Observed Mean (seconds)	Task Time Std Dev (seconds)	Task Time Optimal (seconds)
	170.315(a)(3) Computerized provider order entry—diagnostic imaging					
13	Access patient's Orders List.	2	2	4	3	8
14	Place order for x-ray of left ankle. Accept but do not sign the order. Confirm that the order has been added.	6	6	50	24	92
15	Change the Transport method to Stretcher. Accept and sign the order.	5	5	20	7	33

Table 10: Efficiency – Group A

4.2.2.2 Group B

#	Tasks - Group B	Observed # Steps	Optimal # Steps	Task Time Observed Mean (seconds)	Task Time Std Dev (seconds)	Task Time Optimal (seconds)
	170.315(a)(5) Demographics					
1	Register New Patient	16	15	282	105	483
2	Add Preferred Language to Existing Patient	11	10	73	29	127
3	Edit Patient Information	8	7	83	38	151
4	Add SO/GI Information	8	7	57	34	113
5	Edit SO/GI Information	7	7	50	18	85
6	Update Preliminary Cause of Death	13	12	74	29	128

Table 11: Efficiency – Group B

4.2.2.3 Group C

#	Tasks - Group C	Observed # Steps	Optimal # Steps	Task Time Observed Mean (seconds)	Task Time Std Dev (seconds)	Task Time Optimal (seconds)
	170.315(a)(14) IDL					
1	Add New Implantable Device	0.35	261	255	135	487
2	Access and change UDI and Status	0	61	61	55	145
3	Preview a list that contains UDIs, description and method to access UDIs	0	40	41	28	86
	170.315(b)(2) CIR					
4	Reconcile CCDA Problems	0.2	120	139	87	282
5	Reconcile CCDA Adverse Reactions	0.7	142	158	93	313
6	Reconcile CCDA Medications	0.35	122	129	55	230
7	Preview new CCDA with reconciled data	0.15	116	115	74	236

Table 12: Efficiency – Group C

4.2.3 Satisfaction

4.2.3.1 Group A

#	Tasks - Group A	# Participants	Task Rating Likert Scale	Task Rating Mean	Task Rating Std Dev
	170.315(a)(9) Clinical decision support				
1	Access Clinical Reminders List.	12	1-5	5	0
2	Select a reminder and view details.	12	1-5	5	0
3	Resolve the reminder.	12	1-5	5	0
4	Refresh the Clinical Reminders list and confirm that the reminder has been resolved.	12	1-5	5	0
	170.315(a)(1) Computerized provider order entry—medications & 170.315(a)(4) Drug-drug, drug-allergy interaction checks				
5	Access the patient's Orders List.	12	1-5	4.67	0.78
6	Place order for Warfarin. Accept and sign the order. Refresh the list and view that the order has been added. (Successful order test)	12	1-5	4.67	0.78
7	Place order for Penicillin. Accept but do not sign the order. Confirm that the order has been added. (Test trigger for a drug-allergy alert)	12	1-5	4.67	0.78
8	Change the Penicillin order for to Erythromycin. (Test trigger for drug-drug interaction alert)	12	1-5	4.67	0.78
9	Accept and sign order. Confirm that the order has been added. (Test justification for bypassing the alert)	12	1-5	4.67	0.78
	170.315(a)(2) Computerized provider order entry—laboratory				
10	Access the patient's Orders List.	12	1-5	4.83	0.58
11	Place HgbA1c lab order. Accept but do not sign the order. Confirm that the order has been added.	12	1-5	4.83	0.58
12	Change the collection date of the HgbA1c order. Accept and sign the order.	12	1-5	4.83	0.58
	170.315(a)(3) Computerized provider order entry—diagnostic imaging				
13	Access patient's Orders List.	12	1-5	4.67	1.15
14	Place order for x-ray of left ankle. Accept but do not sign the order. Confirm that the order has been added.	12	1-5	4.67	1.15
15	Change the Transport method to Stretcher. Accept and sign the order.	12	1-5	4.67	1.15

Table 13: Satisfaction – Group A

4.2.3.2 Group B

#	Tasks - Group B	# Participants	Task Rating Likert Scale	Task Rating Mean	Task Rating Std Dev
	170.315(a)(5) Demographics				
1	Register New Patient	11	1-5	4.82	0.60
2	Add Preferred Language to Existing Patient	11	1-5	4.82	0.60
3	Edit Patient Information	11	1-5	4.82	0.60
4	Add SO/GI Information	11	1-5	5.00	0.00
5	Edit SO/GI Information	11	1-5	5.00	0.00
6	Update Preliminary Cause of Death	11	1-5	5.00	0.00

Table 14: Satisfaction – Group B

4.2.3.3 Group C

#	Tasks - Group C	# Participants	Task Rating Likert Scale	Task Rating Mean	Task Rating Std Dev
	170.315(a)(14) IDL				
1	Add New Implantable Device	11	1-5	4.09	1.38
2	Access and change UDI and Status	11	1-5	3.91	1.64
3	Preview a list that contains UDIs, description and method to access UDIs	11	1-5	4.64	1.21
	170.315(b)(2) CIR				
4	Reconcile CCDA Problems	11	1-5	4.82	0.6
5	Reconcile CCDA Adverse Reactions	11	1-5	4.45	0.93
6	Reconcile CCDA Medications	11	1-5	4.82	0.6
7	Preview new CCDA with reconciled data	11	1-5	4.64	1.21

Table 15: Satisfaction – Group C

4.2.3.4 System Usability Scale (SUS)

The results from the System Usability Scale (SUS) from the post-test questionnaire, scored the subjective satisfaction with the system based on performance with the listed testing tasks by group.

System Usability Scale (SUS) Score	Score
Group A (a)(1)-(4); (a)(9)	73.13
Group B (a)(5)	90.68
Group C (a)(14) & (b)(2)	87.05

Table 16: SUS Scores

According to usability.gov, "[b]ased on research, a SUS score above a 68 would be considered above average and anything below 68 is below average".

4.2.4 Major Findings

4.2.4.1 Group A

Criteria/Module	Findings
(a)(1) CPOE – medications	All liked the Quick Order menus. Very valuable tool.
(a)(2) CPOE – laboratory	Easy to use. Consistent workflow.
(a)(3) CPOE – diagnostic imaging	Easy to use. Does not follow a logical tab order.
(a)(4) Drug-drug, drug-allergy interaction checks for CPOE	Some found the alerts to be too frequent and of little use. They can be bypassed and ignored. Alert fatigue causes some to turn it off completely.
(a)(9) Clinical decision support	Useful. Not flexible enough to be used beyond a limited set of functionalities. Needs more customization options. Great when it works but difficult to troubleshoot.

Table 17: Major Findings – Group A

4.2.4.2 Group B

Criteria/Module	Findings
(a)(5) Demographics	Participants liked that more than 1 ethnicity and race could be selected, as well as how many more options are available for ethnicity and race. Participants did not like the inconsistency of the form inputs. Overall, test participants found the criteria capabilities usable.

Table 18: Major Findings – Group B

4.2.4.3 Group C

Criteria/Module	Findings
(a)(14) Implantable device list	Nearly all test participants were new to this functionality. Even without experience, participants were able to successfully complete complex tasks. Usability can be improved. Form inputs are not consistent with similar inputs in the EHR or with industry standards. Most participants had trouble with the Imprecise Date Picker.
(b)(2) Clinical information reconciliation and incorporation	Form inputs are not consistent in labeling or functionality. Liked the addition of a "reviewed" indicator and a Set All Reviewed button. Much faster and more usable than before. It was unusable before the updates. Looking forward to using. CCDA document can be too long and tricky to navigate.

Table 19: Major Findings – Group C

4.2.5 Areas for Improvement

4.2.5.1 Group A

Criteria/Module	Findings
(a)(1) CPOE – medications	Clinical Indication box under Medication Order -- if a provider has not already added a diagnosis to the problem list and they search for it here, it does not also save to the problem list; this causes some providers frustration. Participants did not like that if POV is not added for acute visit, they have to go to dropdown menu and select what the medicine is treating.
(a)(2) CPOE – laboratory	'Order a Lab Test' screen – when a provider is searching a 'clinical indication' but has not added it to the problem list, there is no additional option to add it to the problem list from this screen.
(a)(3) CPOE – diagnostic imaging	Fix tab order of form fields. Improve form field labeling.
(a)(4) Drug-drug, drug-allergy interaction checks for CPOE	Would like to see a hard stop for alerts, something interactive that providers would have to read and acknowledge they have done before continuing. Better configuration for alerts to reduce alert fatigue.
(a)(9) Clinical decision support	Better training available on demand. Better documentation and training on troubleshooting procedures. Nurses have commented that they would like the capability to complete the note/dialogue associated with the reminder from the "Available Reminders" pop up box. Needs to be more flexible of configurable. Ability to set reminders as "Do not remind" or "No longer relevant".

Table 20: Areas for Improvement – Group A

4.2.5.2 Group B

Criteria/Module	Findings
(a)(5) Demographics	Fix consistency of design and functionality for form input fields. Not all drop-down menus look or function the same. Error messaging is too far from the input field. First "Remove" link for Ethnicity and Race is disabled but should be removed. Better instructions for form inputs. SO/GI checkbox groups should instruct user if it is single or multi-select.

Table 21: Areas for Improvement – Group B

4.2.5.3 Group C

Criteria/Module	Findings
(a)(14) Implantable device list	Make form inputs more consistent with similar inputs in the EHR or with industry standards. Most participants had trouble with the Imprecise Date Picker. Any form input that required the use of a dialog or widget was troublesome. For Imprecise Date Picker, participants wanted to type directly into the input without having to launch the date picker. Layout of the Add Implant Event form was confusing. Form labels were underneath the inputs which is not consistent with other forms in the EHR. Drop-down Menus do not have a function to clear the selection. Placement of tooltips hid menu options. Improve navigation of the CCDA review view. When user checks or unchecks a section, they are taken to the top of the CCDA preview.
(b)(2) Clinical information reconciliation and incorporation	Form inputs are not consistent in labeling or functionality. Liked the addition of a "reviewed" indicator and a Set All Reviewed button. Much faster and more usable than before. It was unusable before the updates. Looking forward to using. CCDA document can be too long and tricky to navigate

Table 22: Areas for Improvement – Group C

5.0 Acronym List

Acronym	Description
EHR	Electronic Health Record
CHIT	Certified Health Information Technology
UI	User Interface
IHS	Indian Health Service
ISO	International Organization for Standardization
NIST	National Institute of Standards and Technology
OIT	Office of Information Technology
RPMS	Resource and Patient Management System
SESS	Software Engineering Support Services

Table 23: Acronyms

6.0 Appendix A: Participant and Test Result Data

Participant Identifier	Participant Gender	Participant Age	Participant Education	Participant Occupation/Role	Participant Professional Experience (months)	Participant Computer Experience (months)	Participant Product Experience (months)	Participant Assistive Technology Needs
Group A - 14	Female	30-39	Doctorate degree	General Pediatrician	24	25	24	No
Group A - 1	Female	40-49	Master's degree	Registered Nurse/Case Manager	168	60	96	No
Group A - 12	Female	30-39	Doctorate and Master's degree	Clinical Applications Coordinator	120	60	120	No
Group A - 11	Male	30-39	Master's degree	Chief of Staff, Physician Assistant/Informatics	48	60	48	No
Group A - 8	Female	30-39	Doctorate degree	Clinical Informaticist	168	25	168	No
Group A - 3	Male	30-39	Doctorate degree	Clinical Informaticist	144	60	144	No
Group A - 4	Female	40-49	Doctorate degree	Clinical Applications Coordinator	240	60	240	No
Group A - 13	Male	40-49	Doctorate degree	Clinical Informaticist	180	60	204	No
Group A - 7	Female	30-39	Doctorate degree	Family Medicine Physician	24	25	24	No
Group A - 15	Male	50-59	Doctorate degree	Physician	120	60	120	No
Group A - 6	Male	40-49	Doctorate and Master's degree	Clinical Informaticist	360	60	360	No
Group A - 9	Female	40-49	Bachelor's degree	Nurse Informaticist	252	60	252	No
Group B - 2	Female	30-39	Bachelor's degree	Business Office Manager	72	60	72	No
Group B - 10	Male	30-39	Associate degree	IT Specialist	192	60	180	No
Group B - 5	Male	50-59	Associate degree	IT Specialist, CAC	216	60	192	No
Group B - 7	Female	40-49	Bachelor's degree	Supervisory Health Systems Specialist	228	25	228	No
Group B - 8	Female	30-39	Some college credit, no degree; Trade/technical/vocational training	MSA	12	25	12	No
Group B - 1	Female	30-39	Associate degree	Registration Supervisor	24	25	24	No
Group B - 9	Female	20-29	Some college credit, no degree	MSA	9	25	9	No
Group B - 11	Female	40-49	high school graduate, diploma or the equivalent	Administrative Support Assistant	96	25	96	No
Group B - 6	Female	40-49	Some college credit, no degree	Supervisory Medical Support Assistant	144	60	144	No
Group B - 12	Female	40-49	Associate Degree	Supervisory Medical Support Assistant	120	25	120	No
Group B – 3	Female	40-49	Some college credit, no degree	IT Specialist/Application Coordinator	240	60	240	No
Group C - 6	Male	40-49	Doctorate and Master's degree	Clinical Informaticist	360	60	360	No
Group C - 9	Female	40-49	Bachelor's degree	Nurse Informaticist	252	60	252	No
Group C - 8	Female	30-39	Doctorate degree	Clinical Informaticist	168	25	168	No
Group C - 5	Female	60-69	Master's degree	Clinical Application Coordinator	240	60	240	No
Group C - 14	Female	30-39	Doctorate degree	General Pediatrician	24	25	24	No
Group C - 13	Male	40-49	Doctorate degree	Clinical Informaticist	180	60	204	No

Participant Identifier	Participant Gender	Participant Age	Participant Education	Participant Occupation/Role	Participant Professional Experience (months)	Participant Computer Experience (months)	Participant Product Experience (months)	Participant Assistive Technology Needs
Group C - 20	Male	40-49	Doctorate degree	Health Systems Analyst	120	60	120	No
Group C - 17	Male	30-39	Doctorate degree	Physician/Medical Officer	72	60	72	No
Group C - 10	Male	50-59	Associate degree	IT Specialist, Clinical Application Coordinator	216	60	108	No
Group C - 19	Male	30-39	Doctorate degree	Clinical Informaticist	132	60	132	No
Group C - 2	Female	30-39	Bachelor's degree	Supervisory Clinical Nurse	96	60	96	No

Test Group	Task	Task Success Rate - Mean (%)	Task Success Rate - Standard Deviation (%)	Mean observed number of steps taken for the corresponding task	Optimal number of steps for the corresponding task
	170.315(a)(9) Clinical decision support				
A	1. Access Clinical Reminders List.	100%	0%	2	2
A	2. Select a reminder and view details.	100%	0%	3	3
A	3. Resolve the reminder.	100%	0%	4	4
A	4. Refresh the Clinical Reminders list and confirm that the reminder has been resolved.	100%	0%	2	2
A	**170.315(a)(1) Computerized provider order entry—medications, 170.315(a)(4) Drug-drug, drug-allergy interaction checks**				
A	5. Access the patient's Orders List.	100%	0%	2	2
A	6. Place order for Warfarin. Accept and sign the order. Refresh the list and view that the order has been added. (Successful order test)	100%	0%	12	12
A	7. Place order for Penicillin. Accept but do not sign the order. Confirm that the order has been added. (Test trigger for a drug-allergy alert)	100%	0%	14	14
A	8. Change the Penicillin order for to Erythromycin. (Test trigger for drug-drug interaction alert)	100%	0%	14	14
A	9. Accept and sign order. Confirm that the order has been added. (Test justification for bypassing the alert)	100%	0%	5	5
A	**170.315(a)(2) Computerized provider order entry—laboratory**				
A	10. Access the patient's Orders List.	100%	0%	2	2
A	11. Place HgbA1c lab order. Accept but do not sign the order. Confirm that the order has been added.	100%	0%	6	6
A	12. Change the collection date of the HgbA1c order. Accept and sign the order.	100%	0%	5	5
A	**170.315(a)(3) Computerized provider order entry—diagnostic imaging**				
A	13. Access patient's Orders List.	92%	29%	2	2
A	14. Place order for x-ray of left ankle. Accept but do not sign the order. Confirm that the order has been added.	92%	29%	6	6
A	15. Change the Transport method to Stretcher. Accept and sign the order.	92%	29%	5	5

Test Group	Task	Task Success Rate - Mean (%)	Task Success Rate - Standard Deviation (%)	Mean observed number of steps taken for the corresponding task	Optimal number of steps for the corresponding task
B	**170.315(a)(5) Demographics**				
B	1. Register New Patient	100%	0%	16	15
B	2. Add Preferred Language to Existing Patient	100%	0%	11	10
B	3. Edit Patient Information	100%	0%	8	7
B	4. Add SO/GI Information	100%	0%	8	7
B	5. Edit SO/GI Information	100%	0%	7	7
B	6. Update Preliminary Cause of Death	100%	0%	13	12
C	**170.315(a)(14) IDL**				
C	1. Add New Implantable Device	91%	30%	16	15
C	2. Access and change UDI and Status	82%	40%	6	6
C	3. Preview a list that contains UDIs, description, and method to access UDIs	91%	30%	5	5
C	**170.315(b)(2) CIR**				
C	4. Reconcile CCDA Problems	100%	0%	11	10
C	5. Reconcile CCDA Adverse Reactions	100%	0%	14	12
C	6. Reconcile CCDA Medications	100%	0%	16	15
C	7. Preview new CCDA with reconciled data	91%	30%	5	5

Task	Mean Task Time (seconds)	Standard Deviation for Task Time (seconds)	Observed Task Time (seconds)	Optimal Task Time (seconds)
170.315(a)(9) Clinical decision support				
1. Access Clinical Reminders List.	7	4	8	13
2. Select a reminder and view details.	12	4	8	20
3. Resolve the reminder.	46	21	38	83
4. Refresh the Clinical Reminders list and confirm that the reminder has been resolved.	7	5	5	15
170.315(a)(1) Computerized provider order entry—medications, 170.315(a)(4) Drug-drug, drug-allergy interaction checks				
5. Access the patient's Orders List.	5	1	5	7
6. Place order for Warfarin. Accept and sign the order. Refresh the list and view that the order has been added. (Successful order test)	71	31	45	127
7. Place order for Penicillin. Accept but do not sign the order. Confirm that the order has been added. (Test trigger for a drug-allergy alert)	45	6	42	63
8. Change the Penicillin order for to Erythromycin. (Test trigger for drug-drug interaction alert)	55	10	44	81
9. Accept and sign order. Confirm that the order has been added. (Test justification for bypassing the alert)	35	11	24	57
170.315(a)(2) Computerized provider order entry—laboratory				
10. Access the patient's Orders List.	4	2	2	7
11. Place HgbA1c lab order. Accept but do not sign the order. Confirm that the order has been added.	47	8	42	68
12. Change the collection date of the HgbA1c order. Accept and sign the order.	38	7	34	56
170.315(a)(3) Computerized provider order entry—diagnostic imaging				
13. Access patient's Orders List.	4	3	3	8
14. Place order for x-ray of left ankle. Accept but do not sign the order. Confirm that the order has been added.	50	24	51	92
15. Change the Transport method to Stretcher. Accept and sign the order.	20	7	27	33
170.315(a)(5) Demographics				
1. Register New Patient	282	105	223	483
2. Add Preferred Language to Existing Patient	73	29	58	127
3. Edit Patient Information	83	38	53	151
4. Add SO/GI Information	57	34	47	113
5. Edit SO/GI Information	50	18	37	85
6. Update Preliminary Cause of Death	74	29	113	128

Task	Mean Task Time (seconds)	Standard Deviation for Task Time (seconds)	Observed Task Time (seconds)	Optimal Task Time (seconds)
170.315(a)(14) IDL				
1. Add New Implantable Device	255	135	263	487
2. Access and change UDI and Status	61	55	35	145
3. Preview a list that contains UDIs, description, and method to access UDIs	41	28	30	86
170.315(b)(2) CIR				
4. Reconcile CCDA Problems	139	87	101	282
5. Reconcile CCDA Adverse Reactions	158	93	130	313
6. Reconcile CCDA Medications	129	55	77	230
7. Preview new CCDA with reconciled data	115	74	154	236

Task	Mean Task Errors (%)	Standard Deviation of Task Errors (%)
170.315(a)(9) Clinical decision support		
1. Access Clinical Reminders List.	0%	0%
2. Select a reminder and view details.	0%	0%
3. Resolve the reminder.	0%	0%
4. Refresh the Clinical Reminders list and confirm that the reminder has been resolved.	0%	0%
170.315(a)(1) Computerized provider order entry—medications, 170.315(a)(4) Drug-drug, drug-allergy interaction checks		
5. Access the patient's Orders List.	0%	0%
6. Place order for Warfarin. Accept and sign the order. Refresh the list and view that the order has been added. (Successful order test)	0%	0%
7. Place order for Penicillin. Accept but do not sign the order. Confirm that the order has been added. (Test trigger for a drug-allergy alert)	0%	0%
8. Change the Penicillin order for to Erythromycin. (Test trigger for drug-drug interaction alert)	0%	0%
9. Accept and sign order. Confirm that the order has been added. (Test justification for bypassing the alert)	0%	0%
170.315(a)(2) Computerized provider order entry—laboratory		
10. Access the patient's Orders List.	0%	0%
11. Place HgbA1c lab order. Accept but do not sign the order. Confirm that the order has been added.	0%	0%
12. Change the collection date of the HgbA1c order. Accept and sign the order.	0%	0%
170.315(a)(3) Computerized provider order entry—diagnostic imaging		
13. Access patient's Orders List.	0%	0%
14. Place order for x-ray of left ankle. Accept but do not sign the order. Confirm that the order has been added.	0%	0%
15. Change the Transport method to Stretcher. Accept and sign the order.	0%	0%
170.315(a)(5) Demographics		
1. Register New Patient	0%	0%
2. Add Preferred Language to Existing Patient	0%	0%
3. Edit Patient Information	9%	30%
4. Add SO/GI Information	0%	0%
5. Edit SO/GI Information	0%	0%
6. Update Preliminary Cause of Death	0%	0%

Task	Mean Task Errors (%)	Standard Deviation of Task Errors (%)
170.315(a)(14) IDL		
1. Add New Implantable Device	0%	0%
2. Access and change UDI and Status	0%	0%
3. Preview a list that contains UDIs, description, and method to access UDIs	0%	0%
170.315(b)(2) CIR		
4. Reconcile CCDA Problems	9%	30%
5. Reconcile CCDA Adverse Reactions	9%	30%
6. Reconcile CCDA Medications	0%	0%
7. Preview new CCDA with reconciled data	0%	0%

Task	Task Rating - Scale Type	Mean Task Rating (1-5)	Mean Task Rating Standard Deviation (1-5)
170.315(a)(9) Clinical decision support			
1. Access Clinical Reminders List.	Likert Scale	5	0
2. Select a reminder and view details.	Likert Scale	5	0
3. Resolve the reminder.	Likert Scale	5	0
4. Refresh the Clinical Reminders list and confirm that the reminder has been resolved.	Likert Scale	5	0
170.315(a)(1) Computerized provider order entry—medications, 170.315(a)(4) Drug-drug, drug-allergy interaction checks			
5. Access the patient's Orders List.	Likert Scale	4.67	0.78
6. Place order for Warfarin. Accept and sign the order. Refresh the list and view that the order has been added. (Successful order test)	Likert Scale	4.67	0.78
7. Place order for Penicillin. Accept but do not sign the order. Confirm that the order has been added. (Test trigger for a drug-allergy alert)	Likert Scale	4.67	0.78
8. Change the Penicillin order for to Erythromycin. (Test trigger for drug-drug interaction alert)	Likert Scale	4.67	0.78
9. Accept and sign order. Confirm that the order has been added. (Test justification for bypassing the alert)	Likert Scale	4.67	0.78
170.315(a)(2) Computerized provider order entry—laboratory			
10. Access the patient's Orders List.	Likert Scale	4.83	0.58
11. Place HgbA1c lab order. Accept but do not sign the order. Confirm that the order has been added.	Likert Scale	4.83	0.58
12. Change the collection date of the HgbA1c order. Accept and sign the order.	Likert Scale	4.83	0.58
170.315(a)(3) Computerized provider order entry—diagnostic imaging			
13. Access patient's Orders List.	Likert Scale	4.67	1.15
14. Place order for x-ray of left ankle. Accept but do not sign the order. Confirm that the order has been added.	Likert Scale	4.67	1.15
15. Change the Transport method to Stretcher. Accept and sign the order.	Likert Scale	4.67	1.15

Task	Task Rating - Scale Type	Mean Task Rating (1-5)	Mean Task Rating Standard Deviation (1-5)
170.315(a)(5) Demographics			
1. Register New Patient	Likert Scale	4.82	0.60
2. Add Preferred Language to Existing Patient	Likert Scale	4.82	0.60
3. Edit Patient Information	Likert Scale	4.82	0.60
4. Add SO/GI Information	Likert Scale	5.00	0.00
5. Edit SO/GI Information	Likert Scale	5.00	0.00
6. Update Preliminary Cause of Death	Likert Scale	5.00	0.00
170.315(a)(14) IDL			
1. Add New Implantable Device	Likert Scale	4.09	1.38
2. Access and change UDI and Status	Likert Scale	3.91	1.64
3. Preview a list that contains UDIs, description, and method to access UDIs	Likert Scale	4.64	1.21
170.315(b)(2) CIR			
4. Reconcile CCDA Problems	Likert Scale	4.82	0.6
5. Reconcile CCDA Adverse Reactions	Likert Scale	4.45	0.93
6. Reconcile CCDA Medications	Likert Scale	4.82	0.6
7. Preview new CCDA with reconciled data	Likert Scale	4.64	1.21

IHS RESOURCE AND PATIENT MANAGEMENT SYSTEM

SUMMATIVE USABILITY TESTING REPORT

Version: 2.0

Date: 8/18/2021

Dates of Testing: 6/1/2021-6/11/2021

System Test Laboratory:

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1.0 Executive Summary

A summative usability test (hereinafter referred to as “usability test”) of the Electronic Heath Record (EHR) application was conducted during the months of May and June 2021 as part of the 21st Century Cures Act (21st CCA) (g)(3) Safety-Enhanced Design criterion. The purpose of this test was to evaluate and validate the usability of the current user interface, and provide evidence of user-centered design (UCD) practices in the application.

During the usability test, healthcare providers and other users matching the target demographic criteria participated in summative usability testing for each safety-enhanced design criterion and the associated capabilities.

This study collected performance data on the top tasks as identified by the owners of the criteria to be tested.

The criteria included in this test report are:

- (b)(3) ePrescribing (eRX)

During the approximately 60-minute one-on-one usability test sessions, each participant was greeted by the administrator who introduced the test. Participants were asked to share their prior EHR experience. The administrator logged in to the application and then passed control over to the participant to complete a series of tasks (given one at a time) using the application.

During each test session, the administrator timed the test and recorded user performance data. Participant screens and audio were also recorded for subsequent analysis.

The following types of data were collected for each participant:

- Demographic data
- Number of tasks successfully completed
- Time to complete the tasks
- Number and types of errors
- Path deviations
- Participant’s verbalizations (comments)
- Participant’s satisfaction ratings of the system

All participant data was de-identified so that no correspondence could be made from the identity of the participant to the data collected.

The test method and metrics were based on the National Institute of Standards and Technology (NIST) Guide to the Processes Approach for Improving the Usability of Electronic Health Records (NISTIR 7741). Modifications were made where necessary to better evaluate the application against the contract goals and requirements. Following the conclusion of the test, participants were asked to complete a post-test questionnaire and were thanked for their participation.

The Task Satisfaction Rating is based on the following pre-defined of 1 (Very Difficult) to 5 (Very Easy). These data are averaged across participants.

1.1 Major Findings

Based on the score of the Task Satisfaction Rating, the participants found the eRX component of the EHR easy to use.

Participants did state that the initial learning curve is steep and training is necessary. However, once they learned to use the application, participants completed tasks with great efficiency and effectiveness.

Most test participants felt the components were consistent and functioned as expected. The majority found the RPMS EHR to be an effective tool for completing their work tasks.

The top issues the test participants remarked on were:

- Font size and contrast made readability difficult
- Text was unable to be resized
- Button and menu text was not clear or intuitive
- More instructions especially for the functionality of the notes area that activates the action buttons (i.e. Approve, Accept, etc.)
- The right-click menus are not intuitive. Users did not know that they had to right-click to find the available actions

Tasks	Task Success	Task Satisfaction Rating (Scale 0-2)
	Mean %	% Rated 2 – Completed Easily
1. Create new prescription	100%	91%
2. Change prescription	91%	82%
3. Renew prescription	100%	82%
4. Cancel prescription	100%	100%

Table 1: Criteria Success and Satisfaction Rating Summary

1.2 Recommendations

Specific recommendations for the criteria are as follows:

- Default font size and contrast should be readable enough to meet Web Content Accessibility Guidelines (WCAG) 2.0 Level AA success criterion 1.4.3 Contrast (Minimum)
- Text size should be able to be increased by the end user to a minimum of 200% to meet WCAG 2.0 Level AA success criterion 1.4.4 Resize text
- Review all micro text to ensure that meaning and intent is clear
- Spell out acronyms
- Add clear and understandable instructions, hints or tool tips for complex or unintuitive actions. Examples of such actions include right-clicking on a change request to see the options available, and scrolling down to the bottom of a page to activate an approval button.

General recommendations for future development suggest that usability activities continue to be part of the development process for projects and/or products that involve user interfaces, and that usability lessons learned continue to be documented for potential future improvements.

2.0 Introduction

The Office of the National Coordinator for Health Information Technology (ONC) Health IT Certification Program is a voluntary certification program established by the Office of the National Coordinator for Health IT to provide for the certification of health IT.

The Indian Health Service (IHS) Office of Information Technology (OIT) has requested that the Resource and Patient Management System Electronic Health Record (RPMS EHR) achieve certification as part of the 21st CCA. As part of the certification criteria, (g)(3) Safety-Enhanced Design requires that summative usability testing be performed on specific criteria and the test data be provided as part of a final test report. The test report will follow the National Institute of Standards and Technology (NIST) Customized Common Industry Format Template for Electronic Health Record Usability Testing (NISTIR 7742).

Summative usability testing is a task-based evaluation that measures the ease of use of a completed product. The results are analyzed and compared to the usability requirements to determine if those requirements have been met.

2.1 Purpose

The purpose of this test was to evaluate and validate each safety-enhanced design criterion and the associated capabilities. The test ensures that the completed product meets the 21st CCA certification requirements concerning user-centered and safety-enhanced design.

2.2 Scope

The scope of usability testing is limited to testing user-involved tasks. Automated tasks or tasks without user interaction are not covered in this test. Functional testing is not covered in detail. Functionality is only tested as it pertains to the usability of the product or feature being tested.

The test was limited in scope to the following criterion:

- (b)(3) ePrescribing

3.0 Method

See Appendix A for Participant and Test data.

The test method and metrics were based on the NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records (NISTIR 7741). Modifications were made where necessary to better evaluate the application against the contract goals and requirements.

The objective of this test was to uncover areas where the application performed well and areas where the application failed to meet the usability 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 capability and/or comparison with other EHR capabilities provided the same tasks are used. This testing serves as both a means to record or benchmark current usability and to identify areas where improvements must be made.

The application was evaluated for effectiveness, efficiency and satisfaction as defined by measures collected and analyzed for each participant:

- Number of tasks successfully completed
- Time to complete the tasks
- Number and types of errors
- Path deviations
- Participant's verbalizations (comments)
- Participant's satisfaction ratings of the system (Task Satisfaction Rating)
    - 1(Very Difficult to 5 (Very Easy)

3.1 Roles and Responsibilities

Role/Function	Responsibilities
Project Manager/Criteria Owner	Responsible for the management, monitoring and tracking of the project and oversees all areas.
Usability Test Lead / Test Administrator	• Ensures that usability testing is conducted successfully and meets all usability testing deadlines. • Provides application systems analysis for application testing activities. • Prepares required documentation at the program level for testing activities. • Monitors and escalates risks or concerns about achieving goals or meeting schedules to program leadership. • Prepares all testing instructions, scripts and materials for use in the testing session. • Performs analysis of testing results, prepares and delivers test report. • Moderates the test • Collects test data
Test Observers	• Provide any needed training or support • Monitor the testing session
Test Participants	• Complete the assigned tasks • Provide honest feedback on their experience

Table 3: Roles and Responsibilities

3.1.1 Test Participants

There was a total of 11 test participants for this round of testing.

Participants in this test were:

- typical end-users such as physicians and medical providers
- trained to use the application prior to usability testing
- recruited by the 21st CCA project team and IHS criteria owners
- not compensated for participation
- had no direct connection to the development of the application
- given the same orientation and level of training as the actual end users
- assigned a participant ID initially based on scheduling order

Once participants were identified, they were scheduled for 60-minute one-on-one web conferencing (Skype, Adobe Connect) sessions. A calendar was used to keep track of the participants' schedule and a spreadsheet tracked participants' location (site) and contact information.

3.2 Test Location

The test was conducted remotely via the use of video conferencing and desktop sharing software (Microsoft Skype for Business, Adobe Connect).

3.3 Test Environment

The test participants were physically located at their normal duty stations, logged into their assigned workstations, and connected to the video conferencing software. The test administrator and observers were also physically distributed and connected via video conferencing software.

The test administrator shared his screen and was the only desktop visible during testing. Participants were given control of the test application through the test administrator's screen and used a mouse and keyboard when interacting with the application.

Technically, the system performance (i.e., response time) was not representative to what actual users would experience in a field implementation, as they were working through the test administrator's workstation and not their own.

3.4 Test Tools

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

1. Demographic Questionnaire
2. Moderator's Guide
3. Post-test Questionnaire

The Moderator's Guide was devised so as to capture the required data.

Video conferencing software (MS Skype, Adobe Connect) was used to connect participants, the administrator and observers. This software was also used to record the video and audio of test sessions.

3.5 Tasks

The testing scenarios and tasks were constructed to be realistic and representative of the kinds of activities a user would perform using the capabilities being tested. Tasks were chosen with the test objectives in mind to ensure that participants provided the most meaningful data possible. The tasks were arranged to facilitate a typical end-user workflow.

The testing tasks include:

1. Create new prescription
2. Change prescription
3. Renew prescription
4. Cancel prescription

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

3.6 Procedure

Upon arrival, each participant was greeted by the administrator and matched to a name on the participant schedule. The participant was then assigned a participant ID.

The test administrator moderated the test session including administering instructions and tasks. The administrator also monitored task times, obtained post-task rating data, and took notes on participant comments.

Each participant was instructed to perform the tasks:

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

Each participant used the same application version and was provided with the same set of instructions.

The administrator logged into the test environment and then instructed the user to request control. After log in, the user was instructed to complete a series of tasks (given one at a time) using the application. The participant was given a written copy of each task, and the administrator also read each task aloud and ensured the participant understood the task.

Task timing began once the administrator finished reading the question. The task time was stopped once the participant indicated that the task was successfully completed.

Scoring is discussed in Section 3.7 Usability Metrics.

After completion of the testing tasks, the administrator gave the participant a post-test questionnaire (System Usability Scale), asked if they had any questions, and thanked them for their participation.

Each participant’s demographic information, task success rate, time on task, errors, deviations, verbal responses, and post-test questionnaire ratings were recorded into the participant spreadsheet.

Following each test session, the video recordings were reviewed and checked against the data logged in the participant spreadsheet. The participant spreadsheet was updated with any edits or additional information such as verbalizations.

3.7 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 by measuring participant success rates and errors
2. Efficiency by measuring the average task time and path deviations
3. Satisfaction by measuring task satisfaction ratings and SUS scores

3.7.1 Data Scoring

The following table (Table 4) details how tasks were scored, errors evaluated, and the time data analyzed.

Measures	Rationale and Scoring
Effectiveness: Task Success	A task was counted as a "Success" if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis. The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage. Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency. Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target task times used for task times in the Moderator's Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by some factor [e.g., 1.25] that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was [x] seconds then allotted task time performance was [x * 1.25] seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.
Effectiveness: Task Failures	If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as a "Failures." No task times were taken for errors. The total number of errors was calculated for each task and then divided by the total number of times that task was attempted. Not all deviations would be counted as errors.[11] This should also be expressed as the mean number of failed tasks per participant. On a qualitative level, an enumeration of errors and error types should be collected.

Measures	Rationale and Scoring
Efficiency: Task Deviations	The participant's path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.
Satisfaction: **Task Satisfaction Rating**	Participant's subjective impression of the ease of use of the application was measured by administering both a simple post-task question as well as a post-session questionnaire. After each task, the participant was asked to rate "Overall, this task was:" on a scale of 1 (Very Difficult) to 5 (Very Easy). These data are averaged across participants. Common convention is that average ratings for systems judged easy to use should be 3.3 or above. To measure participants' confidence in and likeability of the system overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, "I think I would like to use this system frequently," "I thought the system was easy to use," and "I would imagine that most people would learn to use this system very quickly."

Table 4: Measure Scoring

4.0 Results

4.1 Data Analysis and Reporting

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above.

Participants who failed to follow session and task instructions had their data excluded from the analyses.

4.2 Discussion of Findings

Based on the score of the Task Satisfaction Rating, the participants found the EHR easy to use. Participants did state that the initial learning curve is steep and training is necessary. However, once they learned to use the application, participants completed tasks with great efficiency and effectiveness.

The path taken to complete the tasks differed from participant to participant. This was influenced by the differing configuration of the test sites' EHR UIs. In spite of the varied paths to complete tasks, time per task was minimal and consistent, and errors were virtually non-existent.

All test participants felt the components were consistent and functioned as expected. The majority found the RPMS EHR to be an effective tool for completing their work tasks. Most said they would recommend this EHR to their colleagues.

The top issues the test participants remarked on were:

- Font size and contrast made readability difficult
- Text was unable to be resized
- Button and menu text was not clear or intuitive
- More instructions especially for the functionality of the notes area that activates the action buttons (i.e. Approve, Accept, etc.)
- The right-click menus are not intuitive. Users did not know that they had to right-click to find the available actions

4.2.1 Effectiveness

#	Tasks	# Participants	Task Success Rate - Mean %	Task Success Rate - Std Dev %	Task Errors Mean %	Task Errors Std Dev %
	(b)(3) ePrescribing					
1	Create new prescription	11	100%	0%	0%	47%
2	Change prescription	11	91%	30%	0%	52%
3	Renew prescription	11	100%	0%	0%	50%
4	Cancel prescription	11	100%	0%	0%	0%

Table 5: Effectiveness

4.2.2 Efficiency

#	Tasks	Observed # Steps	Optimal # Steps	Task Time Observed Mean (seconds)	Task Time Std Dev (seconds)	Task Time Optimal (seconds)
	(b)(3) ePrescribing					
1	Create new prescription	12	11	207	161	250
2	Change prescription	12	12	146	52	236
3	Renew prescription	14	14	128	42	180
4	Cancel prescription	4	4	46	15	90

Table 6: Efficiency

4.2.3 Satisfaction

#	Tasks	# Participants	Task Rating Likert Scale	Task Rating Mean	Task Rating Std Dev
	(b)(3) ePrescribing				
1	Create new prescription	11	1-5	4.82	0.60
2	Change prescription	11	1-5	4.45	1.29
3	Renew prescription	11	1-5	4.64	0.81
4	Cancel prescription	11	1-5	5.00	0.00

Table 7: Satisfaction

4.2.3.1 System Usability Scale (SUS)

The results from the System Usability Scale (SUS) from the post-test questionnaire, scored the subjective satisfaction with the system based on performance with the listed testing tasks by group.

System Usability Scale (SUS) Score	Score
(b)(3) ePrescribing	77.05

Table 8: SUS Scores

According to usability.gov, "[b]ased on research, a SUS score above a 68 would be considered above average and anything below 68 is below average".

4.2.4 Major Findings

Based on the score of the Task Satisfaction Rating, the participants found the eRx component of the EHR easy to use.

Participants did state that the initial learning curve is steep and training is necessary. However, once they learned to use the application, participants completed tasks with great efficiency and effectiveness.

Most test participants felt the components were consistent and functioned as expected. The majority found the RPMS EHR to be an effective tool for completing their work tasks.

The top issues the test participants remarked on were:

- Font size and contrast made readability difficult
- Text was unable to be resized
- Button and menu text was not clear or intuitive
- More instructions especially for the functionality of the notes area that activates the action buttons (i.e. Approve, Accept, etc.)
- The right-click menus are not intuitive. Users did not know that they had to right-click to find the available actions

4.2.5 Recommendations

Overall recommendations focus on more effectively communication meaning to the end user, as well as enhancing readability. Specific recommendations for the criteria are as follows:

- Default font size and contrast should be readable enough to meet Web Content Accessibility Guidelines (WCAG) 2.0 Level AA success criterion 1.4.3 Contrast (Minimum)
- Text size should be able to be increased by the end user to a minimum of 200% to meet WCAG 2.0 Level AA success criterion 1.4.4 Resize text
- Review all micro text to ensure that meaning and intent is clear
- Spell out acronyms
- Add clear and understandable instructions, hints or tool tips for complex or unintuitive actions. Examples of such actions include right-clicking on a change request to see the options available, and scrolling down to the bottom of a page to activate an approval button.

5.0 Acronym List

Acronym	Description
CCA	21st Century Cures Act
EHR	Electronic Health Record
eRX	ePrescribing
IHS	Indian Health Service
ISO	International Organization for Standardization
NIST	National Institute of Standards and Technology
OIT	Office of Information Technology
RPMS	Resource and Patient Management System
SESS	Software Engineering Support Services
UI	User Interface
WCAG	Web Content Accessibility Guidelines

Table 23: Acronyms

6.0 Appendix A: Participant and Test Result Data

Participant Identifier	Participant Gender	Participant Age	Participant Education	Participant Occupation/Role	Participant Professional Experience (months)	Participant Computer Experience (months)	Participant Product Experience (months)	Participant Assistive Technology Needs
TP1	Female	30-39	Pharm D	Clinical Informaticist	20	8	16	None
TP2	Female	40-49	Master's Degree	Clinical Informaticist	27	13	13	None
TP3	Female	40-49	Bachelor's Degree	Clinical Nurse Case Manager	30	18	9	None
TP5	Male	40-49	Doctorate, Master's Degree	Health Informaticist	30	13	13	None
TP8	Female	30-39	Doctorate	Pediatrician	25	5	2	None
TP9	Male	40-49	Pharm D	Health Systems Specialist	25	2	10	None
TP10	Male	50-59	Doctorate	Subject Matter Expert Physician	30	2	15	None
TP13	Male	50-59	AA Degree	IT Specialist, CAC	35	6	1	None
TP14	Female	30-39	Bachelor's Degree	Nurse Consultant	30	1	9	None
TP15	Male	40-49	Pharm D	Pharmacy Consultant, Clinical Informaticist	40	15	25	None
TP17	Male	70-79	Doctorate	Subject Matter Expert Physician	40	3	19	None

Task	Task Success Rate - Mean (%)	Task Success Rate - Standard Deviation (%)	Mean observed number of steps taken for the corresponding task	Optimal number of steps for the corresponding task
1. Create new prescription	100%	0%	12	11
2. Change prescription	91%	30%	12	12
3. Renew prescription	100%	0%	14	14
4. Cancel prescription	100%	0%	4	4

Task	Task Rating - Scale Type	Mean Task Rating (1-5)	Mean Task Rating Standard Deviation (1-5)
1. Create new prescription	Likert Scale	4.82	0.60
2. Change prescription	Likert Scale	4.45	1.29
3. Renew prescription	Likert Scale	4.64	0.81
4. Cancel prescription	Likert Scale	5.00	0.00

Task	Mean Task Time (seconds)	Standard Deviation for Task Time (seconds)	Observed Task Time (seconds)	Optimal Task Time (seconds)
1. Create new prescription	207	161	159	250
2. Change prescription	146	52	113	236
3. Renew prescription	128	42	95	180
4. Cancel prescription	46	15	42	90

Task	Mean Task Errors (%)	Standard Deviation of Task Errors (%)
1. Create new prescription	27%	47%
2. Change prescription	45%	52%
3. Renew prescription	36%	50%
4. Cancel prescription	0%	0%

IHS RESOURCE AND PATIENT MANAGEMENT SYSTEM

Health Information Technology Systems and Support

Summative Usability Testing

Report

Version 1.0
November 2024

Office of Information Technology
Division of Information Technology

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Preface

This document presents the Summative Usability Testing for §170.315 (b)(11) Decision Support Intervention for the IHS Resource and Patient Management System Electronic Health Record BCER v8.2 application.

1.0 Executive Summary

From September 24, 2024, through October 3, 2024, a summative usability test of the IHS Resource and Patient Management System Electronic Health Record BCER v8.2 application evaluated new Clinical Reminder features: Source Attributes, and the Clinical Reminder Feedback form. This test aimed to validate the User-Centered Design (UCD) of these updates in alignment with the Health Data, Technology, and Interoperability (HTI-1) program requirements, which emphasize certification, transparency, and safety. Results support that the EHR's updated features meet UCD best practices, addressing both §170.315(g)(3) Safety-enhanced design and §170.315(b)(11) Decision Support Intervention (DSI) certification criteria. The UCD is functional, accessible and intuitive.

The intended users for this application are healthcare providers and healthcare management. This study collected performance data tasks identified by the project team and involved participants matching the target demographic criteria.

During the approximately 60-minute one-on-one usability test sessions, each participant was greeted by the administrator who introduced the test. The participant logged in to the application to complete a series of tasks (given one at a time) using the application.

During each test session, the administrator timed the test and recorded user performance data. Participant screens and audio were also recorded for subsequent analysis.

The following types of data were collected for each participant:

- Demographic data
- Number of tasks successfully completed
- Time to complete the tasks
- Number and types of errors
- Path deviations
- Participant's verbalizations (comments)
- Participant's satisfaction ratings of the system

All participant data was de-identified so that no correspondence could be made from the identity of the participant to the data collected.

The test method and metrics were based on the National Institute of Standards and Technology (NIST) Guide to the Processes Approach for Improving the Usability of Electronic Health Records (NISTIR 7741)[i]. The NISTIR 7741, provides a detailed set of guidelines to improve the usability, safety, and effectiveness of EHR systems. These guidelines focus on human-centered design principles to enhance user interaction, reduce errors, and optimize workflow efficiency in clinical environments. This report outlines best practices, usability evaluation methods, and design principles to ensure EHRs support healthcare providers effectively while improving patient care.

Following the conclusion of the test, participants were asked to complete a post-test questionnaire and were thanked for their participation.

The Task Satisfaction Rating is based on the following pre-defined scale:

- 0 – The tester is unable to complete the task.
- 1 – The tester is able to complete the task with some difficulty.
- 2 – The tester is able to complete the task easily.

1.1 Major Findings

Users found the new features implemented on the Clinical Reminders easy to access and convenient to use. The majority found it to be resourceful and effective, to find additional source information on Clinical Reminders and the ability to submit feedback on Clinical Reminders. However, communicating the purpose and process was not completely clear to users. The user experience could be improved by making modifications to design elements to improve UCD.

The top issues the test participants remarked on were:

- Clinical sites did not have text next to the clock icon that could help distinguish the Clinical Reminders. (See section 4.2.4.1)
- Unnecessary additional clicks to access the Source Attributes and Clinical Reminder Form. (See section 4.2.4.1)
- Unclarity in accessing the right-click functionality on Clinical Reminders. (See section 4.2.4.1)

[i] National Institute of Standards and Technology, *NISTIR 7741: Usability Guidelines for Electronic Health Records (EHRs)*, 2010. [Online]. Available: https://www.nist.gov/publications/nistir-7741-nist-guide-processes-approach-improving-usability-electronic-health-records

- The naming conventions on these new features were difficult to understand. (See section 4.2.4.2)
- Navigating through the Evidence Based Decision Support Intervention Source Attributes document was difficult because it was categorized by year instead of alphabetically. (See section 4.2.4.3)
- Inconsistent document structure, missing source information, and information overload on Clinical Reminder source list. (See section 4.2.4.3)
- Uncertainty on Clinical Reminder Form purpose and options: Important Message, Category, Application, Priority, Actions Taken on Reminder, (See section 4.2.4.4)
- Success state on Clinical Reminder Form was not as effective. (See section 4.2.4.4)
- Clarity on form to allow users to fill out more efficiently. (See section 4.2.4.5)
- Improvement on design changes of interactive and disabled text fields. (See section 4.2.4.6)
- Improvement and clarity of usage for drop down selection within a specific text field. (See section 4.2.4.7)

Detailed findings as well as additional issues identified by the test participants will be discussed in Section 4.2, Discussion of Findings.

Table 1-1: Criteria Success and Satisfaction Rating Summary

Tasks	Task Success	Task Satisfaction Rating (Scale 0-2)
	Mean %	% Rated 2 – Completed Easily
1. Find the Reminder Source Attribute Dialog	100%	100%
2. Find Specific Citation Information within the Source Attribute Webpage	100%	90%
3. Access the Reminder Feedback Form Through the EHR application	100%	100%
4. Fill out the Clinical Reminder Feedback Form	100%	90%

1.2 Recommendations

Specific recommendations for the application are as follows:

- Reduce the number of additional clicks to access the Source Attributes and Clinical Reminder Form when right-clicking a Clinical Reminder.

- Make it clear to the user that they can access additional options by right-clicking a Clinical Reminder.
- Change the ordered list and naming to the following: Clinical Maintenance, Reminder Inquiry, Education Topic Definition, Additional Source Details, National Reminder Feedback, Evaluate Reminder, Reminder Icon Legend.
- Include text Clinical Reminders next to the clock icon for all sites.
- Change the title to, "Additional Source Details for VA Clinical Reminders (PXRM)."
- Categorize the sources alphabetically, followed by year.
- Align all source information to the left, and include the following: a table of contents, headings, and missing information such as page numbers, citations for certain clinical reminders and age ranges.
- The Important Message should be reworded to state, "Local sites experiencing issues please contact your Clinical Application Coordinator (CAC). This form is intended for feedback on National clinical reminders only."
- Auto-populate the text field, "Name of Reminder," to help the user recognize and specify the reminder name.
- Move the Category option to top of the form and do not default it to "General Comment." Increase spacing in between each option and make it responsive for smaller screens.
- Remove the Application field and include the application name in the description of the form.
- Change the title to "Provide National Feedback for VA Clinical Reminders (PXRM)."
- Include time frames for Priority options, Routine and Urgent. This can include days, weeks, or months).
- Reword options on "Actions Taken on Reminder" and remove it being defaulted to "Acknowledged the Reminder."
  - "Acknowledged the Reminder" to "Evaluated the Reminder."
  - Remove "Skipped the Reminder."
- Include text below the "Attachments" option, "Do not include Personal Identifiable Information (PII) in this form."
- Change the text color from red to green, "Your feedback has been submitted! An Email has been sent by this system to notify the proper individuals and a copy was sent to the Email address you registered with this Feedback item."

General recommendations for future development suggest that usability activities continue to be part of the development process for projects and/or products that involve user interfaces, and that usability lessons learned continue to be documented for potential future improvements.

2.0 Introduction

The Health Data, Technology, and Interoperability (HTI-1) program introduces updates to certification, algorithm transparency, and information sharing, requiring §170.315(g)(3) Safety-enhanced design to implement user-centered design and conduct summative usability testing on the newly implemented features for §170.315(b)(11) Decision Support Intervention (DSI) criteria. These features include the Clinical Reminder Source Attribute and Clinical Reminders Feedback form.

In addition, the summative usability test report will follow the National Institute of Standards and Technology (NIST) Customized Common Industry Format Template for Electronic Health Record Usability Testing (NISTIR 7742)[ii]. Summative usability testing is a task-based evaluation that measures the ease of use of a completed product. The results are analyzed and compared to the usability requirements to determine if those requirements have been met.

2.1 Purpose

The purpose of this test is to evaluate and validate the current usability of the new EHR Clinical Reminders features implemented, this includes the Clinical Reminders Feedback Form & the Source Attribute, as well as identify any areas of improvement.

2.2 Scope

The scope of usability testing is limited to testing user-involved tasks. Automated tasks or tasks without user interaction are not covered in this test. Functional testing is not covered in detail. Functionality is only tested as it pertains to the usability of the product or feature being tested.

[ii] National Institute of Standards and Technology, *NISTIR 7742: Customized Common Industry Format Template for Electronic Health Record Usability Testing*, 2010. [Online]. Available: https://www.nist.gov/publications/nistir-7742-customized-common-industry-format-template-electronic-health-record

3.0 Method

The test method and metrics were based on the NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records (NISTIR 7741)[iii].

The objective of this test was to uncover areas where the application performed well and areas where the application failed to meet the usability needs of the participants. The data from this test may serve as a baseline for future tests with an updated version of the same application capability and/or comparison with other application capabilities provided the same tasks are used. This testing serves as both a means to record or benchmark current usability and to identify areas where improvements must be made.

The application was evaluated for effectiveness, efficiency and satisfaction as defined by measures collected and analyzed for each participant:

- Number of tasks successfully completed.
- Time to complete the tasks.
- Number and types of errors.
- Path deviations.
- Participant's verbalizations (comments).
- Participant's satisfaction ratings of the system (Task Satisfaction Rating).
  - 0 – Could not complete the task.
  - 1 – Completed the task with some difficulty.
  - 2 – Completed the task easily.

3.1 Roles and Responsibilities

Table 3-1: Roles and Responsibilities

Role/Function	Responsibilities
Project Manager/Criteria Owner	• Responsible for the management, monitoring, and tracking of the project and oversees all areas.

[iii] National Institute of Standards and Technology, *NISTIR 7741: Usability Guidelines for Electronic Health Records (EHRs)*, 2010. [Online]. Available: https://www.nist.gov/publications/nistir-7741-nist-guide-processes-approach-improving-usability-electronic-health-records

Role/Function	Responsibilities
Usability Test Lead / Test Administrator	• Ensures that usability testing is conducted successfully and meets all usability testing deadlines. • Provides application systems analysis for application testing activities. • Prepares required documentation at the program level for testing activities. • Monitors and escalates risks or concerns about achieving goals or meeting schedules to program leadership. • Prepares all testing instructions, scripts, and materials for use in the testing session. • Performs analysis of testing results, prepares and delivers test report. • Moderates the test. • Collects test data.
Test Participants	• Complete the assigned tasks. • Provide honest feedback on their experience.

3.1.1 Test Participants

There were a total of 10 test participants for this round of testing. Participants in this test were:

- Typical end-users.
- Trained to use the application prior to usability testing.
- Recruited by PXRM project team.
- Not compensated for participation.
- Assigned a participant ID at random.

Once participants were identified, they were scheduled for 60-minute one-on-one web conferencing sessions. A calendar was used to keep track of the participants' schedule, and a spreadsheet tracked participants' location (site) and contact information.

3.2 Test Location

The test was conducted remotely via the use of video conferencing and desktop sharing software (Microsoft Teams).

3.3 Test Environment

The test participants were physically located at their normal duty stations, logged into their assigned workstations, and connected to the video conferencing software. The test administrator was also physically distributed and connected via video conferencing software.

The test participants shared their screen during testing. The response time was representative to what actual users would experience in a field implementation.

3.4 Test Tools

Before and after the usability test, various forms were used, including:

- Demographic & Application Survey
- Moderator's Guide
- Post-test Questionnaire

Video conferencing software was used to connect participants with the administrator. This software was also used to record the video and audio of test sessions.

3.5 Task Scenarios

The testing and step by step tasks were constructed to be a representative of the kinds of activities a user would perform using the capabilities being tested. Tasks were chosen with the test objectives in mind to ensure that participants provided the most meaningful data possible. The tasks were arranged to facilitate a typical end-user workflow.

The moderated testing scenarios and associated tasks include:

- Find the Reminder Source Attribute Dialog in the EHR application.
    - The user must click on the clock icon, labeled as "Clinical Reminders" in the navigation menu. A dialog box appears on the left side with a list of reminders. The user then chooses to select 'Reference Information', followed by 'Reminder Source Attributes' from the list. The user then confirms when the browser pop-up appears.
- Find & Access Citation Information within the Source Attribute Webpage.

    - While on the directed webpage, the user clicks on the link "Evidence-Based Decision Intervention Source Attributes". The user then finds the 'IHS Height 2013' on the third page and finds the Bibliographic Citation information. The user then reads the Bibliographic Citation information out loud.
- Access the Reminder Feedback Form Through the EHR application.
    - The user navigates back to the application. The dialog that was previously opened will still be there. The user then will right click on a reminder, selects 'Reference Information', clicks on 'Clinical Reminder Feedback'. The user then confirms when the browser pop-up appears.
- Fill out the Clinical Reminder Feedback Form.
    - The user then fills out their personal details: first name, last name, email, confirms email. Then provides issue information details: subject, category, priority, reminder name, clinical/hospital name, and actions taken on reminder. The user then enters feedback and then sends the form.

These tasks encompass newly implemented features that need certification testing for HTI-1. Given the recent updates to the user interface and user experience, these tasks are expected to effectively evaluate functionality and performance with participants.

3.6 Procedure

Upon arrival, each participant was greeted by the administrator and matched to a name on the participant schedule. The test administrator moderated the test session including administering instructions and tasks. The administrator also monitored task times, obtained post-task rating data, and took notes on participant comments.

Each participant was instructed to perform the tasks:

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

Each participant used the same application version. The instructions were modified after the third participant to include missing instructions when users had to fill out the Clinical Reminder form. These included providing the Category and Actions Taken on Reminder text fields. The Category uses would select Application Problem, and Actions Taken on Reminder is defaulted to Acknowledged the Reminder. The instructions were more direct to the user after these modifications.

In addition, there were modifications to word instructions to help make the testing process clearer. This included changing the word from “Submit” to “Send,” since that is what was shown to users in the feedback form.

The test participant logged into the test environment. After login, the user was instructed to complete a series of tasks (given one at a time) using the application. The participant was given a written copy of each task, and the administrator also read each task aloud and ensured the participant understood the task. Task timing began once the administrator finished reading the question. The task time was stopped once the participant indicated that the task was completed.

Scoring is discussed in Section 3.7, Usability Metrics.

After completion of the testing tasks, the administrator gave the participant a post-test questionnaire (System Usability Scale), asked if they had any questions, and thanked them for their participation.

Each participant’s demographic information, task success rate, time on task, errors, deviations, verbal responses, and post-test questionnaire ratings were recorded into the participant spreadsheet.

Following each test session, the video recordings were reviewed and checked against the data logged in the participant spreadsheet. The participant spreadsheet was updated with any edits or additional information such as verbalizations.

3.7 Usability Metrics

According to the NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records, EHRs and supporting applications 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 the following:

- Effectiveness by measuring participant success rates and errors.
- Efficiency by measuring the average task time and path deviations.
- Satisfaction by measuring task satisfaction ratings and SUS scores.

3.7.1 Data Scoring

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

Table 3-2: Data Scoring Methodology

Measures	Rationale and Scoring
Effectiveness: Task Success	A task was counted as a "Success" if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis. The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage. Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency. Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target task times used for task times in the Moderator's Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by some factor [e.g., 1.25] that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was [x] seconds then allotted task time performance was [x * 1.25] seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.
Effectiveness: Task Failures	If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as a "Failures." No task times were taken for errors. The total number of errors was calculated for each task and then divided by the total number of times that task was attempted. Not all deviations would be counted as errors.11 This should also be expressed as the mean number of failed tasks per participant. On a qualitative level, an enumeration of errors and error types should be collected.
Efficiency: Task Deviations	The participant's path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.

Measures	Rationale and Scoring
Efficiency: Task Time	The workflow was timed from the moment the participant said "begin" until they said "done." If the participant failed to say "done," timing ceased when they stopped performing the tasks. Only workflows that were successfully completed were included in the time analysis. The average time for the workflow was calculated, along with variance measures, including standard deviation and standard error.
Satisfaction: Task Satisfaction Rating	User satisfaction is rated using the Task Satisfaction Rating. Performance Standard: 80% of tested users complete the testing tasks, as specified by the customer, easily during summative usability testing, using the following scale: 0 – Unable to complete the task. 1 – Completed the task with some difficulty. 2 – Completed the task easily. To measure participants' confidence in and likeability of the system overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, "I think I would like to use this system frequently," "I thought the system was easy to use," and "I would imagine that most people would learn to use this system very quickly."

4.0 Results

4.1 Data Analysis and Reporting

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above.

Participants who failed to follow session and task instructions had their data excluded from the analyses.

4.1.1 Effectiveness, Efficiency & Satisfaction Data

Table 4-1: Effectiveness

Task Identifier	Task Description	# Participants	Suc Rat
b11.1	Find the Reminder Source Attribute Dialog in the EHR application.	10	100%
b11.2	Find Specific Citation Information within the Source Attribute Webpage.	10	100%
b11.3	Access the Reminder Feedback Form Through the EHR application.	10	100%
b11.4	Fill out the Clinical Reminder Feedback Form.	10	100%

Table 4-2: Efficiency

Task Identifier	Observed # Steps	Optimal # Steps	Task Time Mean (seconds)	Task Time Std Dev (seconds)	Task Time Deviation Observed (seconds)	Task Time Deviation Optimal (seconds)	Task Errors Mean	Task Errors Std Dev	Task Rating-Scale Type
b11.1	4	4	36	28	20	22	0%	0%	Likert
b11.2	4	4	40	12	9	9	0%	0%	Likert
b11.3	4	4	19	8	6	7	0%	0%	Likert
b11.4	5	4	107	32	24	55	0.8%	1.03%	Likert

Table 4-3: Task Satisfaction Rating (0-Cannot complete task, 1-Completed with difficulty, 2-

Task Identifier	Task	% Rated 2-
b11.1	Find the Reminder Source Attribute Dialog in the EHR application	100%
b11.2	Find Specific Citation Information within the Source Attribute Webpage	90%
b11.3	Access the Reminder Feedback Form Through the EHR application	100%
b11.4	Fill out the Clinical Reminder Feedback Form	90%

4.1.1.1 System Usability Scale (SUS)

The results from the System Usability Scale (SUS) from the post-test questionnaire scored subjective satisfaction with the system based on performance with the listed testing tasks by group.

Table 4-1: SUS Score

System Usability Scale (SUS)	Score
EHR Application Clinical Reminders	84.75

According to usability.gov, "[b]based on research, a SUS score above a 68 would be considered above average and anything below 68 is below average."

4.2 Discussion of Findings

4.2.1 Effectiveness

The success rate for all tasks among the 10 participants were 100% completed, with a standard deviation of 0%. This means all tasks were completed without failure, with no variation in the success rate among participants.

4.2.2 Efficiency

Task Deviations

Participants completed the tasks with the optimal steps on task identifier b.11.1, b11.2, & b11.3. Participants completed task identifier b11.4 in 5 steps, exceeding the optimal 4 steps.

Task Time

Participants completed the tasks faster than the optimal time, which may indicate over performance or shortcuts. This potentially can include participants copying and pasting on task identifier b11.4. In addition, participants had variability completing the tasks but performed consistently.

4.2.3 Satisfaction

Participants followed a task satisfaction rating of 0- cannot complete the task, 1-completed with difficulty and 2-completed easily. 100% of participants rated a 2 on task identifiers b11.1 & b11.3. While 90% of participants rated a 2 on task identifiers b11.2 & b11.4. This means that there was one participant from task identifier b11.2 & b11.4 who did not rate it as a 2. Overall the System Usability Scale (SUS) score was 84.75, which concludes the system satisfaction being above average.

The task errors and task errors standard deviation were 0% on task identifiers b11.1, b11.2 & b11.3. For task identifiers b11.4 the task error was 0.8% and the task error standard deviation was 1.03%. This means that task b11.4 had more errors than the other tasks.

These task ratings were converted to a Likert scale ranging from 1 to 5, where 1 represents “difficult to complete” and “highly dissatisfied,” while 5 represents “very easy to complete,” “highly satisfied,” and “high quality.” Task identifiers b11.1 and b11.3 received a perfect score of 5, indicating that all participants rated these tasks at the highest level. Task identifiers b11.2 and b11.4 received an average score of 4.80, indicating that at least one participant rated these tasks below a 5.

4.2.4 Major Findings & Areas for Improvement

4.2.4.1 New Features & EHR Application

4.2.4.1.1 Major Findings

- The new features consist of users accessing the Source Attribute and Clinical Reminder Feedback by right-clicking a Clinical Reminder then Reference Information. This can be accessed in the RPMS EHR Application.

- The majority of the sites tested did not have text next to the clock icon in the application. This made it slightly more difficult for users to find the Clinical Reminders in the task. Another finding was that users did not know they could right-click a Clinical Reminder. A user also did not like the additional steps taken to access these new options.

4.2.4.1.2 Areas for Improvement

- Include the text “Clinical Reminders” next to the clock icon for all sites. This will help users understand the purpose of the clock icon.

- Reduce the number of steps required to access the Source Attributes and Clinical Reminder Form when right-clicking on a Clinical Reminder. This can be done by modifying the right-click options and removing the Reference Information. Change the ordered list and naming to the following: Clinical Maintenance, Reminder Inquiry, Education Topic Definition, More Reminder Details, National Reminder Feedback, Evaluate Reminder, Reminder Icon Legend. This was the sequence based on user feedback and priority sequence.

- Make it clear to the user that they can access additional options by right-clicking a Clinical Reminder. This can be done by including an icon and text that can help users recognize the right-click functionality exists on a Clinical Reminder. Users are aware of the double click functionality.

4.2.4.2 New Features & Webpages

4.2.4.2.1 Major Findings

- In one feature, users can access a Source Attribute webpage, which contains links to documents with additional Clinical Reminder source information. In the other feature, users can choose Clinical Reminder Feedback to submit feedback on national Clinical Reminders.

- Users had trouble understanding the titles and meaning of the webpages Source Attribute and Decision Support Intervention (Reminders) Feedback. Users also did not know what information to expect from the name alone with no description.

4.2.4.2.2 Areas for Improvement

- Change the title of the webpage “Source Attribute” to “Additional Source Details for VA Clinical Reminders (PXRM),” change “Decision Support Intervention (Reminders) Feedback” to “Provide National Feedback for VA Clinical Reminders (PXRM).”

- It is also important to provide additional details on the Source Attribute webpage to help users understand the purpose of the page. Also, including the date of publication or last updated for each source document provided.

4.2.4.3 Source Attributes Documents

4.2.4.3.1 Major Findings

- Users had difficulty understanding the order structure of the Clinical Reminders in the document Evidence Based Decision Support Intervention Source Attributes. Users could not tell if the document was organized alphabetically or by year. Users disliked document structure with too much information being shown at once. A user mentioned that a Clinical Reminder was missing source information, since there was an empty clinical reminder with no source.

4.2.4.3.2 Areas for Improvement

- Categorize the sources alphabetically as a priority, followed by year.
- Include a table of contents to find sources efficiently. Incorporate different heading sizes to help distinguish between sources and information. Integrate page numbers on each page and left-align all content.
- Add source information on Clinical Reminders that did not have any information directly below. Include age details on the reminders since all reminders don't have any specific details on age.

4.2.4.4 Clinical Reminders Form Messaging & Structure

4.2.4.4.1 Major Findings

- Users can access this form in the EHR application by right-clicking a Clinical Reminder, followed by Reference Information and Clinical Reminder Feedback. Users had trouble understanding the purpose of the form and certain options in the form.
- The title of the form, Decision Support Intervention (Reminders) Feedback, could be iterated to provide more meaning to the user. Users also had trouble comprehending the important message, "Important: the form is not intended for troubleshooting local clinical site issues. Those issues should be reported locally." It was not clear to the user when this form should be filled out in local sites. Users also had difficulty knowing that the form was successfully submitted because of the red font text.

4.2.4.4.2 Areas for Improvement

- Change the title to "Provide National Feedback for VA Clinical Reminders (PXRM)."
- The Important Message should be reworded to state, "Local sites experiencing issues please contact your Clinical Application Coordinator (CAC). This form is intended for feedback on National clinical reminders only."

- Move the Category option to top of the form and do not default it to "General Comment." Increase spacing in between each option and make it responsive for smaller screens. Moving it to the top of the form can help users understand the purpose of this form almost immediately.

- Change the success state when users successfully submit the form, "Your feedback has been submitted! An Email has been sent by this system to notify the proper individuals and a copy was sent to the Email address you registered with this Feedback item," color from red to green.

4.2.4.5 Form Functionality & Clarity

4.2.4.5.1 Major Findings

- The form could also use changes on text fields to help users understand and fill the form more efficiently. Users would prefer an auto-populated feature to help recognize the clinical reminder name and prevent errors. Users were also not sure when they would get a response after successfully filling out the form. Users were also concerned about users mistakenly including Personally Identifiable Information (PII) in the attachments.

4.2.4.5.2 Areas for Improvement

- Auto-populate the text field, "Name of Reminder," to help the user recognize and specify the reminder name.

- Include time frames for Priority options, Routine and Urgent. This can include days, weeks, or months).

- Include text below the "Attachments" option, "Do not include Personal Identifiable Information (PII) in this form."

4.2.4.6 Application Text Field Option

4.2.4.6.1 Major Findings

- Users were confused and could not understand if the Application dropdown was interactive or not. The current user design is gray and is supposed to be non-interactive in a disabled state. Users would hover over the option to verify if the option is interactive. Users should not have to spend time verifying if a disabled state is interactive.

4.2.4.6.2 Areas for Improvement

- Change the text field, “Application,” to not a required field. Remove the chevron arrows on the right side of the text field. Decreasing the opacity or making the field gray compared to the interactive text fields. Another option is to remove the field and include the application name in the description in the form.

4.2.4.7 Actions Taken on Reminder

4.2.4.7.1 Major Findings

- Users were confused about the text field options in, “Actions Taken on Reminder,” and did not find it useful. Users could not comprehend the difference between “Acknowledged the Reminder” and “Used the Reminder.” Users thought that they had the same meaning. Also, users were conflicted on the meaning between “Skipped the Reminder” and “Did Not Understand the Reminder.”

4.2.4.7.2 Areas for Improvement

- Reword options on “Actions Taken on Reminder” and remove it being defaulted to “Acknowledged the Reminder.”
    - “Acknowledged the Reminder” to “Evaluated the Reminder.”
    - Remove “Skipped the Reminder.”

5.0 Test Participant Data

Table 5-1: Test Participant Data

TP Identifier	Gender	Age	Education	Computer Experience	Occupation/Role	Professional Experience (months)	Particip Comput Experie (months
TP1-b11	Female	40-49	Bachelor's Degree	Advanced	Program Analyst	96	360
TP2-b11	Male	40-49	Doctorate Degree	Advanced	Clinical Informaticist	44	420
TP3-b11	Female	50-59	Master’s Degree	Intermediate	Director of Nursing	35	132
TP4-b11	Male	40-49	Doctorate Degree	Advanced	Clinical Informaticist	56	420
TP5-b11	Male	40-49	Doctorate Degree	Advanced	Pharmacy Informaticist	15	480
TP6-b11	Male	50-59	Doctorate Degree	Intermediate	Clinical Informaticist Consultant	120	240
TP7-b11	Unknown	40-49	Doctorate Degree	Advanced	Clinical Informaticist	73	600
TP8-b11	Male	30-39	Doctorate Degree	Intermediate	Clinical Informaticist	72	336
TP9-b11	Male	30-39	Doctorate Degree	Advanced	Clinical Pharmacist	48	312
TP10-b11	Female	40-49	Doctorate Degree	Intermediate	Clinical Application Coordinator	108	160

Acronym List

Acronym	Term Meaning
CAC	Clinical Application Coordinator
DSI	Decision Support Intervention
HTI-1	Health Data, Technology, and Interoperability
IHS	Indian Health Service
NIST	National Institute of Standards and Technology
NISTIR 7741	Processes Approach for Improving the Usability of Electronic Health Records
NISTIR 7742	Customized Common Industry Format Template for Electronic Health Record Usability Testing
PII	Personal Identifiable Information
PXRM	VA Clinical Reminders
RPMS	Resource and Patient Management System
SUS	System Usability Scale
UCD	User-Centered Design