

EHR Usability Test Report of Varian ARIA Oncology Information System (for Medical Oncology) V15.5

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

Varian ARIA Oncology Information System (for Medical Oncology) V15.5

Date of Usability Test: June 21 - July 7, 2017

Date of Report: July 27, 2017

Report Prepared By: Macadamian Technologies

Anneliis Tosine, Senior User Experience Researcher, Healthcare
Macadamian Technologies
819.772.0300 or 877.779.6336 ext. 137
atosine@macadamian.com
4^e étage
179 Promenade Du Portage,
Gatineau, Quebec
J8X 2K5 Canada

Alessandra Smircich, User Experience Researcher, Healthcare
Macadamian Technologies
asmircich@macadamian.com
4^e étage
179 Promenade Du Portage,
Gatineau, Quebec
J8X 2K5 Canada

TABLE OF CONTENTS

EXECUTIVE SUMMARY	3
INTRODUCTION	9
METHOD	9
Participants.....	9
Study Design.....	11
Tasks.....	11
Procedures	12
Test Environment	13
EHR Scenario and Patient Setup.....	14
Test Forms and Tools.....	14
Participant Instructions.....	15
Usability Metrics.....	15
RESULTS	17
Data Analysis and Reporting.....	17
DISCUSSION OF THE FINDINGS	20
Computerized Physician Order Entry - Medications	20
Computerized Physician Order Entry - Laboratory	23
Computerized Physician Order entry – Diagnostic Imaging.....	24
Drug-Drug, Drug-Allergy Interaction Check	25
Demographics.....	27
Problem List	28
Medication List.....	31
Medication Allergy List	34
Clinical Decision Support.....	36
Implantable Device List.....	37
Clinical Information Reconciliation.....	39
Electronic Prescribing.....	42
APPENDIX 1: INVITATION	45
APPENDIX 2: TEST PROTOCOL AND POST-TEST QUESTIONNAIRE	46
Background and Introduction	47
Task 1 Demographics: document demographic information.....	48
Task 2 Problem List: document an existing problem	50
Task 3 Medication Allergy List: document an allergy.....	52
Task 4 Medications List: document a medication from an external provider	53
Task 5 CIR: perform CIR.....	54
Task 6 CPOE (Medications), CDS & Drug-Allergy Interaction Check: order a medication (favorite), review CDS rules, and acknowledge an interaction alert	56
Task 7 CPOE (Medications): order a medication (non-favorite)	57
Task 8 e-Prescribe: send prescriptions to a pharmacy.....	58
Task 9 CPOE (labs and imaging): order a lab and diagnostic imaging.....	59
Task 10 Implantable Device List: document an implantable device	60
System Usability Scale Questionnaire	61

EXECUTIVE SUMMARY

A usability test of Varian ARIA Oncology Information System (for Medical Oncology), version 15.5, clinic EHR was conducted from June 21, 2017 – July 7, 2017 remotely by Macadamian Technologies. The purpose of this test was to test and validate the usability of the current user interface, and provide evidence of usability in Varian ARIA Oncology Information System (for Medical Oncology). During the usability test, 11 healthcare providers matching the target demographic criteria served as participants and used ARIA in simulated, but representative tasks.

This study collected performance data on 10 tasks typically conducted with the EHR.

Meaningful Use Criterion Tested	Task
Section 170.315(a)(5) Demographics	1. Document demographic information
Section 170.315(a)(6) Problem List	2. Document an existing problem
Section 170.315(a)(8) Medication Allergy List	3. Document an allergy
Section 170.315(a)(7) Medication List	4. Document a medication from an external provider
Section 170.315(b)(2) Clinical Information Reconciliation and Incorporation	5. Perform clinical information reconciliation
Section 170.315(a)(1) Computer Physician Order Entry – Medications, Section 170.315(a)(4) Drug-Drug, Drug-Allergy Interaction Check, and Section 170.315(a)(9) Clinical Decision Support	6. Order a medication (favorite), review clinical decision support, and acknowledge an interaction alert
Section 170.315(a)(1) Computer Physician Order Entry – Medications	7. Order a medication (non-favorite)
Section 170.315(b)(3) Electronic Prescribing	8. Send prescriptions to a pharmacy
Section 170.315(a)(2) Computer Physician Order Entry - Laboratory and Section 170.315(a)(3) Computer Physician Order Entry – Diagnostic Imaging	9. Order a lab and diagnostic imaging
Section 170.315(a)(14) Implantable Device List	10. Document an implantable device

During the 60-minute one-on-one usability test, each participant was greeted by the moderator and given a standardized introduction to the test. All of the participants had previous experience with ARIA. The moderator instructed participants to complete a series of tasks (given one at a time) using ARIA. During the testing, the moderator timed the test and, along with the note taker, recorded user performance data on paper and electronically.

The moderator provided assistance in completing the task only when participants were unable to go to the next step. The moderator's screen – which participants had control over – and audio were recorded for subsequent analysis.

The following types of data were collected for each participant:

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

All participant data was de-identified – no correspondence could be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants completed a post-test questionnaire. Various recommended metrics, in accordance with the examples set forth in the *NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records*¹, were used to evaluate the usability of ARIA.

Following is a summary of the performance and rating data collected on ARIA.

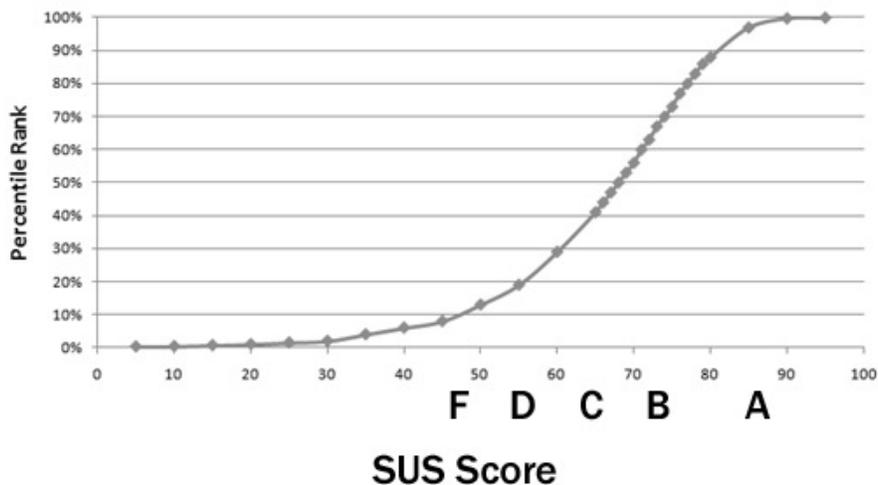
¹ NISTIR 7741, R. Schumacher & S. Lowry, (2010) NIST Guide to the Processes Approach for Improving the Usability of Electronic

Measure	N	Task Success	Path Deviations	Task Time (seconds)			Errors	Task Ratings 5 = Easy
Task	#	Percentage	Deviations [Observed/Optimal]	Mean (SD)	Optimal	Deviations [Observed/Optimal]	Mean (SD)	Mean (SD)
1. Document demographic information	11	91	1.07	71 (29)	45	1.6	0.1 (0.3)	5.0 (0)
2. Document an existing problem	11	73	1.02	81 (39)	67	1.2	0.3 (0.5)	3.8 (0.7)
3. Document an allergy	11	91	1.02	68 (47)	30	2.3	0.8 (1.3)	4.2 (1.2)
4. Document a medication from an external provider	11	100	1.02	47 (21)	28	1.7	0 (0)	4.7 (0.7)
5. Perform clinical information reconciliation	11	0	N/A	N/A (-)	105	N/A	N/A (-)	N/A (-)
6a. Order a medication (favorite)	11	91	1.04*	98* (45)	77*	1.3*	0.1 (0.3)	4.5* (0.7)
6b. Review clinical decision support	10	80					0.2 (0.4)	
6c. Acknowledge interaction alerts	10	40					0.5 (0.5)	
7. Order a medication (non-favorite)	11	82	1.01	92 (58)	77	1.2	0.3 (0.5)	4.4 (0.5)
8. Send prescriptions to a pharmacy	10	100	1.09	50 (20)	30	1.7	0.4 (1.3)	4.0 (1.2)
9. Order a lab and diagnostic imaging	11	100	1.02	38 (13)	21	1.8	0.0 (0.0)	5.0 (0)
10. Document an implantable device	11	55	1.17	106 (42)	49	2.2	0.2 (0.5)	4.2 (0.4)

*Includes task times and ratings for the CDS and Alerts attempts that failed, as the data could not be separated for those attempts

The results from the System Usability Scale [SUS] scored the subjective satisfaction with the system based on performance with these tasks to be: 70. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.²

More recent work by Sauro (2011) provides a norming distribution based on 500 comparative SUS scores (from usability tests of a wide range of applications). Based on this distribution, the SUS result of 70 ranks roughly in the 55th percentile or equivalent to a letter grade 'B', see the figure below.



Usability judgments were also collected at the end of each major task. The averages obtained from those task-based usability scores varied between 3.8 and 5.0, quite a bit above the recommendation put forward in NISTIR3 7742. The NISTIR 7742 states that — common convention is that average ratings for systems judged easy to use should be 3.3 or above. This is consistent with the overall SUS ratings at the end of the session.

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

Major Findings

- Of the 10 tasks and two subtasks that participants attempted, participants completed eight of them with success rates over 70%.
- Performing clinical information reconciliation proved to be the most challenging, as evidenced by the failure rate. The main difficulty was knowing where to go to start the task of incorporating the clinical data and then after incorporation, knowing that reconciliation still needed to be completed
- Documenting an allergy was troublesome to participants, as many participants documented an allergy to a specific drug rather than a drug class (as required) and only two of the attempts had no errors
- Acknowledging interaction alerts was another task with a low success rate, as many participants skipped over reviewing the alert due to their relevancy and presentation
- Documenting an implantable device was tricky for participants due to the unfamiliar workflow, lack of calls to action and smooth user experience
- Observations were made that participants completed the order entry tasks in a very standardized and consistent fashion by working from the top of the order screen to the bottom and systematically selecting

² See Tullis, T. & Albert, W. (2008). *Measuring the User Experience*. Burlington, MA: Morgan Kaufman (p. 149).

options from each appropriate drop-down menu.

- It was observed that participants often completed extra work (e.g. completing fields and/ or making drop-down selections that are not necessary)
- It was observed that participants often attempted to finalize a task prematurely as well as begin a task unknowingly and in both cases received warning messages
- All of the order entry tasks proved to be easy for the participants, especially the favorite drug order and the lab and imaging order
- Documenting demographics was a very successful task and participants rated their experience very positively
- Documenting a medication from an external provider was a very successful task, as evidenced by the small number of observed deviations, no errors committed, and high satisfaction rating

Areas for Improvement

Handling Mandatory Fields and Data Entry

- Some search fields require an explicit action to begin (i.e. selecting a 'Search' button in the diagnosis lookup pop-up) and others do not (e.g. search for an agent name from the 'New Medication' tab in the patient's history); be consistent, as users are often left wondering whether or not the system has already begun the search or is waiting for them to do something.
- The application does not indicate mandatory fields anywhere, which leads users to (try to) submit incomplete work and/or requires them to go back and edit their work.
- Participants sometimes started a new task (e.g. new medication) but did not take the task any further by documenting information before selecting 'Cancel'. In this case, the application provides a pop-up message inquiring whether or not the user would like to save their work when s/he actually has not done anything. Consider removing this pop-up interaction, as users begin to doubt their actions and whether or not they may lose work.
- The application uses a mixed model of grayed out text or tabs for items that are not populated as well as disabled or unavailable. This led participants to attempt to type into fields that were unavailable or select disabled drop-down menus or controls which caused deviations in the observed attempts during the test.

Task Completion

- The application allows users to (try to) submit incomplete work, as action buttons to save/ submit data are always available. Consider disabling these buttons until an action has been committed that would allow the action button to do its job.
- Compare the frequency and importance of the 'Save – Add' and 'Save – New' versus the confusion it causes for end users when adding medications or allergies to a patient's history.

Computerized Physician Order Entry – Medications

- While the system provides drop-down menus for many of the selections during order entry, which alleviates the user from having to type, the application could be more effective and efficient in supporting user actions. For example, auto-populating data that apply for a specific medication, indicating mandatory fields, and not allowing for incorrect data entries to be entered (e.g. text in a numerical field).

Drug-Drug, Drug-Allergy Interaction Check

- Improve noticeability of the impact that a specific order has (e.g. interaction, contraindication) which is triggered by patient demographics or conditions within the 'Medi-Span Medication Screening' pop-up.

Problem List

- Participants found it cumbersome to search for a diagnosis, as diagnoses descriptions are very long and are truncated by the column width. Consider improving the presentation of information within the 'Advanced Search for Diagnosis/ Problem Code' pop-up (e.g. column widths and highlighting similarities or differences of the different diagnosis to provide for easier scanning).

Medication Allergy List

- Consider guiding users to make a selection from the 'Drug Class Allergy Selection' and 'Drug Selection' lists for the corresponding interactions checks to take place.

Clinical Decision Support

- During order entry tasks, the format for presenting clinical decision support is not effective, as it provides a disrupted user experience, end users do not have to take any action in order to proceed, and participants commented that the content is not always relevant for a particular patient and cannot be dismissed for subsequent orders.

Implantable Device List

- Upon entering a complete UDI, consider auto-completing the fields for the user without a distinct action or with a tab or enter action.
- Ensure that the starting point (i.e. the 'New' button) is in a consistent location, as compared to other areas of the application.

Clinical Information Reconciliation

- Consider further user research regarding messaging during this workflow (i.e. the difference between 'incorporating' and 'reconciling' is not well understood by end users).
- Consider guiding end users more through this workflow so that they can transition efficiently and clearly from the incorporation steps to the reconciliation steps.
- Consider simplifying the incorporation and reconciliation of information by joining both activities within one workflow.

Electronic Prescribing

- Consider a means for allowing end users to send prescriptions to the same pharmacy by batch.

INTRODUCTION

The EHR tested for this study was ARIA Oncology Information System (for Medical Oncology), version 15.5. Designed to present outpatient medical information to healthcare providers, the application supports the entire clinical process for medical oncology practices and comprehensive cancer centers. ARIA is a desktop application that consists of patient care options for recording patient encounters, supporting order entry, and tracking patient histories. Primarily, oncologists, nurse practitioners, nurses, medical assistants, and other related healthcare professions use the application to track all patient interactions and manage their practices. The usability testing attempted to represent realistic exercises and conditions.

The purpose of this study was to test and validate the usability of the current user interface, and to provide evidence of usability in ARIA. To this end, measures of effectiveness, efficiency and user satisfaction, such as error rates, time on task, ease of use ratings and the SUS, were captured during the usability test.

METHOD

PARTICIPANTS

A total of 11 participants were involved in the usability test of ARIA. Participants in the test were registered nurses, a nurse practitioner, and an oncologist, as they are the primary users groups for this product and the specific meaningful use criterion being tested. Participants were recruited by Varian from their existing customer base. All participants were located in the United States. In addition, participants had no direct connection to the development of, or the organization producing ARIA; participants were not from the testing or supplier organization. Participants all had some experience with ARIA.

For the test purposes, end-user characteristics were identified and translated into seven pre-test questions asked of participants by the test moderator or via an email questionnaire. The questions are included in the test protocol shown in Appendix 2.

Recruited participants had a mix of backgrounds and demographic characteristics conforming to the recruitment criteria agreed with Varian prior to recruitment. The following is a table of participants by characteristics, including demographics, professional experience, and EHR experience. The included sample was comprised of: nine nurses, one nurse practitioner, and one medical oncologist. All but one were female. The group fell into the following age categories: three are 30 – 39 years old, three are 40 – 49 years old, four are 50 – 59 years old, and one is 60 – 69 years old. The included sample was comprised of individuals with the following education levels: one with some college credit and no degree, one with trade/technical/vocational training, two with associate degrees, four with bachelor's degrees, two with master's degrees, and one with doctorate degrees. As a group, the sample had practiced an average of 17.5 years (with a range between 10 months – 45 years in their current roles) and they had an average of 11 years of experience using electronic health records (with a range between 4 – 22 years). Participants had an average of 24 years of experience using a computer for personal or business use (with a range between 12 – 38 years). None of the participants use any assistive technologies to help them with their job.

Participants were scheduled for 60-minute remote test sessions with at least 15 minutes in between each session.

Part ID	Sex	Age Range	Education Level	Role	Professional Experience [months]	Computer Experience [years]	EHR Experience [years]
P0	Female	50-59	Associate degree	Clinical Director	120	30	22
P1	Female	40-49	Bachelor's degree	Research Nurse	324	25	13
P2	Female	50-59	Bachelor's degree	Director of Education in Resources- Data Manager	180	20	9
P3	Female	30-39	Master's Degree	Nurse Navigator	10	20	14
P4	Female	30-39	Associate Degree	Registered Nurse	144	25	13
P5	Female	30-39	Bachelor's Degree	Registered Nurse	72	25	6
P6	Female	50-59	Bachelor's Degree	Nurse Manager	468	38	5
P8	Female	40-49	Doctorate degree	Medical Oncologist	42	22	10
P9	Female	60-69	Some college credit, no degree	Registered Nurse	564	12	10
P10	Male	50-59	Master's Degree	Nurse Practitioner	39	35	4
P11	Female	40 – 49	Trade/ technical/ vocational training	Licensed Practical Nurse	360	15	14

STUDY DESIGN

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

During the test, participants interacted with the EHR. Each participant used the system remotely using GoToMeeting by means of remote desktop connection and was provided with the same instructions. The system was evaluated for effectiveness, efficiency and satisfaction as defined by measures collected and analyzed for each participant:

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

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

TASKS

A number of tasks were constructed that would be realistic and representative of the kinds of activities a user might do with this EHR and are included in the table below.

Meaningful Use Criterion Tested	Task
Section 170.315(a)(5) Demographics	1. Document demographic information
Section 170.315(a)(6) Problem List	2. Document an existing problem
Section 170.315(a)(8) Medication Allergy List	3. Document an allergy
Section 170.315(a)(7) Medication List	4. Document a medication from an external provider
Section 170.315(b)(2) Clinical Information Reconciliation and Incorporation	5. Perform clinical information reconciliation
Section 170.315(a)(1) Computer Physician Order Entry – Medications, Section 170.315(a)(4) Drug-Drug, Drug-Allergy Interaction Check, and Section 170.315(a)(9) Clinical Decision Support	6. Order a medication (favorite), review clinical decision support, and acknowledge an interaction alert
Section 170.315(a)(1) Computer Physician Order Entry – Medications	7. Order a medication (non-favorite)
Section 170.315(b)(3) Electronic Prescribing	8. Send prescriptions to a pharmacy
Section 170.315(a)(2) Computer Physician Order Entry - Laboratory and Section 170.315(a)(3) Computer Physician Order Entry – Diagnostic Imaging	9. Order a lab and diagnostic imaging
Section 170.315(a)(14) Implantable Device List	10. Document an implantable device

Tasks were constructed that would sufficiently evaluate the Meaningful Use Stage 3 prioritized Certification Criteria and their frequency of use, criticality of function, and those that might be troublesome for users. Tasks were constructed that would be realistic and representative of the kinds of activities a healthcare provider might do with this EHR. Prior to testing, an expert review was conducted with internal experts of ARIA to assess risk to patient safety based on common interface criteria. As part of the task construction, tasks were prioritized in accordance with the risk associated with use errors. NISTIR 7804; Form for Expert Review Items 1A through 1H was used to create and prioritize tasks based on design areas related to known use errors. The outcome of this review was used as a factor to determine selection of appropriate tasks for this test.

PROCEDURES

A selection of Varian customer contacts were initially sent an email describing the study and asked if they, or their staff, would be willing to participate [see Appendix 1: Invitation]. The contact information for those who responded were sent to the Macadamian research prime who contacted each participant individually to set up a usability test session time and provide the necessary GoToMeeting information and preparation instructions.

When each participant joined the web conference session, the moderator shared her screen and passed keyboard and mouse control to the participant. The moderator then read a standard introduction to him/her and asked for permission to record the session. The moderator then read the first task. After the tenth task, the SUS was administered in order to acquire a SUS rating [see Appendix 2: Test Protocol].

To ensure that the test ran smoothly, two staff members participated in this test, a moderator and a note taker. The moderator conducting the test is an experienced usability researcher with a master's in applied science in biomedical engineering and nine years of experience conducting usability research. The note taker was also a Macadamian user experience researcher with a bachelor's in human biology and a degree in medical radiation with six years of design and usability research experience.

The moderator facilitated the session including administering instructions and tasks. The moderator also monitored task times, obtained post-task rating data, took notes on participant comments, and documented SUS ratings. The moderator also noted task success. The note taker took detailed notes on paths, participant comments and ratings. The moderator and note taker debriefed after the sessions, if any discrepancies were noted or clarifications were needed.

Participants were instructed to perform the tasks [see Appendix 2: Test Protocol]:

- Without assistance from the moderator [except to repeat task details or give clarification on the tasks]
- Without doing anything more than was asked for each task – specifically, not to enter notes or complete fields not requested

For each participant, the moderator read the task and the participant jotted down details on paper. Task timing began once the participant indicated they were ready to start the task and/ or selected the first action button to start the task. Task timing stopped once the participant indicated they had completed the task and/ or selected the final action button to complete the task. Once the task was completed, the participant was asked to provide an ease of use rating for that task based on their use of the application. Scoring is discussed in the section 'Data Scoring'.

Following completion of the tasks, the moderator administered the SUS³ and thanked each individual for his/her participation.

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

TEST ENVIRONMENT

ARIA would typically be used in medical oncology practices and comprehensive cancer centers. In this case, the testing was conducted remotely and via a remote desktop connection to ARIA with test patients and was running version 15.5 of the system. ARIA is in place in the United States and the areas under evaluation are similar, if not identical, for customers. Participants used their own mouse and keyboard to interact with ARIA, once they were passed keyboard and mouse control via GoToMeeting. For testing, the computer hosting the GoToMeeting and ARIA via remote desktop connection was a PC running Windows 10.

³ Brooke, J.: SUS: A "quick and dirty" usability scale. In: Jordan, P. W., Thomas, B., Weerdmeester, B. A., McClelland (eds.) *Usability Evaluation in Industry* pp. 189--194. Taylor & Francis, London, UK (1996). SUS is copyrighted to Digital Equipment Corporation, 1986.

The test patients were created by the vendor according to the vendor’s documentation describing the system set-up and preparation. The application itself was running on Windows 10 using test patients. The task times captured for each task were averaged across two experts for all the tasks and the resulting number was used as the optimal time for each task. The optimal time for each task was used for time comparisons to provide a measure of how much longer an average user would take to perform these tasks.

The following table provides the technical data set-up for the test environment.

Connection	Connection into a remote login server running ARIA with test patients.
Provider Desktop Usability Test Environment	A special login was created with the same privileges as a physician. The login had access to the complete EHR including all functions and backend support software that a real implementation would provide. For the test, 11 patients were created to allow each participant to experience the exact same configuration of patient data. It is important to note that while all efforts were made to create a fully functioning test environment, the configuration of menus and menu choices, applications, alerts, prescription lists, etc. were similar but not the same as what any particular health care provider would use. All of the customized functions are different from site to site, depending on clinic policies and implementation.
EHR software and version	ARIA Oncology Information System (for Medical Oncology) version 15.5
Testing software	GoToMeeting

EHR SCENARIO AND PATIENT SETUP

During the usability study, the participants interacted with ARIA in order to treat one patient. The patient was a new patient that needed her demographic information and diagnosis updated, an allergy documented, a transition of care documented reconciled, medications, a lab and diagnostic imaging ordered, prescriptions sent to pharmacy, and a pacemaker documented. The details of each scenario can be found in the test protocol in Appendix 2. In order to allow each participant to interact with the identical set of data, 11 identical patients were created.

TEST FORMS AND TOOLS

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

- Moderator’s guide
- Post-test SUS

Examples of these documents can be found in the Appendix 2. The moderator’s guide was devised to capture the required test data.

The participants’ interaction with ARIA and their verbal comments were captured and recorded digitally via GoToMeeting. The note taker observed the session live or from the recording.

PARTICIPANT INSTRUCTIONS

The moderator read precise test instructions to each participant [see Introduction in Appendix 2: Test Protocol].

Following the procedural instructions, participants viewed multiple screens of the EHRUT for a particular patient and were asked whether it looked similar to what they were using at their clinic. They were also shown where to document an implantable device, as that was a newly implemented feature.

Participants were asked to indicate when they were ready to begin each task and when they were finished. Then the first task was read to the participant. The participants were given 10 tasks to complete in this manner. The tasks are detailed in the Test Protocol in Appendix 2.

USABILITY METRICS

According to the *NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records*⁴, EHRs should support a process that provides a high level of usability for all users. The goal is for users to interact within the system effectively, efficiently, and with an acceptable level of satisfaction. To this end, metrics for effectiveness, efficiency, and user satisfaction were captured during the usability testing. The goals of the test were to assess:

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

Data Scoring

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

⁴ NISTIR 7741, R. Schumacher & S. Lowry, (2010) NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records.

Measures	Rationale and Scoring
Effectiveness: Task Success	<p>A task was counted as a "Success", if the participant was able to achieve the correct outcome, without user interface directed assistance. Direction was occasionally provided with understanding task instructions but never in how a task was to be completed.</p> <p>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.</p> <p>Task times were recorded for successes. Optimal task performance times, as benchmarked by expert performance under realistic conditions, were recorded when constructing the tasks. These task times were determined by taking multiple measures of optimal performance and then averaged. No adjustments were made to the optimal times, as there is no generally accepted empirical or principled way to determine meaningful adjustments.</p> <p>All participants were allowed to finish the tasks and the time comparisons provide a measure of how much longer an average user would take to perform these tasks.</p>
Effectiveness: Task Failure	<p>If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, the task was counted as a "Failure". For each task the percentage of participants who successfully completed it is reported. The failures can be calculated by subtracting the successful completions from 100.</p> <p>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 were counted as errors. Errors are selections of wrong menu items, wrong list items, or entering wrong data formats. If an error results in a number of corrective steps, only the first actions, resulting in the error is counted as error. All corrective steps are counted as deviations. On a qualitative level, an enumeration of errors and error types was collected.</p>
Efficiency: Task Deviations	<p>The participant's path (i.e., steps) through the application was recorded. Deviations occurred if the participant, for example, went to a wrong screen, followed an incorrect link, interacted incorrectly with an on-screen control, performed any steps to correct a previous error. This path was compared to the optimal path. The number of steps in the observed path was divided by the number of optimal steps to provide a ratio of path deviation.</p> <p>Optimal paths (i.e., procedural steps) along with alternate paths were recorded when constructing the tasks. Deviations were recorded for all tasks completed successfully.</p>
Efficiency: Task Time	<p>Each task was timed from when the participant said, "Ready" or took the first action to start the task until the participant said, "Done." If he or she failed to say, "Done," the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation) were also calculated.</p>
Satisfaction: Task Rating	<p>Participant's subjective impression of the ease of use of the application was measured by administering a simple post-task question. After each task, the participant was asked to answer "Overall, this task was:" on a scale of 1 (Very Difficult) to 5 (Very Easy)". This data is averaged across participants.</p> <p>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 ARIA overall, the moderator administered the SUS questionnaire. Questions included, "I think I would like to use this system frequently," "I thought the system was easy to use," and "I would imagine that most people would learn to use this system very quickly." See full System Usability Scale questionnaire in Appendix 2.</p>

RESULTS

DATA ANALYSIS AND REPORTING

The results of the usability test were calculated according to the methods specified in the 'Usability Metrics' section above. There were no data exclusions for participants not following test instructions. There was a task that could not be completed by a participant due to the incorrect completion of two previous tasks (i.e. medication orders) that did not allow for Task 8 to be completed (i.e. e-prescribing). The incorrect completion of the medication order tasks also prevented this participant the opportunity to complete the clinical decision support and interaction alerts tasks.

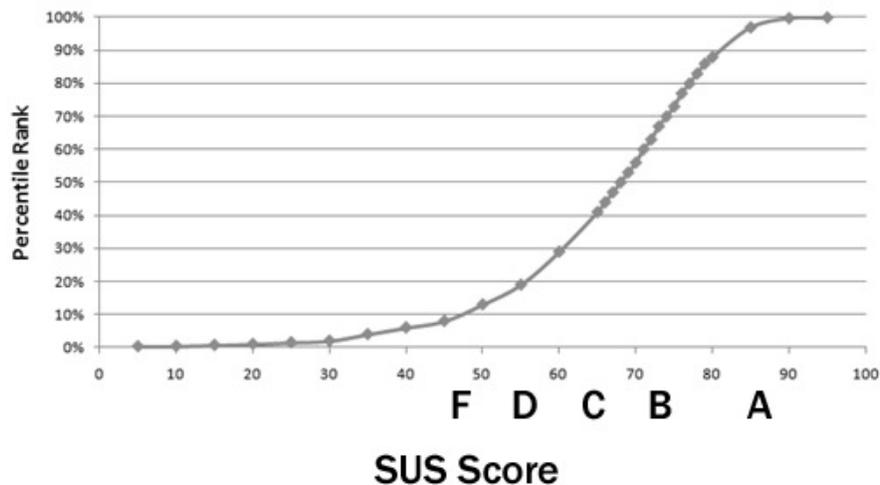
The usability testing results for ARIA are detailed in the table below. The results should be seen in light of the objectives and goals outlined in the section 'Study Design'. The data should yield actionable results that, if corrected, yield material, positive impact on user performance. The following table presents the data such that the tasks can be easily identified and their performance results examined and compared.

Measure	N	Task Success	Path Deviations	Task Time (seconds)			Errors	Task Ratings 5 = Easy
Task	#	Percentage	Deviations [Observed/Optimal]	Mean (SD)	Optimal	Deviations [Observed/Optimal]	Mean (SD)	Mean (SD)
1. Document demographic information	11	91	1.07	71 (29)	45	1.6	0.1 (0.3)	5.0 (0)
2. Document an existing problem	11	73	1.02	81 (39)	67	1.2	0.3 (0.5)	3.8 (0.7)
3. Document an allergy	11	91	1.02	68 (47)	30	2.3	0.8 (1.3)	4.2 (1.2)
4. Document a medication from an external provider	11	100	1.02	47 (21)	28	1.7	0 (0)	4.7 (0.7)
5. Perform clinical information reconciliation	11	0	N/A	N/A (-)	105	N/A	N/A (-)	N/A (-)
6a. Order a medication (favorite)	11	91	1.04*	98* (45)	77*	1.3*	0.1 (0.3)	4.5* (0.7)
6b. Review clinical decision support	10	80					0.2 (0.4)	
6c. Acknowledge interaction alerts	10	40					0.5 (0.5)	
7. Order a medication (non-favorite)	11	82	1.01	92 (58)	77	1.2	0.3 (0.5)	4.4 (0.5)
8. Send prescriptions to a pharmacy	10	100	1.09	50 (20)	30	1.7	0.4 (1.3)	4.0 (1.2)
9. Order a lab and diagnostic imaging	11	100	1.02	38 (13)	21	1.8	0.0 (0.0)	5.0 (0)
10. Document an implantable device	11	55	1.17	106 (42)	49	2.2	0.2 (0.5)	4.2 (0.4)

*Includes task times and ratings for the CDS and Alerts attempts that failed, as the data could not be separated for those attempts

The results from the System Usability Scale [SUS] scored the subjective satisfaction with the system based on performance with these tasks to be: 70. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.⁵

More recent work by Sauro (2011) provides a norming distribution based on 500 comparative SUS scores (from usability tests of a wide range of applications). Based on this distribution, the SUS result of 70 ranks roughly in the 55th percentile or equivalent to a letter grade 'B', see the figure below.



Usability judgments were also collected at the end of each major task. The averages obtained from those task-based usability scores varied from 3.8 – 5.0, quite a bit above the recommendation put forward in NISTIR 7742. The NISTIR 7742 states that — common convention is that average ratings for systems judged easy to use should be 3.3 or above. This is consistent with the overall SUS ratings at the end of the session.

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

DISCUSSION OF THE FINDINGS

The results for each of the twelve areas under evaluation will be discussed separately. For each area, the results are discussed based on the tasks' effectiveness, efficiency and satisfaction. The satisfaction ratings are subjective responses provided by each participant at the end of each task. The 'Major Findings' section includes discussion of the participants' comments, qualitative findings such as errors and deviations made during the performance of tasks, and moderator observations of participant performance patterns. The 'Areas for Improvement' section provides suggestions for improving the areas under evaluation and reducing errors.

Participants began their test session on the 'Visit' tab of the 'Open Patient' window. None of the participants reported that it looked very different from what they use in their current system.

COMPUTERIZED PHYSICIAN ORDER ENTRY - MEDICATIONS

Two tasks were included to evaluate computerized physician order entry [CPOE] for medications. These included:

- Order a favorite medication
- Order a non-favorite medication

Analysis Notes

Task Description

Task 6 was a simple favorite medication order that included the review of clinical decision support and triggered an interaction alert that required participants to provide a reason for overriding the system (see the 'Clinical Decision Support' and 'Drug-Drug, Drug-Allergy Interaction Check' sections for more information regarding the results for those Meaningful Use areas).

Task 7 was a non-favorite medication order with similar alerts and interactions.

These tasks were included to evaluate the participants' workflows of submitting medication orders electronically. The participants had to navigate to 'Orders/Rx', review clinical decision support contents, complete the order screen, review alerts, and approve the orders.

Scoring Notes

All participants followed instructions, as expected. There were no difficulties resulting in exclusions.

Effectiveness

Ten of the 11 participants successfully completed the task of ordering a favorite medication. One participant did not successfully order the medication, as she documented a home medication instead.

One participant provided the following comment regarding effectiveness:

"It is fairly intuitive. It was easy."

Nine participants successfully completed the task of ordering a non-favorite drug. Two participants did not successfully order the medication, as they had the following errors: one participant selected the wrong medication and one participant documented a home medication instead.

Participants provided the following comments regarding effectiveness after completing this non-favorite medication order:

"I think the list of choices is extensive and gives you the option to select the 'mg' option and no hunting."

"Simple and easy."

"You have the variety in the list to choose from and you can pick the drug when you type a name in the 'Agent' field."

Efficiency

For the favorite medication order, all participants started the task by going to the 'Chemo/ Drug Orders' from 'My Agenda' or the 'Rx' button on the toolbar. Once on the 'New Prescription Details' screen, all but one of the participants completed the order by working through the same optimal path (i.e. they majority of participants selected the 'New' button at the top, followed by accessing a list of favorites to select the appropriate medication, and finished the order by selecting 'Approve').

One participant did not use the favorite list to create the order. This was considered as a deviation observed during the completion of this task. One other deviation was observed with another participant who closed the 'New Prescription Details' pop-up when the 'Alerts' tab appeared for the new order only to re-launch it.

There was considerable variability in task times across the successful participants; five finished with no deviations in less than the optimal time and four other participants had no deviations, but took longer than the optimal time to finish. This variability was due to the interactions and alerts posed to the participants that required them to review and consume the information. Some participants were able to do this more efficiently than others (a more detailed analysis of this can be found in the 'Clinical Decision Support' and 'Drug-Drug, Drug-Allergy Interaction Check' sections). One participant had a deviation by not using the list of favorites and therefore, took much longer to complete the task.

It was also noted during this ordering task that participants really appreciate the favorite medication list feature, as it allows them to move through the task more efficiently:

"It is easier when [an order] is a favorite. I do not need to populate 'Dose' and 'Frequency' [information]."

"It's less typing... that is user friendly."

"Nice being in the favorite. [The task was] quick and easy."

"I do like the favorites. It speeds up the process quite a bit and is something I prefer."

For the non-favorite medication order, all participants started the task by selecting 'New' (if they were still on the 'Order/ Rx' tab), 'Chemo/ Drug Orders' from 'My Agenda', or the 'Rx' button on the toolbar. After selecting 'Add' from the 'Order/ Rx' tab, participants completed the order by first typing in the 'Agent' field or selecting the lookup button associated with that field. Most participants selected an associated strength from the 'Dispensed As' area within the 'Agent Selection' pop-up. Once the medication was selected and participants were back on the 'Add Dosage Specification' screen, all participants completed the order by working their way from top-to-bottom and left-to-right (i.e. they worked their way down the form and finished the order by selecting 'Ok').

One participant did not select a strength from the 'Dispensed As' area within the 'Agent Selection' pop-up, so was required to complete the 'Dose/ Range' field and associated 'Unit' field when back on the 'Add Dosage Specification' screen (i.e. they needed to indicate "1 mg").

Most of the other participants committed to extra work in completing the details of the order, as they decided to complete the 'Dose/ Range' field and associated 'Unit' field on their own as additional steps. These fields affected task completion times. The two behaviors observed were: indicating "1 tablet" when "tablet" was already captured as a 'Form' and indicating "1 mg" when "1 mg" was already captured as a 'Strength'.

Only one participant selected the 'Sync. Dur/Qty' checkbox to automatically populate the 'Quantity' field.

The only deviation observed during this test was to correct an error, a selection of an incorrect frequency. All other participants had no deviations in this task.

Participants provided the following comments regarding efficiency after completing this non-favorite medication order:

"Fairly simple but a lot of clicks since it is not on a favorite list."

"Everything is in a drop-down so makes it easy. We do not have to type everything in."

"It is very cumbersome."

Satisfaction

Overall, the task satisfaction rating across the two tasks was 4.5 for CPOE - Medications. This average rating is well above the 'easy to use' threshold [3.3]. The higher rating was for the task of placing an order for a favorite medication [4.5] versus a non-favorite medication [4.4]. As noted above and below, many participants also commented on the ease of creating a medication order, especially when it is for a favorite medication.

"It was easy to use."

Major Findings

- When a user creates an order, the system does not indicate mandatory fields and this slows the user down. For example, if a user does not indicate a 'Dose', s/he receives a warning upon selecting 'Ok'.
- Two of the errors observed during the order entry tasks (one instance for each task) were due to a home medication being documented rather than an order being placed by the same participant
- For the non-favorite order, one error was due to an incorrect medication selection
- For the non-favorite order, one error was due to an incorrect frequency being selected with a corresponding deviation to correct the error
- The 'Dose/ Range' field and associated 'Unit' field was a pain point for participants when trying to complete the order, as many committed extra work thinking it was necessary to complete both fields. For example, indicating "1 tablet" when "tablet" was already captured as a 'Form' and indicating "1 mg" when "1 mg" was already captured as a 'Strength'.
- The favorite medication order worked well for users, as there is very no typing required to place the order.
- Ordering a favorite medication was the easier task for the participants, as proved by the success rate and satisfaction score.

Areas for Improvement

Based on the results, the following potential improvements are suggested:

- Consider indicating mandatory fields when creating orders.
- Consider disabling the 'Ok' button when mandatory fields have not been filled (i.e. instead of providing a warning message to users that information is missing).

- Consider streamlining the fields required when entering an order to avoid duplicative entry by users (i.e. 'Dose/Range' and corresponding 'Unit' fields)
- Consider calculating the 'Quantity' based on previous entries (i.e. 'Duration' and 'Frequency')

COMPUTERIZED PHYSICIAN ORDER ENTRY - LABORATORY

One task was included to evaluate CPOE for a laboratory and was paired with the task of ordering diagnostic imaging. It included:

- Order a lab and a diagnostic imaging

Analysis Notes

Task Description

Task 9 was a simple lab and diagnostic imaging order task that included ordering a CA-125 test and mammogram, both by the next visit.

This task was included to evaluate the participants' workflow of submitting lab orders electronically. The participants had to navigate to 'Physician Orders', select the appropriate lab, and select 'Approve' to submit the order.

Scoring Notes

All participants followed instructions, as expected. There were no difficulties resulting in exclusions.

Effectiveness

All participants successfully completed the task of ordering a lab. There were no errors observed during this test task.

Participants provided the following comment regarding effectiveness:

"It is fairly easy to chose from the ['Physician Orders' pop-up]."

Efficiency

For the lab order, all participants started the task by going to the 'Physicians Orders' button on the toolbar. The one deviation observed during this task was related to the imaging order and not the lab order (i.e. both orders were analyzed as one task). Once the lab order had been appropriately chosen, all participants completed the order by working through the same optimal path (i.e. they selected the 'Approve' button at the bottom-right).

The task time did not vary greatly for this task, as participants were able to very efficiently complete the task. Two participants completed the task at the optimal time and slightly faster.

One participant mentioned that for a patient who requires many of the same labs on a regular basis, checking so many boxes is cumbersome:

"It's cumbersome because I have to order the same labs every week... and when there is a lot of labs, you have to select each and every box."

Other participants commented on the efficiency of ordering labs by using the 'Physician Orders' pop-up:

"It's a nice flow. I did not have anything to type and just selected items instead of typing."

"Being able to set the default to what is most common and frequent and having the notes already there and no need to type."

"I like the fact that the tests are all there and is very efficient and fast. I would like the orders for drugs to be like that."

"It's all there right in front of you, just selecting what you need all options available."

"Easy clicks and available."

Satisfaction

Overall, the task satisfaction rating for this task was 5.0 for CPOE – Laboratory and Diagnostic Imaging. This average rating is well above the 'easy to use' threshold [3.3]. As noted above, many participants also commented on the ease and efficiency of creating a lab order.

Major Findings

- The lab order worked well for users, as there is no typing required to place the order.
- Ordering a lab was an easy task for the participants, as proved by the success rate and satisfaction score.

Areas for Improvement

Based on the results, the following potential improvements are suggested:

- Consider providing users with customized templates for most common lab test orders per diagnosis

COMPUTERIZED PHYSICIAN ORDER ENTRY – DIAGNOSTIC IMAGING

One task was included to evaluate CPOE for diagnostic imaging and was paired with the task of ordering a laboratory. It included:

- Order a lab and diagnostic imaging

Analysis Notes

Task Description

Task 9 was a simple lab and diagnostic imaging order that included ordering a mammogram by the next visit and to indicate, as a note, to compare this mammogram to the last mammogram.

This task was included to evaluate the participants' workflow of submitting diagnostic imaging orders electronically. The participants had to navigate to 'Physician Orders', select the appropriate option from the 'Diagnostics' section and select 'Approve' to submit the order.

Scoring Notes

All participants followed instructions, as expected. There were no difficulties resulting in exclusions.

Effectiveness

All participants successfully completed the task of ordering a mammogram. There were no errors observed during this test task.

Efficiency

For the diagnostic imaging order, all participants started the task by going to the 'Physicians Orders' button on the toolbar. One deviation was observed during this task, as one participant closed and reopened the mammogram pop-up. Once a mammogram had been appropriately chosen, all participants completed the order by working through the same optimal path (i.e. they selected the appropriate note followed by the 'Approve' button at the bottom-right).

One participant mentioned that for mammograms, the ability to quickly add order details via the automatic pop-up, is a big time saver:

“Having the list to choose from it is easy, especially for mammogram when you put the reason because for approval internally, we have to give a reason and it is important since it is a huge time saver to have that already listed there.”

In general, other participants commented on the efficiency of ordering items by using the ‘Physician Orders’ above in the ‘CPOE – Laboratory’ section.

Satisfaction

Overall, the task satisfaction rating for this task was 5.0 for CPOE – Laboratory and Diagnostic Imaging. This average rating is well above the ‘easy to use’ threshold [3.3]. As noted above in the previous section, many participants also commented on the ease and efficiency of creating an imaging order.

Major Findings

- The diagnostic imaging order worked well for users, as there is no mandatory typing required to place the order.
- Ordering diagnostic imaging was an easy task for the participants, as proved by the success rate and satisfaction score.
- It was observed that many participants scrolled down the list of images that could be added to the order, not realizing that mammogram was already presented to them at the top; this may be due to this list being ordered by something other than alphabetical, as compared to all the other lists in the ‘Physicians Orders’ which, are organized alphabetically

Areas for Improvement

Based on the results, there are no improvements are suggested.

DRUG-DRUG, DRUG-ALLERGY INTERACTION CHECK

One task was included to evaluate drug-drug, drug-allergy interaction checks:

- Order a favorite medication

Analysis Notes

Task Description

Task 6 was a simple favorite medication order that included the review of clinical decision support and triggered interaction alerts that required participants to provide a reason for overriding the system (see the ‘Clinical Decision Support’ section for more information regarding that review).

This task was included to evaluate the participants’ workflows of submitting medication orders electronically and reviewing and addressing drug-drug and drug-allergy alerts. The participants had to navigate to ‘Orders/Rx’, review clinical decision support contents, complete the order screen, review interaction alerts, and approve the order.

Scoring Notes

One participant documented a home medication instead of ordering a new medication. This resulted in a failure for the drug entry task and therefore, was the only issue that resulted in exclusion for the interaction alerts task.

Exclusions

Task #	Participant ID	Comment
6	P9	Medication order were incorrectly completed so there were no interactions checks

Effectiveness

For Task 6, nine of the 10 included participants successfully reviewed the 'Summary' tab, after ordering a favorite medication. However, only four of these participants explored the 'Medi-Span Medication Screening' pop-up in more depth for additional information in the 'Interactions' tab.

Three participants verbalized their concerns or objections while completing the task, as they found 'Medi-Span Medications Screening' pop-up disrupting or expressed alert fatigue and not noticing the interactions:

"[I rated it lower for ease of use] because of the pop-up."

"Just about always there is pop-up when ordering. This is not good for safety since I get them all the time. It would be good to get them when there is really a problem like an allergy because then they become a true warning."

"An alert came up with interaction and I am annoyed by it every time because I have never come to a situation that I prescribe somebody something they are allergic to."

One participant commented that alerts during medication ordering is helpful in providing relevant clinical information:

"The alerts were nice. They were informational."

Efficiency

For Task 6, the 'Medi-Span Medications Screening' pop-up itself did not pose any severe challenges to those who reviewed it and noticed the interaction checks. It was straightforward and simple for participants to provide a reason for prescribing the medication. The only observed deviations were exploring additional tabs in the pop-up such as the 'Contraindications' and 'Disclaimer' tabs which were not related to the interaction check task.

One participant expressed concern that the 'Medi-Span Medications Screening' pop-up slows him/ her down while ordering medications:

"Pop-ups can be tedious when you prescribe drugs and slows the process down."

Satisfaction

The overall satisfaction rating for Task 6 is 4.5. There were no comments specifically directed at the 'Medi-Span Medications Screening' pop-up regarding satisfaction.

Major Findings

- For Task 6, the alerting system includes a pop-up whose 'Interaction' tab content is populated when a medication is chosen that interacts with the patient's allergy and/ or medications. After reviewing the interactions, participants were required to provide a reason for prescribing the medication (i.e. 'clinically acceptable risk'). This pop-up was immediately effective for four of the 10 participants. Four other participants did not review the 'Interactions' tab but spent time reviewing the 'Summary' tab. These four participants and another participant moved on with just providing the reason for continuing with the order.
- The pop-up could be more effective at alerting the participants to any interactions

- Additionally, some participants found the pop-up irritating because it occurs so frequently (perhaps with every order in their context; this was not explored in-depth during the test)

Areas for Improvement

Based on the results, the following areas for improvement are suggested:

- Improve noticeability of the impact (i.e. contraindication, interactions) that a specific order has which is triggered by patient demographics or conditions
- Consider including a brief summary of the 'Interactions', 'Contraindications' and 'Prior Adverse Reactions' on the 'Summary' tab within the 'Medi-Span Medication Screening' pop-up to avoid users an extra click and allow to dive into detail as required

DEMOGRAPHICS

One task was included to evaluate demographics:

- Document demographic information

Analysis Notes

Task Description

Task 1 was a task that included documenting the patient's demographic information, specifically her ethnicity, race, and language fields, within the 'Modify Patient' window.

This task was included to evaluate the participants' workflows of accessing the patient's demographic information from the 'Visit' tab and documenting three items within the 'Demographics' tab.

Scoring Notes

All participants followed instructions, as expected. There were no difficulties resulting in exclusions.

Effectiveness

For Task 1, 10 of the 11 participants successfully added the demographic information to the patient's record.

One participant documented this demographic information in the patient's history within the 'Family' tab. This was the only failed attempt.

Despite many of the participants noting that they do not typically complete this task in their daily practice, the success rate was very high:

"I am a research nurse and do not normally enter this information."

"I do not typically do this."

"This is something I do not normally do."

Many of the participants noted that they found this task straightforward and easy to complete because of the pre-populated options for each of the pieces of demographic information they were required to document:

"It's self-explanatory."

"The search function for a lot of languages is helpful."

"The drop-down menus for the three fields [made this task easy]."

"The lookup for each demographic field is helpful."

"Everything is there in the drop downs and I can just select it."

“All of the information was right there together.”

Efficiency

For Task 1, adding the demographic pieces of information did pose some challenges to two participants. Once the lookup button was selected from the ‘Demographics’ tab for a particular field, these participants highlighted the correct demographic to add to the patient’s record but did not select the right arrow to move it from the ‘Available’ section to the ‘Selected’ section before selecting the ‘Ok’ button. This resulted in deviations.

The other observed deviations for this task included:

- Going to an incorrect tab within the ‘Modify Patient’ pop-up at the beginning of the task (i.e. ‘IDs’, ‘Preferences’)
- Going to an incorrect tab after the ‘Demographics’ tab (i.e. ‘General’ and ‘Preferences’)
- Saving and closing the ‘Modify Patient’ pop-up prematurely
- Going to the ‘History’ section of the patient’s record
- Re-opening the patient record

One participant commented on the number of steps it took to complete the task:

“I do not usually do this [task]. It’s a lot of steps.”

Only two participants completed the task under the optimal time. Many participants were twice as slow in completing this task because of the hunting behavior observed during the test to find the ‘Demographics’ area.

Satisfaction

The overall satisfaction rating for Task 1 is 5.0. This rating is well above the ‘easy to use’ threshold [3.3]. There were no comments specifically directed at the ‘Demographics’ tab, other than those listed above.

Major Findings

- For Task 1, 10 out of 11 participants documented the patient’s demographic information correctly.
- During this task, it was observed that many participants hunted for the correct place to document the information, as noted by the number of deviations and the other spaces visited in getting started (e.g. within the ‘Modify Patient’ pop-up, this included exploring the ‘IDs’, ‘General’ and ‘Preferences’ tabs).

Areas for Improvement

Based on the results, the following areas for improvement are suggested:

- Consider incorporating a method of adding demographic information that is more consistent with other spaces (e.g. checkboxes as in the ‘Allergy’ space) to decrease the number of selections needed

PROBLEM LIST

One task was included to evaluate the problem list. It included:

- Document an existing problem

Analysis Notes

Task Description

Task 2 was a task focusing on documenting an existing problem for the patient, specifically that she has a malignant neoplasm of the upper-outer quadrant of her left breast.

This task was included to evaluate the participants' workflows of documenting an existing problem in the 'Diagnoses/ Problems' portion of the patient's record. The participants had to navigate to the 'Diagnoses/ Problems' section, select 'New' to document a new diagnosis, followed by selecting the lookup button near the 'Code' field to search and select the proper code for the diagnosis. Once the code was selected, participants had to review that everything was captured accurately and save their work.

Scoring Notes

All participants followed instructions, as expected. There were no difficulties resulting in exclusions.

Effectiveness

Eight of the 11 participants successfully completed the task of documenting an existing problem. Two participants did not successfully document the problem, as they documented another diagnosis instead (i.e. selecting either a diagnosis for the right breast or for a male breast). The other participant did not select a code for the diagnosis before saving the manually entered information and stating that she had completed the task.

A few participants provided the following comments regarding effectiveness, as they struggled trying to complete the task by means of a 'Save' or 'Close' action:

"There is no 'Approve' [button] at the bottom. I do not see it. Can I hit the 'Close' button then?"

"I know there should be an 'Ok' or 'Save' button... [participant selected the 'Refresh' button]... like in the bottom of the screen. I do not see the 'OK' or 'Approve' button."

"I guess [the button] is cut off. I cannot see where 'Save' or 'Close' is... [the participant selected the 'x' button at top-right corner of the window and was prompted to save]."

"I had trouble finding how to save it... I was scrolling down or up to find it. I had to look around. I am used to seeing the 'Save' [button] at the bottom of the screen. I had to find it. It did not [jump out] to me."

Another participant commented on the ease of finding the correct ICD-10 code, based on minimal text entry required in the search field:

"I like that I only have to put a minimal amount of information in the search for ICD-10 to pop up and I like that I can make the column larger to read the entire diagnosis."

Efficiency

For this task, seven participants started the task by going to the 'History' button in the toolbar and then selecting the 'Diagnoses/ Problems' tab from the patient history window. To start this task, three others participants selected the 'Primary Dx' button directly from the 'Patient Agenda' window and one participant selected 'Diagnoses/ Problems' directly from the 'My Agenda' tab for that patient's visit.

Once the participants launched a new diagnosis, participants completed the 'Diagnosis' pop-up by working through similar paths:

- Providing a description for the problem in the 'Clinical Description' comment field and then going through the code lookup workflow, or
- Accessing the code lookup immediately and going through the code lookup workflow

Within the 'Advanced Search for Diagnosis/ Problem Code' pop-up, it was observed that only a few participants used the 'Cancer Codes Only' checkbox in order to filter their results. It was also observed that most participants hovered over the ICD-10 descriptions in order to see the full description in a tooltip (only one participant altered the column width).

One deviation that was observed during the completion of this task was selecting the 'Save' button more than once in order to complete the task. The other deviation that was observed with another participant was the correction of an incorrectly selected code (i.e. a diagnosis for a male breast instead of a female).

There was considerable variability in task times across the successful participants; three finished with no deviations in less than the optimal time and five other participants had no deviations, but took longer than the optimal time to finish. This variability was due to the speed at which participants could search for and find the correct diagnosis to document in the patient's record. Some participants were able to do this more efficiently than others by using either the 'Cancer Codes Only' checkbox and/ or typing a more specific diagnosis in the search field. Participants were slowed down significantly, if their means of finding the correct diagnosis was by hovering over each diagnosis line and waiting for the tooltip to appear and show the full code description in the 'ICD-10 CM Description' column (within the 'Advanced Search for Diagnosis/ Problem Code' pop-up).

Participants expressed that during this task, searching and identifying a code directly impacted their efficiency:

"Easy to use but cumbersome since there are many diagnoses to choose from. We changed from ICD-9 to ICD-10 codes so you need to be more specific."

"I do enter a lot of the diagnosis and every now and then there are diagnosis that are difficult to search for."

"There are a lot of codes... a lot to dig in there."

"It seems very cumbersome and not intuitive where to look."

"Taking the time to read and find the appropriate code to select [impacts ease of use]."

Satisfaction

Overall, the task satisfaction rating for this task was 3.8. This average rating is above the 'easy to use' threshold [3.3]. As noted above, many participants commented on the slow workflow of documenting a diagnosis, especially when needing to select a code, and the confusion of how to complete the task and have the information captured in the record.

Major Findings

- Eight of the 11 participants, successfully passed this task and three did so without deviations and faster than the optimal time
- Three errors were observed during this task due to participants selecting an incorrect diagnosis code; one error was corrected before the completion of the task
- A fourth error was the omission of a diagnosis code before the completion of the task
- The number of results presented to the participants in combination with their long descriptions was a pain point for participants when trying to identify and select the correct code, as many hovered over codes and waited for the corresponding tooltip.
- Locating the code lookup button and the action buttons (i.e. 'Save' or 'Close') to complete the task were pain points for the participants and contributed to lengthy task completion times

Areas for Improvement

Based on the results, the following potential improvements are suggested:

- Do not allow users to select an incorrect diagnosis only to alert them of the incorrect selection upon saving the diagnosis (e.g. cancer of the male breast in a female patient's record) (i.e. providing this alert at the end of the workflow: "Data Validation Error: The selected ICD code is only applicable for males.")
- Only disclose the fields to enter the diagnosis information once the user selects 'New' (i.e. like when adding new allergies, implantable device)
- Consider providing better tools to search for diagnosis (e.g. if cancer diagnoses are the most prevalent, checking the 'Cancer code only' checkbox by default to make the diagnosis results list much shorter and therefore, facilitates user search and selection and/or suggesting a minimum text search criterion for a more efficient search)
- Consider making the 'OK' button unavailable in the 'Advanced Search for Diagnosis/Problem Code' window until the user makes a selection.
- Ensure action buttons remain in a consistent location for starting and completing tasks (e.g. 'Save', 'Cancel', and 'Close')
- Upon selecting the 'Save' button, the new diagnosis appears above but the form stays filled with the same information and does not become blank, as in other spaces in the application
- It is difficult for users to know if their actions were successful when using action buttons within pop-ups (i.e. selecting 'Save' in the 'Diagnosis' pop-up, presents the user with the new diagnosis above (that may or may not be noticed) but not behind in the 'Patient History' (until the pop-up has been closed))

MEDICATION LIST

One task was included to evaluate the medication list. It included:

- Document a medication from an external provider

Analysis Notes

Task Description

Task 4 was a task focusing on documenting a medication from an external provider, specifically that the patient is taking Coumadin 4 mg tablet daily.

This task was included to evaluate the participants' workflows of documenting a current medication from an external provider in the 'Medications' portion of the patient's record. The participants had to navigate to 'Patient History', select the 'Medications' tab, and select 'New' to begin documenting the medication. They could have also started this task by selecting 'Current Medications' from the 'My Agenda' tab. Upon selecting 'New', the participants had to select the 'Medication' field lookup button and search for the medication using the 'Agent Name' field. Once the medication search was completed, participants could either select the medication from the 'Dispensed As' area at the bottom of the 'Agent Selection' pop-up or continue on and complete that information and the rest of the details back on the 'New Medication' pop-up. In order to complete the task, participants needed to select 'Ok' at the bottom of the 'New Medication' pop-up.

Scoring Notes

All participants followed instructions, as expected. There were no difficulties resulting in exclusions.

Effectiveness

All the participants successfully completed the task of documenting a medication from an external provider. None of the participants committed any errors during this task.

Two participants commented on the ability to indicate the correct strength within the 'Dispensed As' area in the 'Agent Selection' pop-up and its ability to auto-populate fields in the 'New Medication' pop-up:

"It is easy to search for and the doses are all listed."

"Just following multiple doses to choose from and being there listed [so I rated the task as easy to use]."

"I like the way you select the drug and auto-populates the information for you."

About half of the participants ran into difficulty completing the task using the action buttons (i.e. 'Save – Add', 'OK' and 'Cancel'). In general, the behavior observed was the selection of 'Save – Add' followed by 'Cancel' or 'x' and receiving the warning: "Do you want to save your changes?" for a blank new medication form. The participants then selected 'Yes' only to then receive the message: "A value for 'Medication' is required". (Note: the same behavior occurs if a user selects 'New' (to begin the new medication workflow) followed by 'Cancel' (without adjusting any of the 'New Medication' pop-up fields).) Two participants commented on the difficulty of using the action buttons at the bottom of the 'New Medication' pop-up, specifically referring to the 'Save – Add' action button:

"I do not like [the 'New Medication' pop-up]... the 'Save – Add' medication [action]. When you get done, it automatically pulls the blank page up again, so you have to say 'No' to let you come out again."

"This window did the same as previously when you finished and you save. It leaves the window open and it does not close it. It leaves the window there and I keep getting the [confirmation and error] messages."

When searching for a medication, two participants commented on the flexibility of using either brand or generic names for medications:

"When the name pops up, it shows brand and generic and that is easy. A lot of the time, the patient takes the generic brand and then we can change it to brand name."

"I normally put the generic name 'Warfarin' [for Coumadin] and not the brand name."

Efficiency

For this task, all but one of the participants started the task by going to the 'History' button in the toolbar and then selecting the 'Medications' tab from the patient history window. The other participant selected the 'Current Medications' directly from the 'My Agenda' tab for that patient's visit.

Once the participants had selected the correct drug, participants stated that the 'New Medication' pop-up was fairly straightforward to complete:

"The form comes up and it is pretty use to use... just need to follow the form. Makes it easy."

"All the information was available and easy to click."

"It is all there for you... just fill everything in."

However, participants expressed that during this task, remembering mandatory fields directly impacts their efficiency and the labeling of some of the fields are confusing:

"I have all the fields that I need to enter the medication. One thing that I would recommend is to make the fields required... 'What is the strength and how many times should the patient be taken the drug per day?' and so on."

"If you choose the 'mg' of the tablet [in the 'Dispensed As' area], lots of people put '4 mg' in the dose again [back on the 'New Medication' pop-up], but if you do that, then it says, 'you take 4 of 4 mg tablet daily' so it is a little confusing right there."

Participants could complete this task fairly efficiently but only two under the optimal time. Participants took longer if they completed additional fields within the 'New Medication' pop-up that were not necessary but seem to be based on their labeling (see quotes above). The fields that are troublesome to end users are the 'Dose' and related 'Unit' fields. For example, if participants selected a strength for the medication from the 'Dispensed As' area, they continued on to select "1" for the 'Dose' field and then committed extra work by selecting "Tablet" from the 'Unit' field or "4" for the 'Dose' field and "mg" from the 'Unit' field. This is not necessary, as their selection from the 'Dispensed As' area already indicates that the 'Form' is a "Tablet" and "mg" in the 'Strength' field. This additional work does not change the information displayed on the 'Medications' tab in the patient's history either.

Only two deviations were observed during the completion of this task and they were selecting the 'Save -Add' button (i.e. the correct path would have been to select the 'Ok' button after completing the 'New Medication' pop-up). These participants then went to the 'Cancel' or 'x' buttons and received the warning: "Do you want to save your changes?".

Satisfaction

Overall, the task satisfaction rating for this task was 4.7. This average rating is above the 'easy to use' threshold [3.3]. As noted above, participants commented on the confusing labeling of fields while documenting an external medication and the confusion of how to complete the task and have the information captured in the record.

Major Findings

- All participants successfully passed this task and nine did so without deviations
- No errors were observed during this task
- Completing the task was a pain point for about half the participants, as they selected 'Save – Add' followed by the action of selecting 'Cancel' or 'x' that produced a warning message; this warning message was followed by another if they selected 'Y' to the question, 'Do you want to save your changes?'
- Participants could complete this task fairly efficiently but only two under the optimal time; participants were slowed down because of the issue presented in the previous point and/ or completing extra work in the 'New Medication' pop-up

Areas for Improvement

Based on the results, the following potential improvements are suggested:

- Compare the frequency and importance of the 'Save – Add' versus the confusion it causes for end users when adding medications to a patient's history
 - If 'Save – Add' needs to stay, ensure that the language used is consistent with other spaces in the application (e.g. for the 'Allergies' pop-up, this button is labeled as 'Save – New')
 - If 'Save – Add' needs to stay, conduct additional user research to ensure that the contrast between 'Ok' and 'Save – Add' is clear; the control 'Ok' needs to give users the impression that the application will save their work (i.e. the resulting action is a 'Save' and 'Close' of the pop-up when this button is selected)

MEDICATION ALLERGY LIST

One task was included to evaluate the medication list. It included:

- Document an allergy

Analysis Notes

Task Description

Task 3 was a task focusing on documenting an allergy, specifically that the patient has a suspected allergy to the Penicillin drug class. Participants were also required to document two reactions due to this allergy: mild nausea and mild rash.

This task was included to evaluate the participants' workflows of documenting a current allergy and two reactions in the 'Allergies' portion of the patient's record. The participants had to navigate to 'Patient History', select the 'Allergies' tab, and select 'New' to begin documenting the allergy. They could have also started this task by selecting 'Allergies' from the 'My Agenda' tab. Upon selecting 'New', the participants had to select 'Drug Class' from the 'Type' drop-down and use the 'Allergy' lookup to find and select 'Penicillins'. Once the 'Drug Class Search' was completed, participants had to select or indicate the two responses at the bottom of the 'New Allergy/ Adverse Reaction' pop-up. Alternatively, participants could have chosen to keep the 'Allergy Type' as 'Drug' and chose a Penicillin drug or Amoxicillin for this task instead. To complete the task, participants needed to select 'Ok' at the bottom of the pop-up.

Scoring Notes

All participants followed instructions, as expected. There were no difficulties resulting in exclusions.

Effectiveness

All but one of the participants successfully completed the task of documenting an allergy. The eleventh participant committed the error of documenting an adverse reaction instead of an allergy (i.e. she selected the 'Adverse Reaction' radio button instead of staying with default 'Allergy' radio button).

The other observed errors during this task included:

- Not indicating one or both responses; two participants committed this error
- Not indicating one or both of the responses' severities; two participants committed this error

The participants who did not select 'Drug Class' from the 'Type' drop-down were frustrated and confused with the amount of results they received after selecting the 'Allergy' lookup button and attempting a search for 'penicillin'. This resulted in participants choosing any penicillin drug or amoxicillin to add to the patient's record:

"It comes down to workflow process. I can be confusing about penicillin as a drug."

"It is so specific. It tries to be too specific and I have this problem with most EHRs with penicillin."

"It has a huge list of options for Penicillins and it was difficult to choose which one so then I switch to 'Amoxicillin'."

One participant commented on the need to separate some of the responses to be more appropriate:

“The nausea and diarrhea should be separated and the same goes for rash and hives. You can have a rash without hives and to have hives is way more significant [than a rash]. There is a lot of details with the drug but not the allergy and the effects.”

Only one participant completed the task with a free text allergy (i.e. she typed ‘Penicillin’ as a drug), which resulted in the warning: “Manually entered agent names will result in no interaction checking being performed. Do you wish to search for the entered agent?”.

Efficiency

For this task, all but one of the participants started the task by going to the ‘History’ button in the toolbar (unless they were still in the patient’s history) and then selecting the ‘Allergies’ tab from the patient history window. The other participant selected ‘Allergies’ directly from the ‘My Agenda’ tab for that patient’s visit.

Two participants, who completed the task either under the optimal time or very close to, stated that the workflow was easy and straightforward, as all necessary fields were available to them:

“It was all available. Easy to click.”

“We do this every day so it is very easy.”

However, it was observed that a few participants attempted to complete this task using the shorthand for penicillin (i.e. PCN) while searching which was unsuccessful.

Of the successful task completions, the observed deviations included selecting ‘Save – New’ followed by ‘Ok’ and getting a warning message and toggling between ‘Therapeutic Class’ and the ‘Agent Name’ during lookup.

This task had the second highest deviation in regards to time, as compared to the optimal time, due to the unsuccessful and multiple attempts of participants trying to identify and select an appropriate drug or drug class.

Satisfaction

Overall, the task satisfaction rating for this task was 4.2. This average rating is above the ‘easy to use’ threshold [3.3].

Major Findings

- Ten of 11 participants successfully passed this task
- The observed errors during this task included not selecting a response and/ or severity of a response or responses
- The successful participants were able to complete this task fairly efficiently; two at or under the optimal time and most of the others close to the optimal time (there was only one outlier that took six times longer to complete the task, as searching for the desired allergy took longer)

Areas for Improvement

Based on the results, the following potential improvements are suggested:

- Consider providing the ability for users to pick a search result from either a ‘Drug Class’ or ‘Drug’ search, as the frequency of needing a ‘Drug Class’ results seems to be quite prevalent
- The same consideration is needed, as in ‘Medication List’ section regarding the ‘New Medication’ pop-up and the action buttons ‘Save – New’ versus ‘Ok’

CLINICAL DECISION SUPPORT

One task was included to evaluate clinical decision support:

- Order a favorite medication

Analysis Notes

Task Description

Task 6 was a simple favorite medication order that included the review of clinical decision support and triggered interaction alerts that required participants to provide a reason for overriding the system (see the 'Drug-Drug, Drug-Allergy Interaction Check' section for more information regarding the interaction checks).

This task was included to evaluate the participants' workflows of submitting medication orders electronically and reviewing any clinical decision support items. The participants had to navigate to 'Orders/Rx', review clinical decision support contents, complete the order screen, review interaction alerts, and approve the order.

Scoring Notes

One participant documented a home medication instead of ordering a new medication. This resulted in a failure for the drug entry task and therefore, was the only issue that resulted in an exclusion for the clinical decision support task.

Exclusions

Task #	Participant ID	Comment
6	P9	Medication order were incorrectly completed so there was no clinical decision support to review

Effectiveness

For Task 6, eight of the 10 included participants successfully reviewed the 'Alerts' tab.

Two participants did not pause and review the clinical decision support content within the 'Alerts' tab at all. These participants clicked on to the 'Order/ Rx' tab immediately to continue on with the medication order.

Efficiency

For Task 6, the 'Alerts' tab itself did not pose any severe challenges. There was one observed deviation, as one participant closed the 'New Prescription Details' window completely and had to re-launch the window to place the order.

Two participants verbalized their concerns regarding efficiency while completing the task:

"[I rated it lower for ease of use] because of the alerts. The 'Alerts' tab and toggling back-and-forth is quite annoying."

"When trying to do this [order], I get these alerts and interactions from government and it slows you down and it is not productive. Compared to other EHR systems, this is very cumbersome. If a patient has 20 pills, it would take a great amount time of doing the prescriptions."

Satisfaction

The overall satisfaction rating for Task 6 is 4.5. Some comments specifically directed at the 'Alerts' tab can be found above and additionally, one participant verbalized her objections while completing the task:

"I am annoyed by that ['Alerts' tab]. I do not need to know all of that and do not think every patient needs to be enrolled in a breast support group... Because of the alerts [I rated it lower for ease of use]."

Major Findings

- For Task 6, eight out of 10 participants reviewed the 'Alerts' tab and successfully complete the task
- The clinical decision support for this medication order task includes a tab whose presence is triggered when a new medication order is started and is based on the patient's demographic, condition, allergies, etc. After reviewing the tab's content, participants needed to continue with the order by selecting the 'Order/ Rx' tab within the same 'New Prescription Details' pop-up. This 'Alerts' tab was immediately effective for eight of the 10 participants. The other participants skipped reviewing the content.
- The 'Alerts' tab was irritating to some of the participants, as noted by their ad-hoc comments. They found it interrupted their workflow and/ or was not appropriate for the patient.

Areas for Improvement

Based on the results, the following areas for improvement are suggested:

- After an initial presentation, consider providing users with the ability to dismiss alerts for a particular patient; this would be especially of use if in the current visit, a patient has subsequent orders (i.e. then the same alerts would not appear each time)
- Improvements to the flow of launching a new order and providing users with the clinical decision support are needed, as it is currently providing a disjointed user experience with many calls to action in different locations around the screen (i.e. after navigating to the 'Medication' space, users need to select the 'New...' button from the middle-top of the screen which launches the 'New Prescription Details' pop-up. Once within the pop-up, users need to review the 'Alerts' tab, select the 'Order/ Rx' tab on the far left, followed by selecting the 'Favorite...' button on the far right, selecting a med, and then the 'Add' at the bottom-right).

IMPLANTABLE DEVICE LIST

One task was included to evaluate the medication list. It included:

- Document an implantable device

Analysis Notes

Task Description

Task 10 was a task focusing on documenting an implantable device, specifically, that the patient has a pacemaker that was implanted in June 8, 2016. This was a new workflow for all test participants so it was introduced to them at the beginning of the test session.

This task was included to evaluate the participants' workflows of documenting an implantable device in the patient's history. The participants had to navigate to 'Patient History', select the 'Implantable Devices' tab, and select 'Modify' and 'New' to begin documenting a new implantable device. Upon selecting 'New', the participants had to paste the unique device identifier (UDI) provided to them via the GoToMeeting or remotely via MS Notepad and indicate the correct 'Date of Implantation'. Participants could either select the UDI lookup button to have the application auto-complete the rest of the data fields or select 'Ok' followed by addressing the confirmation pop-up asking them if they wanted to review or not review the auto-completed fields before saving.

Scoring Notes

All participants followed instructions, as expected. There were no difficulties resulting in exclusions.

Effectiveness

Six participants successfully completed the task of documenting an implantable device. The rest of the participants all committed errors during this task that led to task failures or abandoned the task:

- Two participants documented the implantable device in the 'Procedures/ Surgical' tab
- Three participants could not complete the task and two were provided hints to get started (i.e. selecting the 'New' button within the 'Patient Implantable Devices' pop-up) (note: the two that were provided hints were automatically counted as failed attempts)

Three participants commented specifically on the difficulty of locating the 'New' button at the top-right corner of the pop-up:

"Where would you put this [UDI]? There are so many menus and options. Putting the buttons scattered across the window is confusing. I was focusing on the bottom right of window [to get started]. It was not quite self-evident where to find [the 'New' button]. Once you learn it is okay but for the first time, it is not evident."

"It was knowing that I needed to click 'New' [that made this task challenging]."

"I am trying to figure out how to paste [the UDI]. If it would allow me to do it, I would put the date of the implant but it is grayed out and in 'General Comments', I would type: pacemaker chest."

Seven participants, who got to the point of pasting the UDI (with or without help), did not use the lookup button next to the field to auto-populate the other fields. This led to such behaviors as:

- Documenting "pacemaker" or "PPM" in the 'General Comments' field
- Trying to type in fields that were grayed out

It also led to such comments as:

After pasting the UDI: "Let's see... I am looking for a place to indicate what the device is...the device description box is grayed out... [tried typing in unavailable fields]."

After pasting the UDI: "Should it allow me to type there in the ['Device Identifier' field]?"

For some, the date picker was quite frustrating to use and for those who did not notice that ability to do so, commented on the need to document a less specific date than Year/Month/Day:

"My complaint is that it requires you to pick a specific date and most patients do not know specific date [of implantation]. The patient has no idea what the date is so it would be nice to have an option to put 'Unknown'."

"It is tricky to go back manually many years."

"It did not allow me to type the month. I could not go back by year, just by month."

Efficiency

For this task, nine of the participants started the task by going to the 'History' button in the toolbar (unless they were still in the patient's history) and then selecting the 'Implantable Devices' tab from the patient history window. The other participants, who were unsuccessful in completing this task, selected 'Procedures/ Surgical' from the patient's history.

Only one participant completed the task under the optimal time. All other participants took two to three times longer to complete the task. This was certainly due to the unfamiliar workflow but also due to the weak calls to action within the 'Patient Implantable Devices' pop-up.

Of the successful task completions, all but one participant deviated. These deviations included trying to type and/ or paste the UDI before selecting 'New' and/ or trying to type in unavailable fields that become auto-populated once a user either selects the lookup button or 'Ok' followed by addressing the confirmation pop-up.

Satisfaction

Overall, the task satisfaction rating for this task was 4.2. This average rating is above the 'easy to use' threshold [3.3]. For those participants that experienced the auto-populated fields, the reactions were very positive:

"Once you put the [UDI] number, everything was populated. That was good."

"I like the fact that you can enter this in the patient chart. It is important information."

"It was fairly easy and very helpful. It is pretty neat that you get that number and it populates all that information. That is pretty sleek."

"I like this a lot, once you have the [UDI] number."

"Wow! That was pretty cool."

Major Findings

- Six of 11 participants successfully passed this task and five did so with deviations:
 - Trying to type and/ or paste the UDI before selecting 'New'
 - Trying to type in unavailable fields that become auto-populated once the participant either selected the lookup button or selected 'Ok' followed by addressing the confirmation pop-up
- The errors that were observed during this task was the documentation of the implantable device in the 'Procedures/ Surgical' tab
- The successful participants were not able to complete this task very efficiently; only one under the optimal time and the others took two to three times longer to complete the task

Areas for Improvement

Based on the results, the following potential improvements are suggested:

- Upon entering a complete UDI, consider auto-completing the fields for the user without a distinct action or with a tab or enter action
- Ensure that the starting point (i.e. the 'New' button) is in a consistent location, as compared to other areas of the application
- Incorporate a date picker that has a stronger affordance for the 'Precision' selection so that users are aware that they can choose from:
 - yyyy
 - m/yyyy
 - m/d/yyyy
 - Unknown

CLINICAL INFORMATION RECONCILIATION

One task was included to evaluate the clinical information reconciliation (CIR). It included:

- Perform CIR

Analysis Notes

Task Description

Task 5 was a task focusing on performing CIR. Specifically, participants had to incorporate information from a transition of care document into the patient's record and then reconcile additional allergies, problems and medications in the record. This was a fairly unfamiliar or unfamiliar workflow for all test participants.

This task was included to evaluate the participants' workflows of performing CIR. The participants had to navigate to 'Workup' in the top menu and select 'Inbound Transition of Care'. Once in the 'Inbound Transition of Care' pop-up, participants had to select 'New' to get started and complete all the necessary fields before selecting the 'Approve' button to incorporate the information. After receiving the pop-up that items had been incorporated into the record, participants had to go to each of the three areas, 'Current Medications', 'Allergies' and 'Diagnoses/ Problems', to reconcile the clinical information.

Scoring Notes

All participants followed instructions, as expected. There were no difficulties resulting in exclusions.

Effectiveness

None of the participants successfully completed the task of performing CIR.

Many participants struggled with knowing how to start and where to find the document to incorporate into the record, despite some visiting the correct spot.

Five participants were directed to go to 'Workup' in the top menu and select 'Inbound Transition of Care' to observe whether or not they could successfully complete the task from that point. After launching the pop-up, five participants could work through the pop-up successfully with no guidance.

However, once the information was entered in the pop-up and 'Approve' was selected, three participants stated that they thought they had completed the task because the message provided to them in a new pop-up listed the data that had been incorporated into the record. Only two participants continued on to reconcile the information in each of the three areas (i.e. 'Current Medications', 'Allergies' and 'Diagnoses/ Problems').

After incorporating the information, participants stated:

"I think I did [the task]."

"Ok, I think it worked at the end. It is totally unfamiliar. I do not think it is difficult. I could probably look in 'My History' and see if it says it is incorporated. It gave me an indication that it was incorporated, so it did."

Efficiency

For this task, none of the participants successfully completed the task of performing CIR and therefore, no deviations were calculated.

However, the observations made during this task brought light to areas that are difficult for users:

- Understanding that the 'Workup' menu item provides access to the 'Inbound Transition of Care' space
 - Many participants explored other areas looking such as the top level menus or toolbar buttons: 'History', 'Notes' ^ 'Import C-CDA', 'Manage Tx', 'View', 'Pharmacy', 'Assessments', 'System Admin', and 'File'

- "I'm not sure how to do this one... I'm not sure what to do here."
- "I cannot remember where to find it."
- "I really... I have no idea where it would come in."
- "I do not know where else to look other than [in the 'Notes']."
- "I do not see anywhere here where I can find it. Where can I find it?"
- "I'm not sure where to look."
- Knowing how to get started in the 'Inbound Transition of Care' pop-up (i.e. finding and selecting the 'New' button)
 - Many participants attempted to select drop-down menus or type in fields before 'New' was selected
 - "I do not know where to go from here."
- Knowing that all fields and drop-downs were mandatory fields in the pop-up
 - Most of the participants tried to 'Approve' the incorporation of information before having completed all the necessary entries
 - "It seems a little cumbersome trying to figure out which fields to complete."
- Trying to select the checkbox within the pop-up related to reconciliation
 - Participants thought that selecting this checkbox would complete the reconciliation of the information from the transition of care document
- Two participants who stopped after approving the incorporation wondered whether or not they had to go to each different space in the patient's record to check the clinical information and then stated it would be time consuming
 - Participants were hoping for a more efficient process
 - "When I clicked 'Approve' and things being imported and then I feel I need to go to check if it has been imported or not. It seems a lot of steps."
 - "It seems that it imported some information like allergies but I did not see anything in her records. It is cumbersome."

Satisfaction

A task satisfaction rating for this task could not be calculated, as none of the participants successfully completed this task. Of those that experienced the complete task with hints, the task rating was 3.0. For those participants that experienced part of the workflow, the rating was 2.2. Both of these ratings are below the 'easy to use' threshold [3.3].

Participants provided the following comments regarding the learning curve and actual difficulty in completing the task:

"I guess if you do it every day it is not that difficult, as you saw I stumbled through it."

"I have never seen this before... never looked at that screen. It is not difficult, if I knew what I was doing."

Major Findings

- None of the participants successfully passed this task
- Beginning the task was a major issue for participants (i.e. navigating to 'Workup' and then 'Inbound Transition of Care')
- Calls to action and mandatory fields to complete were troublesome to participants (i.e. selecting 'New' to begin the process and knowing to complete all fields in the 'Inbound Transition of Care' pop-up)
- Messaging alluded that the task was finished after incorporation

Areas for Improvement

Based on the results, the following potential improvements are suggested:

- Consider highlighting all mandatory fields in the 'Inbound Transition of Care' window instead of providing messages when required fields are not completed and making the 'Approve' button grayed out and unavailable until all mandatory fields are completed.
- Consider further user research regarding messaging during this workflow (i.e. the difference between 'incorporating' and 'reconciling' is not well understood by end users)
- Consider guiding end users more through this workflow so that they can transition efficiency and clearly from the incorporation steps to the reconciliation steps

ELECTRONIC PRESCRIBING

One task was included to evaluate electronic prescribing (e-prescribing). It included:

- Send prescriptions to a pharmacy

Analysis Notes

Task Description

Task 8 was a task focusing on sending two prescriptions to a pharmacy. Specifically, participants had to send both prescriptions to the patient's preferred CVS pharmacy.

This task was included to evaluate the participants' workflows of sending prescriptions to a pharmacy. The participants had to navigate to the 'E-Prescribing' tab, select one or both prescriptions, and then the 'Send' button. Once in the 'E-prescribing Drugs' pop-up, participants had to select the preferred pharmacy for each of the prescriptions following by selecting the 'Send' button for each prescription.

Scoring Notes

One participant documented home medications instead of ordering new medications. This resulted in a failure for the drug entry tasks and therefore, was the only issue that resulted in an exclusion for the e-prescribing.

Exclusions

Task #	Participant ID	Comment
8	P9	Medications order were incorrectly completed so there were no orders to e-prescribe

Effectiveness

All the included participants successfully completed the task of e-prescribing. However, two successful attempts included the following errors:

- One participant reissued both medication orders before completing the e-prescribing task
- One participant reordered both medications and then proceeded to e-prescribe four prescriptions

The orange drop-down field, as a call of action for selecting a pharmacy, worked well for participants in the 'E-Prescribing' pop-up.

One participant commented on the amount of information presented on the 'E-Prescribing Drugs' pop-up:

"There is a lot of information on this screen."

One participant commented on the need for system feedback to know whether or not their actions were successful:
"I do not know if both [prescriptions] will go or not."

Two participants mentioned the issue of windows not closing after a task has been completed:
"Again, I have an open window when I am done and it should have disappeared... it makes me do an extra click."
"The prescription window should close when I was done as there are no meds to be sent."

Efficiency

For this task, all but one of the participants started the task by going to the 'E-Prescribing' tab in the 'Medication' window and then selecting one or both of the prescriptions before selecting the 'Send...' button.

None of the participants completed the task under the optimal time. All participants took just over the optimal time to three times longer to complete the task. This was certainly due to the unfamiliar workflow and unclear system feedback regarding the status of the medication orders (i.e. applying a pharmacy to an order versus 'Unsent' and 'Sent' statuses).

Of the successful task completions, the deviations included:

- Reissuing the medication orders before sending them to the pharmacy
- Reordering the medication orders
- Selecting the 'Apply' button followed by the 'Send' button
- Selecting the pharmacy for one prescription (without sending) and then selecting the other prescription and receiving a warning pop-up to save work
- Sending two identical prescriptions to the pharmacy

Quite a few participants mentioned the need to send prescriptions by batch to the same pharmacy so as to save time:
"I do not see a 'Send All' option. Maybe it is there... [I would like to] send prescriptions in batches."
"I wish you could chose all medications at once."
"Way too cumbersome and too confusing. If I have 4-5 meds I would strangle the computer. I would like to send all at once instead of one by one."

Satisfaction

Overall, the task satisfaction rating for this task was 4.0. This average rating is above the 'easy to use' threshold [3.3].

One participant provided the following comment:

"It is easy and the version that I am using is not that easy, especially when selecting the pharmacy."

Major Findings

- All the included participants successfully passed this task and four did so with deviations
- The only errors that were observed during this task were not related to the 'E-Prescribing' pop-up but rather the actions of reissuing or reordering medications before accessing the 'E-Prescribing' tab
- Participants expressed the need to send prescriptions by batch to the same pharmacy to save time

Areas for Improvement

Based on the results, the following potential improvements are suggested:

- Consider employing a smoother user experience from the 'E-Prescribing' tab to the pop-up, as selecting one or two prescriptions from the tab does not change anything in the pop-up after the 'Send' button has been selected (i.e. all prescriptions are available for the user in the pop-up even if s/he only selected one in the tab)
- Consider a means for allowing end users to send prescription to the same pharmacy by batch
- Reconsider the need of an 'Apply' button in the context of e-prescribing

APPENDIX 1: INVITATION

Subject: Aria Usability Test

Dear [participant name],

On behalf of Varian Medical Systems, we are pleased to invite you to participate in a usability study organized by the Varian User Experience team to evaluate ARIA.

To conduct the study, we will be working with Macadamian, a user research company, to learn from you how usable and effective the system is and what can be done to improve it further. With this objective in mind, we kindly request that you share your valued professional experience during the study. Please note that there is no need for you to share any confidential, proprietary or patient information.

What is involved?

The study will be conducted remotely via phone and web meeting that you can dial into using your computer at your preferred location (office or home). The study will last about an hour during which you will navigate through the system by completing a few tasks (e.g. updating and reviewing patient information) and provide us with your feedback.

The study session can be done outside of normal working hours. All study sessions will be recorded (with the participant's consent) for reference during the analysis and reporting phase. All comments and feedback will remain anonymous.

In exchange for your participation in this one-hour study and as a thank you for your time, Macadamian will provide you with \$150 to compensate you for your time.

We will be scheduling interviews to take place at the end of June.

Please reply to this e-mail indicating your interest in participating in this study and Anneliis Tosine (atosine@macadamian.com), a Macadamian representative, will get in touch with you soon after to schedule your study session.

We look forward to the opportunity to talk with you and learn from your professional experience.

Thank you very much,

[Varian Project Manager]

APPENDIX 2: TEST PROTOCOL AND POST-TEST QUESTIONNAIRE

Summative Test Protocol: VARIAN ARIA MedOnc

Created by:	Annelis Tosine Alessandra Smircich
Date:	June 2017

Background and Introduction

Thank you for agreeing to participate in this research. Our session today will last for approximately 60 minutes. During this time, I will ask you to complete some tasks using Aria and answer some questions. One thing to keep in mind here is that it is the software that is being tested. You are not being tested in any way. We are interested in how easy or how difficult this system is to use, what in it is useful to you, and how we could improve it. You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Please, do not do anything more than asked for each task. Specifically, do not enter any notes unless asked to. If you get lost or have difficulty, I cannot help you with anything to do with the system itself. Please save your detailed comments until the end of the task or the end of the session as a whole when we can discuss freely.

Varian has requested Macadamian Technologies, an independent research firm that I work for, to conduct these sessions, so I am here as an objective researcher today.

For our sessions, you may notice that the layout and some details of the system may vary from the product that you currently use. Also, you will see some sample patient data that may not be consistent with your system patient data.

It would be helpful for you to have a pen and paper handy to write the details of the tasks as I read them to you. If you do not have that ready please get it now.

We are recording the audio and computer screen of our session today but I'd like to ensure you that all of the information that you provide will be kept confidential and your name will not be associated with the feedback I provide in a report. You are also one of several people providing feedback for this process. Any questions before we get started?

Note: we are accessing the application through VPN and remote desktop connection so you will probably experience delays when selecting certain menu items and buttons.

[Confirm demographics and train on Implantable Devices]

Today, please assume you have a physician's login and that your name is Dr James Byrl Kennedy.

[Press record on GoToMeeting]

First Impressions

This is the application you will be working with today. Does this look similar to what you are using currently? Anything in particular that you notice is different?

- Yes
- No

Task 1 Demographics: document demographic information

Once I read each task, please tell me when you are ready to begin and when you have finished each task.

Start point: 'Visit' tab

Please open Mary Edwin Smyth's record. Today, we'll be working with this patient record and let's assume this is an initial consult for a new patient with breast cancer. Please show me how you would document the following demographic information in her record: her ethnicity is not Hispanic or Latino, her race is Native Hawaiian and her primary language is Spanish. Once you have completed this first task, please let me know.

Optimal Path

1. Select/highlight patient in the 'Visit' tab
2. Select the 'Modify...' button
3. Select the 'Demographics' tab
4. Select the 'Race' lookup button
5. Select 'Native Hawaiian or Other Pacific Islander' in the 'Description' list
6. Select the arrow button
7. Select the 'Ok' button
8. Select the 'Ethnicity' lookup button
9. Select 'Not Hispanic or Latino' in the 'Description' list
10. Select the arrow button
11. Select the 'Ok' button
12. Select the 'Language' lookup button
13. Type 'Spanish' in the search field
14. Select 'Spanish'
15. Select the 'Ok' button
16. Select the 'Ok' button to close the patient window

Alternate Path

1. Double-click on patient in the 'Visit' tab
2. Select 'View ^ Demographics...' from top menu
3. Select the 'Modify...' button
4. Select the 'Demographics' tab
5. Select the 'Race' lookup button
6. Select 'Native Hawaiian or Other Pacific Islander' in the 'Description' list
7. Select the arrow button
8. Select the 'Ok' button
9. Select the 'Ethnicity' lookup button
10. Select 'Not Hispanic or Latino' in the 'Description' list
11. Select the arrow button
12. Select the 'Ok' button
13. Select the 'Language' lookup button
14. Type 'Spanish' in the search field
15. Select 'Spanish'
16. Select the 'Ok' button
17. Select the 'Ok' button to close the patient window

End point:

End point: 'Demographics' tab updated and participant on 'My Agenda' tab

- Deviation(s)

Task Time: _____seconds

Success:

- Successfully completed
- Completed incorrectly/ Abandoned

Observed Errors and User Comments:

On a scale of 1 to 5, how would you rate your experience with the application when completing this task?

Very difficult to use

1

2

3

4

Very easy to use

5

Moderator Comments:

Task 2 Problem List: document an existing problem

Start point: 'Visit' or 'My Agenda' tab

For your patient, please add that she has breast cancer to her record. Specifically, please record that she has a malignant neoplasm of the upper-outer quadrant of her left breast.

Optimal Path:

1. [Double-click on patient or highlight patient and select the 'Open' button]
2. Select 'Hx' button on toolbar
3. Select the 'Diagnoses/ Problems' tab
4. Select the 'New...' button
5. Select the lookup button for the 'Code' field
6. Type in 'breast cancer' as a keyword
7. Select the 'Search' button
8. Select 'Malignant Neoplasm of upper outer quadrant of left female breast – 174.4 – C50.412'
9. Select the 'Ok' button
10. Select the 'Save' button
11. Select the 'Close'
12. Select the 'Close' for the patient window

Alternate Path:

1. [Double-click on patient or highlight patient and select the 'Open' button]
2. Select 'Hx' button on toolbar
3. Select the 'Medical' tab
4. Select the checkbox next to 'Cancer'
5. Select the lookup button
6. Type in 'breast cancer' as a keyword
7. Select the 'Search' button
8. Select 'Malignant Neoplasm of upper outer quadrant of left female breast – 174.4 – C50.412'
9. Select the 'Ok' button
10. Select the 'Ok' button
11. Select the 'Close' button for the patient window

End point:

End point: breast cancer successfully documented and participant back on 'My Agenda' tab

Deviation(s)

Task Time: _____seconds

Success:

- Successfully completed
- Completed incorrectly/ Abandoned

Observed Errors and User Comments:

On a scale of 1 to 5, how would you rate your experience with the application when completing this task?

Very difficult to use

1

2

3

4

Very easy to use

5

Moderator Comments:

Task 4 Medications List: document a medication from an external provider

Start point: 'My Agenda' tab

During the examination, your patient indicates that she is taking Coumadin 4 mg tablet daily. Please show me how you would record that information.

Optimal Path:

1. Select 'Current Medications' from 'My Agenda' tab **OR** Select 'Hx' button on the toolbar ^ Select the 'Medications' tab
2. Select the 'New...' button
3. Select search button
4. Type 'Coumadin' in the 'Drug Name' field
5. Select 'Coumadin – (Tablet Oral)' from the search results
6. Select '4 mg' item in the bottom 'Dispensed as' area
7. Select the 'Ok' button
8. Enter '1' for the 'Dose' field
9. Select 'Daily' from the 'Frequency' drop-down
10. Select the 'Ok' button
11. Select the 'Close' button

End point:

End point: Medication successfully documented and participant back the 'My Agenda' tab

Deviation(s)

Task Time: _____seconds

Success:

- Successfully Completed (i.e. all fields in the order were correctly completed)
- Completed Incorrectly/ Abandoned

Observed Errors and User Comments:

On a scale of 1 to 5, how would you rate your experience with the application when completing this task?

Very difficult to use

1

2

3

4

Very easy to use

5

Moderator Comments:

Task 5 CIR: perform CIR

Start point: My Agenda tab

For this patient, you have received her 'CCDA – Transition of Care' document electronically (but not by direct message) from a referring specialist, Dr Ronald Bolton. Using this document, you need to bring in any additional allergies, problems and medications into her record. Please find this document and incorporate the information into this patient's record. [Note: The 'Transition of Care' document is 'Users ^ varianmo ^ Desktop ^ Transition of Care – Smith, Mary']

Starting Path:

1. Select 'Workup' from the top menu
2. Select 'Inbound Transition of Care...'
3. Select the 'New' button in the 'Inbound Transition of Care' pop-up
4. Select 'Other Electronic' from the 'C-CDA Document Source' drop-down
5. Select today's date as 'Referral Date'
6. Select 'Dr Ronald Bolton' from the 'Referred by' drop-down
7. Select the 'Browse' button to find document
8. Select the document
9. Select the 'Open' button
10. Select 'New patient' from the 'Visit Type' drop-down
11. Select the 'Approve' button
12. Select the 'Ok' button for the 'Incorporating C-CDA' pop-up

Optimal Path (Icon Route)

13. Select 'Medication Reconciliation' from the reconciliation icon in the patient window
 14. Select each medication on left to move to 'Current Medications' list using the arrow button
 15. Select the 'Ok' button
- AND**
16. Select 'Allergies Reconciliation' from the reconciliation icon in the patient window
 17. Select each allergy on the left to move to 'Current Allergies' list using the arrow button
 18. Select the 'Ok' button
- AND**
19. Select 'Problem/ Diagnosis Reconciliation' from the reconciliation icon in the patient window
 20. Select each problem on the left to move to 'Current Problems' list using the arrow button
 21. Select the 'Ok' button for each problem in the 'Search for Diagnosis/ Problem Code' pop-up
 22. Select the 'Ok' button

Alternate Path (My Agenda Route)

13. Select 'Current Medications' from 'My Agenda' tab
 14. Select the 'Reconciliation' button
 15. Select each medication on left to move to 'Current Medications' list using the arrow button
 16. Select the 'Ok' button
- AND**
17. Select 'Allergies' from 'My Agenda' tab
 18. Select the 'Reconciliation' button
 19. Select each allergy on the left to move to 'Current Allergies' list using the arrow button
 20. Select the 'Ok' button
- AND**
21. Select 'Diagnoses/ Problems' from 'My Agenda' tab
 22. Select the 'Reconciliation' button
 23. Select each problem on the left to move to 'Current Problems' list using the arrow button

Task 6 CPOE (Medications), CDS & Drug-Allergy Interaction Check: order a medication (favorite), review CDS rules, and acknowledge an interaction alert

Start point: 'My Agenda' tab

For her ongoing treatment for breast cancer during radiotherapy, please prescribe Tamoxifen Citrate (20 mg) Tablet Oral Daily for 90 days. This medication is one of your favorites. When the 'Alerts' for this order appear, please let me know what they are aloud. Upon approving this medication, a drug-allergy alert will be produced. Please review the interaction and provide a reason for the override.

Optimal Path:

1. Select 'Chemo/ Drug Orders' from 'My Agenda' tab **OR** 'Rx' button on toolbar
2. Select the 'Orders/ Rx' tab
3. Select the 'New...' button
4. Review the 'Alerts' tab aloud
5. Select 'Order/ Rx' tab
6. Select the 'Favorites...' button
7. Select 'Tamoxifen Citrate Tablet Oral 20 mg' from the list
8. Select the 'Add' button
9. Select the 'Approve' button
10. Select 'Clinically acceptable risk' from the 'Reason' drop-down
11. Select the 'Accept' button from the screening pop-up
12. Select the 'Approve' button
13. Select the 'Close' button to return to 'My Agenda' tab

End point:

End point: medication successfully ordered and participant back on 'My Agenda' tab

Deviation(s)

Task Time: _____seconds

Success:

- Successfully Completed
- Completed Incorrectly/ Abandoned

Observed Errors and User Comments:

On a scale of 1 to 5, how would you rate your experience with the application when completing this task?

Very difficult to use

1

2

3

4

Very easy to use

5

Moderator Comments:

Task 8 e-Prescribe: send prescriptions to a pharmacy

Start point: 'Orders/ Rx' tab

The patient would like to pick up the prescriptions at their pharmacy so please send both to her preferred CVS pharmacy.

Optimal Path:

1. Select the 'E-Prescribing' tab
2. Select the first prescription **OR** both prescriptions
3. Select the 'Send...' button
4. Select 'Careplus CVS/ Pharmacy' from the 'Pharmacy' drop-down
5. Select the 'Send' button
6. Select the second prescription
7. Select the 'Send...' button
8. Select 'Careplus CVS/ Pharmacy' from the 'Pharmacy' drop-down
9. Select the 'Send' button

End point:

End point: prescriptions successfully sent to the pharmacy and participant back on the 'E-prescribing' workspace

Deviation(s)

Task Time: _____seconds

Success:

- Successfully Completed
- Completed Incorrectly/ Abandoned

Observed Errors and User Comments:

On a scale of 1 to 5, how would you rate your experience with the application when completing this task?

Very difficult to use

1

2

3

4

Very easy to use

5

Moderator Comments:

Task 9 CPOE (labs and imaging): order a lab and diagnostic imaging

Start point: 'My Agenda' tab

You decide to order CA-125 test and a mammogram for this patient, both by the next visit. You also want to indicate, as a note, to compare this mammogram to the last mammogram. [Nurse: Please approve this order.]

Optimal Path:

1. Select 'Physicians Order' from the toolbar or 'My Agenda' tab
2. Select 'CA-125'
3. Select 'Mammogram'
4. Select 'Compare to Last' from the 'Order Details' pop-up
5. Select the 'Ok' button
6. Select the 'Approve' button

End point:

End point: orders successfully completed and participant back on 'My Agenda'

Deviation(s)

Task Time: _____seconds

Success:

- Successfully Completed
- Completed Incorrectly/ Abandoned

Observed Errors and User Comments:

On a scale of 1 to 5, how would you rate your experience with the application when completing this task?

Very difficult to use

1

2

3

4

Very easy to use

5

Moderator Comments:

System Usability Scale Questionnaire

For each of the following statements please rate them on a scale from 1 to 5 where 1 means strongly disagree and 5 means strongly agree. Please note, for some statements 'strongly agree' is a negative assessment.

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



Compensation Information

Personal Cheque

PayPal Account

Thank you for your participation today! Your feedback is greatly appreciated!

Demographic Questionnaire: VARIAN ARIAN MedOnc

Created by:	Melanie Rodney User Experience Researcher
Date:	June 2017

GENERAL DEMOGRAPHICS

- Female
- Male

1. Which of the following categories best describes your age?

- 20-29
- 30-39
- 40-49
- 50-59
- 60-69
- 70+

2. Which of the following categories best describes your education level?

- No high school degree
- High school graduate [diploma or GED]
- Some college credit, no degree
- Trade/technical/vocational training
- Associate degree
- Bachelor's degree
- Masters degree
- Doctorate Degree [e.g., MD, DNP, DMD, PhD]

3. What is your current role/occupation?

4. How long have you been practicing as a ...[role]?

_____ [years /months]

TECHNOLOGY USE

5. How long have you used a computer?

_____ [years /months]

6. How long have you used an EHR?

_____ [years /months]

7. Do you use assistive technology to help you in your job [screen reader like VoiceOver, etc.]

- No
- Yes Please Describe: _____