EHR Usability Test Report of Ankhos Clinical Oncology Software

Report format based on ISO/IEC 25062:2006 Common Industry Format for Usability Test Reports and NISTIR 7742 Customized Common Industry Format Template for Electronic Health Record Usability Testing v0.2.

Standard used for UCD process:

NISTIR 7741 - *NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records* https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=907313

Ankhos Clinical Oncology Software, Ankhos version 4 (Ambulatory EHR)

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EXECUTIVE SUMMARY

A usability test of Ankhos Version 4.0 (Ambulatory EHR) was conducted between Dec 8, 2016 and December 15, 2016 in Hickory, NC and Raleigh, NC by Ankhos Oncology Software. Additional testing was performed between June 04, 2020 and June 8, 2020. A third round of additional testing was performed between October 8, 2024 and October 10, 2024. The purpose of these tests was to test and validate the usability of the current user interface and provide evidence of usability in the EHR Under Test (EHRUT). During each usability test round, 10 healthcare providers matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks. In this case, the target demographic is comprised of nurses, physicians and support staff involved in the care of cancer patients. This study collected performance data on 33 tasks typically conducted in an EHR:

Task #	Description	Certification Criterion §170.315
1	CPOE - Medications – Access	(a)(1)
2	CPOE – Medications – Record	(a)(1)
3	CPOE – Medications - Change	(a)(1)
4	CPOE - Labs – Access	(a)(2)
5	CPOE – Labs – Record	(a)(2)
6	CPOE – Labs - Change	(a)(2)
7	CPOE - Imaging - Access	(a)(3)
8	CPOE - Imaging - Record	(a)(3)
9	CPOE - Imaging - Change	(a)(3)
10	CPOE - Drug-allergy interaction	(a)(4)
11	Demographics – Access	(a)(5)
12	Demographics – Record	(a)(5)
13	Demographics – Change	(a)(5)
14	Problem List – Access,	(a)(6)
15	Problem List – Record	(a)(6)
16	Problem List – Change	(a)(6)
17	Medication List – Access	(a)(7)
18	Medication List – Record	(a)(7)
19	Medication List – Change	(a)(7)
20	Allergy List – Access	(a)(8)
21	Allergy List – Record	(a)(8)
22	Allergy List – Change	(a)(8)
23	CDS - Allergy with weight + gender	(a)(9)
24	CDS - Medication with weight + gender	(a)(9)

25	CDS - Diagnosis (ICD10) with weight + gender	(a)(9)
26	Implant. Dev. - Enter Device ID	(a)(14)
27	Implant. Dev. - Parse and Save Device	(a)(14)
28	Implant. Dev. - Remove device	(a)(14)
29	CQM-Export one patient	(c)(1)
30	CQM-Export patient list	(c)(1)
31	CDS - Comprehensive rule with new datasets	(b)(11)
32	CDS - Provide Feedback	(b)(11)
33	CDS - Download All Feedback	(b)(11)

During the 30 minute, one-on-one usability test, each participant was greeted by the administrator and asked to review and sign an informed consent/release form (included in Appendix 2); they were instructed that they could withdraw at any time. Some participants had prior experience with the EHRUT. Some participants had minimal exposure to the EHRUT. Some participants had no knowledge of the EHRUT.

The administrator introduced the test, and instructed participants to complete a series of tasks (given one at time) using the EHRUT. During the testing, the administrator timed the test and recorded user performance data on paper and electronically. The administrator did not give the participant assistance in how to complete the task.

The following types of data were collected for each participant:

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

All participant data was de-identified – no correspondence could be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants were asked to complete a post-test questionnaire (Appendix 4). Various recommended metrics, in accordance with the examples set forth in the

NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records, were used to evaluate the usability of the EHRUT. Following is a summary of the performance and rating data collected on the EHRUT.

Task		N	Task Success	Path Deviation	Task Time (Seconds)	Task Time (Paths)	Errors	Task Ratings (5=Easy)
		#						
			Mean % (SD)	Observed/ Optimal	Mean (SD)	Observed/ Optimal	Mean (SD)	Mean (SD)
1	CPOE - Medications – Access	10	80% (.4)	1.11 / 1	10 (5.1)	9.8 / 5	.2 (.44)	4.9 (.35)
2	CPOE – Medications – Record	10	90% (.3)	3.75 / 3	80 (65.2)	80 / 30	.2 (.44)	4.1 (1.1)
3	CPOE – Medications - Change	10	100% (0)	2.1 / 2	32.2 (23.6)	32 / 11	0 (0)	4.5 (.52)
4	CPOE - Labs – Access	10	100% (0)	2.5 / 2	14.5 (16.1)	15 / 5	.1 (.32)	4.9 (.31)
5	CPOE – Labs – Record	10	100% (0)	2.4 / 2	22.2 (16.9)	23 / 18	0 (0)	4.9 (.31)
6	CPOE – Labs - Change	10	100% (0)	2.2 / 2	14.5 (13.1)	15 / 5	0 (0)	4.9 (.31)
7	CPOE - Imaging - Access	10	100% (0)	1.3 / 1	11.3 (13.0)	11 / 5	0 (0)	5 (0)
8	CPOE - Imaging - Record	10	100% (0)	2.6 / 2	23.4 (8.7)	23 / 12	0 (0)	4.6 (.84)
9	CPOE - Imaging - Change	10	100% (0)	2 / 2	9.1 (3.2)	9 / 6	0 (0)	5 (0)
10	CPOE - Drug-allergy interaction	10	100% (0)	2.3 / 1	22.1 (11.3)	22 / 12	.3 (.48)	4.8 (.42)
11	Demographics – Access	10	90% (.3)	1 / 1	5 (2.3)	5 / 4	.2 (.44)	5 (0)

12	Demographics – Record	10	90% (.3)	2.3 / 2	15 (7.2)	15 / 7	.1 (.32)	5 (0)
13	Demographics – Change	10	90% (.3)	2.6 / 2	23.5 (20)	24 / 9	.1 (.32)	4.5 (.71)
14	Problem List – Access	10	100% (0)	1.7 / 1	18.7 (20)	19 / 5	0 (0)	4.6 (.51)
15	Problem List – Record	10	90% (.3)	4.6 / 4	30 (13.9)	30 / 12	.3 (.98)	4.3 (.71)
16	Problem List – Change	10	100% (0)	3.3 / 3	17.2 (11.8)	17 / 6	0 (0)	4.7 (.48)
17	Medication List – Access	10	90% (.3)	1.2 / 2	10.2 (12.1)	10 / 4	.1 (.32)	4.8 (.3)
18	Medication List – Record	10	100% (0)	3.7 / 3	48.4 (31.1)	48 / 16	.2 (.44)	4.6 (.51)
19	Medication List – Change	10	100% (0)	3.5 / 3	21.7 (16.4)	21 / 11	0 (0)	4.7 (.48)
20	Allergy List – Access	10	100% (0)	1.3 / 3	6.6 (4.5)	7 / 5	0 (0)	4.95 (.15)
21	Allergy List – Record	10	100% (0)	4.5 / 4	25.1 (10.2)	25 / 15	.1 (.32)	4.95 (.15)
22	Allergy List – Change	10	100% (0)	3 / 3	13.6 (6.9)	14 / 10	0 (0)	4.95 (.15)
23	CDS- - Allergy	10	100% (0)	2.4/4	20.7/10	5/3	0 (0)	4.8 (.4)
24	CDS - Medication	10	100% (0)	2.4/4	19.1/10	4/3	0 (0)	4.8(.4)
25	CDS - Diagnosis	10	100% (0)	3.1/3	25.4/10	4/3	0 (0)	4.1(.7)
26	Imp. Dev. - Enter ID	10	90% (.3)	3.8/2	70.5/25	5/2	.1 (.32)	2.4(1.11)
27	Imp. Dev. - Save	10	100% (0)	2.4/1	29.8/10	2/1	0 (0)	4.4(.8)

28	Imp. Dev. - Remove	10	100% (0)	1/1	15.1/5	5/3	0 (0)	4.9(.3)
29	CQM-Export one patient	10	100% (0)	5.3/4	31.3/20	6/3	0 (0)	4.1(.8)
30	CQM-Export patient list	10	90% (.3)	8/6	43.2/30	8/4	.1 (.32)	4.3(1.3)
31	CDS – Comp. Rule	10	100% (0)	35 / 27	70 (26)	70 / 45	0 (0)	3.9 (.74)
32	CDS – Provide Feedback	10	100% (0)	4 / 3	39 (23)	39 / 15	0 (0)	4.7 (.48)
33	CDS – Download Feedback	10	100% (0)	2 / 1	15 (9)	15/ 5	0 (0)	4.9 (.31)

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be **85.5**. The usability score for tests conducted from October 8, 2024 through October 10, 2024 was **4.5** out of 5, 5 being easiest on the Likert scale.

Major Findings

1. Overall, participants could easily navigate and perform tasks in Ankhos.
2. Once tasks were completed and learned, similar tasks were easy to complete.
3. Most users had problems in the same areas (e.g. Detailed Demographics, adding an order with a pre-existing allergy).
4. Most users expected dropdowns for reaction types and medication doses.
5. Popups were largely ignored the first time by all users who encountered them.
6. Some areas need larger messaging or higher contrast to stand out (new order categories)
7. Calendar format makes accessing orders very fast.
8. Some aspects of the chart details are not as discoverable as they should be. Some items seemed to be tucked away, adding two to three unnecessary clicks (e.g. Demographics)

9. Most users were confused by the difference between the SNOMED-CT problem list and an ICD10 problem list.
10. A barcode scanner is a necessity to easily enter serial numbers for implantable devices.

Areas for improvement

1. Make allergy interaction details clearer and provide a better way to provide feedback on what items need to be fixed to continue.
2. Consider adding dropdowns for common reaction descriptions (e.g. Hives, Shortness of breath).
3. Consider alternative methods of conveying error statuses other than popups, such as inline text or highlighting the part of the form that needs correction.
4. Reconsider the need for additional information in some cases (e.g. dose change comment)
5. Allow users to customize more alert preferences.
6. Make Detailed demographics (language, race) more accessible from the main demographics page.
7. Consider adding descriptions to cross-map between SNOMED-CT and ICD10. While not a direct map, this may help some users understand the difference between the two code sets to more accurately code problems.
8. Make the interface for exporting patient data more prominent.

INTRODUCTION

The EHRUT tested for this study was Ankhos v. 4.0 (Ambulatory EHR). Designed to present medical information to healthcare providers in ambulatory clinical oncology and outpatient infusion settings, the EHRUT consists of a browser-based, cloud hosted solution. The usability testing attempted to represent realistic exercises and conditions.

The purpose of this study was to test and validate the usability of the current user interface, and provide evidence of usability in the EHR Under Test (EHRUT). To this end, measures of effectiveness, efficiency and user satisfaction, such time to alter a medication list or ease of modifying radiology orders, were captured during the usability testing.

METHOD

Participants

A total of 30 participants were tested on the EHRUT(s). Participants in the test were healthcare providers. Among them were Physicians, Nurses, Pharmacists, medical assistants, administrative staff and Nurse Administrators.

Participants had no direct connection to the development of or organization producing the EHRUT(s). Participants were not from the testing or supplier organization. Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received.

Recruited participants had a mix of backgrounds and demographic characteristics. The following is a table of participants by characteristics, including demographics, professional experience and computing experience. Participant names were replaced with Participant IDs so that an individual's data cannot be tied back to individual identities.

ID01	Female	40-49	Bachelor's Degree	Nurse
ID02	Female	20-29	Associate Degree	MA/Phlebotomist
ID03	Female	20-29	Associate Degree	Pharm. Tech.
ID04	Female	50-59	Master's Degree	Director of Cancer Program
ID05	Female	60-69	Associate Degree	Cancer Registrar
ID06	Female	20-29	Associate Degree	MA/Phlebotomist
ID07	Male	30-39	Master's Degree	Nurse/Administrator
ID08	Female	20-29	Associate Degree	Pharm. Tech.
ID09	Female	50-59	Master's Degree	Oncology Nurse Navigator
ID10	Male	60-69	Doctorate degree (e.g. MD DNP DMD PhD)	Oncologist
ID11	Female	40-49	Associate Degree	Oncology Nurse
ID12	Female	40-49	Associate Degree	Phlebotomist
ID13	Female	40-49	Master's Degree	Physician Assistant
ID14	Female	30-39	Associate Degree	Pharmacy Nurse
ID15	Female	40-49	Master's Degree	Physician Assistant
ID16	Female	20-29	Associate Degree	MA/Phlebotomist
ID17	Female	20-29	Master's Degree	Physician Assistant
ID18	Female	60-69	Associate Degree	Nurse Manager
ID19	Male	50-59	Doctorate degree (e.g. MD DNP DMD PhD)	Oncologist
ID20	Male	60-69	Doctorate degree (e.g. MD DNP DMD PhD)	Oncologist
ID21	Female	40-49	Associate degree	Financial Counselor
ID22	Female	40-49	Master's degree	Physician Assistant
ID23	Female	60-69	Master's degree	Physician Assistant
ID24	Female	30-39	Trade/technical/vocational training	Pharmacy Technician
ID25	Female	60-69	Bachelor's degree	Registered Nurse
ID26	Female	30-39	Master's degree	Physician Assistant
ID27	Male	60-69	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Physician
ID28	Female	30-39	Trade/technical/vocational training	Lab Manager
ID29	Male	20-29	Trade/technical/vocational training	Phlebotomist
ID30	Female	50-59	Bachelor's degree	Registered Nurse

The following is a table of Professional, computer and product experience for each participant. All values are in months.

	Professional Exp.	Computer Exp.	Product Exp.
ID01	240	180	0
ID02	18	18	6
ID03	54	54	6
ID04	216	60	6
ID05	240	240	12
ID06	108	108	6
ID07	36	36	0
ID08	24	24	0
ID09	444	120	12
ID10	396	60	12
ID11	276	96	6
ID12	84	24	0
ID13	180	120	0
ID14	36	120	6
ID15	180	120	24
ID16	36	80	0
ID17	12	120	6
ID18	380	120	24
ID19	372	60	6
ID20	380	240	24
ID21	300	330	180
ID22	240	280	180
ID23	444	500	180
ID24	144	240	72
ID25	384	480	180
ID26	84	320	60
ID27	420	240	60
ID28	96	120	96
ID29	2	96	1
ID30	336	480	180

Ten participants (matching the demographics in the section on Participants) were recruited for each round of testing and all ten participated. No participant failed to show for the study. One participant was black/white colorblind and one participant was red/green colorblind.

Participants were scheduled for 30 minute sessions with 30 minutes in between each session for debrief by the administrator(s) and data logger(s), and to reset systems to proper test conditions. A spreadsheet was used to keep track of the participant schedule, and included each participant's demographic characteristics.

Study Design

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

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

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

Additional information about the various measures can be found in table 2: Usability Metrics.

Tasks

Tasks were constructed that would be realistic and representative of the kinds of activities a user might do with this EHR, including:

Task #	Description	Certification Criterion §170.315
1	CPOE - Medications – Access	(a)(1)
2	CPOE – Medications – Record	(a)(1)
3	CPOE – Medications - Change	(a)(1)
4	CPOE - Labs – Access	(a)(2)
5	CPOE – Labs – Record	(a)(2)
6	CPOE – Labs - Change	(a)(2)
7	CPOE - Imaging - Access	(a)(3)
8	CPOE - Imaging - Record	(a)(3)
9	CPOE - Imaging - Change	(a)(3)
10	CPOE - Drug-allergy interaction	(a)(4)
11	Demographics – Access	(a)(5)
12	Demographics – Record	(a)(5)
13	Demographics – Change	(a)(5)
14	Problem List – Access,	(a)(6)
15	Problem List – Record	(a)(6)
16	Problem List – Change	(a)(6)
17	Medication List – Access	(a)(7)
18	Medication List – Record	(a)(7)
19	Medication List – Change	(a)(7)
20	Allergy List – Access	(a)(8)
21	Allergy List – Record	(a)(8)
22	Allergy List – Change	(a)(8)
23	CDS - Allergy with weight + gender	(a)(9)
24	CDS - Medication with weight + gender	(a)(9)
25	CDS - Diagnosis (ICD10) with weight + gender	(a)(9)
26	Implant. Dev. - Enter Device ID	(a)(14)
27	Implant. Dev. - Parse and Save Device	(a)(14)
28	Implant. Dev. - Remove device	(a)(14)
29	CQM-Export one patient	(c)(1)
30	CQM-Export patient list	(c)(1)
31	CDS - Comprehensive rule with new datasets	(b)(11)
32	CDS - Provide Feedback	(b)(11)
33	CDS - Download All Feedback	(b)(11)

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users. Some tasks were included in the second phase to include updated features. Tasks should always be constructed in light of the study objectives.

Procedures

Upon arrival, participants were greeted; their identity was verified and matched with a name on the participant schedule. Participants were then given a pre-assigned participant ID. Each participant reviewed and signed an informed consent and release form (See Appendix 2). A representative from the test team witnessed the participant's signature.

The test administrator was an experienced usability engineer with seven years of in-field testing and software development experience. The administrator held a Bachelor's and Master's degree in computer science with a focus on software engineering and user experience. The administrator additionally had training in producing and testing medical software and was familiar with oncology software.

The administrator moderated the session including administering instructions and tasks. The administrator also monitored task times, obtained post-task rating data, and took notes on participant comments. The Administrator served as the data logger and took notes on task success, path deviations, number and type of errors, and comments.

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

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

For each task, the participants were given a written copy of the task. Task timing began once the administrator finished reading the question. The task time was stopped once the participant indicated they had successfully completed the task. Scoring is discussed below on page 15.

Following the session, the administrator gave the participant the post-test questionnaire (e.g., the System Usability Scale, see Appendix 4), compensated them for their time, and thanked each individual for their participation. Each post-test usability questionnaire was not identified by participant in an effort to provide double-blind usability feedback.

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

Test Location

The tests were conducted in a quiet testing room with a table and computer for the participant. Only the participant and administrator were in the test room. To ensure that the environment was comfortable for users, noise levels were kept to a minimum with the ambient temperature within a normal range. All of the safety instruction and evacuation procedures were valid, in place, and visible to the participants.

Test Environment

The EHRUT would be typically be used in a healthcare office or facility. In this instance, to accommodate the testers' schedule, the testing was conducted in private offices. For testing, the participants used the same laptop running Windows 10. The participants used a keyboard and mouse when interacting with the EHRUT. The test Ankhos environment used a laptop with a resolution of 1920x1080.

The application was set up by the vendor according to the vendor's documentation describing the system set-up and preparation. The application itself was running on a Windows computer using a training database on a LAN connection. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation. Additionally, participants were instructed not to change any of the default system settings (such as control of font size).

Test Forms and Tools

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

1. Informed Consent
2. Incentive Receipt and Acknowledgment Form
3. Moderator's Guide
4. Post-test Questionnaire

Examples of these documents can be found in Appendices 2-5 respectively. The Moderator's Guide was devised so as to be able to capture required data.

The participant's interactions with the EHRUT was recorded by the administrator as part of the Moderator's Guide. Additionally, all verbalizations and observed reactions and path deviations were recorded by the administrator as part of the Moderator's Guide. A video camera and microphone were not used as part of the recording procedure.

Participant Instructions

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

""Thank you for participating in this study. Your input is very important. Our session today will last about 30 minutes. During that time, you will use an instance of an electronic health record.

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

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

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

"For each task, I will read the description to you and say "Begin." At that point, please perform the task and

say "Done" once you believe you have successfully completed the task. I would like to request that you not *talk aloud or verbalize while you are doing the tasks. I will ask you your impressions about the task once you are done.'*

Participants were then given 22 tasks to complete in the initial round of testing. The subsequent testing round included 8 tasks. A third round of testing included 3 tasks. Tasks are listed in the moderator's guide in Appendix 4.

Usability Metrics

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

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

Data Scoring

The following table (Table 2]) details how tasks were scored, errors evaluated, and the time data analyzed.

Table 1 - Scoring Metrics

Measures	Rationale and Scoring
Effectiveness: Task Success	A task was counted as a "Success" if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis. The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage. Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency. Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target task times used for task times in the Moderator's Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by some factor 1.25 that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was 20 seconds then allotted task time performance was 25 seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.
Effectiveness: Task Failures	If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as an "Failures." No task times were taken for errors. The total number of errors was calculated for each task and then divided by the total number of times that task was attempted. Not all deviations would be counted as errors. This should also be expressed as the mean number of failed tasks per participant. On a qualitative level, an enumeration of errors and error types should be collected.
Efficiency: Task Deviations	The participant's path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.
	It is strongly recommended that task deviations be reported. Optimal paths (i.e., procedural steps) should be recorded when constructing tasks.
Efficiency: Task Time	Each task was timed from when the administrator said "Begin" until the participant said, "Done." If he or she failed to say "Done," the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation and standard error) were also calculated.

Satisfaction: Task Rating	Participant's subjective impression of the ease of use of the application was measured by administering both a simple post-task question as well as a post-session questionnaire. After each task, the participant was asked to rate "Overall, this task was:" on a scale of 1 (Very Difficult) to 5 (Very Easy). These data are averaged across participants. Common convention is that average ratings for systems judged easy to use should be 3.3 or above. To measure participants' confidence in and likeability of Ankhos overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, "I think I would like to use this system frequently," "I thought the system was easy to use," and "I would imagine that most people would learn to use this system very quickly." See full System Usability Score questionnaire in Appendix 4.

Table [2]. Details of how observed data were scored.

RESULTS

Data Analysis and Reporting

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. Participants who failed to follow session and task instructions had their data excluded from the analyses. In these test sessions, all participants were present and no data were excluded.

The usability testing results for the EHRUT are detailed below (see Table 3). The results should be seen in light of the objectives and goals outlined on page 10 Study Design. The data yielded actionable results that, if corrected, yield material, positive impact on user performance.

Table 2 - Usability Test Results

Task		N	Task Success	Path Deviation	Task Time (Seconds)	Task Time (Paths)	Errors	Task Ratings (5=Easy)
		#						
			Mean % (SD)	Observed/ Optimal	Mean (SD)	Observed/ Optimal	Mean (SD)	Mean (SD)
1	CPOE - Medications – Access	10	80% (.4)	1.11 / 1	10 (5.1)	9.8 / 5	.2 (.44)	4.9 (.35)
2	CPOE – Medications – Record	10	90% (.3)	3.75 / 3	80 (65.2)	80 / 30	.2 (.44)	4.1 (1.1)
3	CPOE – Medications - Change	10	100% (0)	2.1 / 2	32.2 (23.6)	32 / 11	0 (0)	4.5 (.52)
4	CPOE - Labs – Access	10	100% (0)	2.5 / 2	14.5 (16.1)	15 / 5	.1 (.32)	4.9 (.31)
5	CPOE – Labs – Record	10	100% (0)	2.4 / 2	22.2 (16.9)	23 / 18	0 (0)	4.9 (.31)
6	CPOE – Labs - Change	10	100% (0)	2.2 / 2	14.5 (13.1)	15 / 5	0 (0)	4.9 (.31)
7	CPOE - Imaging - Access	10	100% (0)	1.3 / 1	11.3 (13.0)	11 / 5	0 (0)	5 (0)
8	CPOE - Imaging - Record	10	100% (0)	2.6 / 2	23.4 (8.7)	23 / 12	0 (0)	4.6 (.84)
9	CPOE - Imaging - Change	10	100% (0)	2 / 2	9.1 (3.2)	9 / 6	0 (0)	5 (0)
10	CPOE - Drug-allergy interaction	10	100% (0)	2.3 / 1	22.1 (11.3)	22 / 12	.3 (.48)	4.8 (.42)
11	Demographics – Access	10	90% (.3)	1 / 1	5 (2.3)	5 / 4	.2 (.44)	5 (0)
12	Demographics – Record	10	90% (.3)	2.3 / 2	15 (7.2)	15 / 7	.1 (.32)	5 (0)

13	Demographics – Change	10	90% (.3)	2.6 / 2	23.5 (20)	24 / 9	.1 (.32)	4.5 (.71)
14	Problem List – Access	10	100% (0)	1.7 / 1	18.7 (20)	19 / 5	0 (0)	4.6 (.51)
15	Problem List – Record	10	90% (.3)	4.6 / 4	30 (13.9)	30 / 12	.3 (.98)	4.3 (.71)
16	Problem List – Change	10	100% (0)	3.3 / 3	17.2 (11.8)	17 / 6	0 (0)	4.7 (.48)
17	Medication List – Access	10	90% (.3)	1.2 / 2	10.2 (12.1)	10 / 4	.1 (.32)	4.8 (.3)
18	Medication List – Record	10	100% (0)	3.7 / 3	48.4 (31.1)	48 / 16	.2 (.44)	4.6 (.51)
19	Medication List – Change	10	100% (0)	3.5 / 3	21.7 (16.4)	21 / 11	0 (0)	4.7 (.48)
20	Allergy List – Access	10	100% (0)	1.3 / 3	6.6 (4.5)	7 / 5	0 (0)	4.95 (.15)
21	Allergy List – Record	10	100% (0)	4.5 / 4	25.1 (10.2)	25 / 15	.1 (.32)	4.95 (.15)
22	Allergy List – Change	10	100% (0)	3 / 3	13.6 (6.9)	14 / 10	0 (0)	4.95 (.15)
23	CDS- - Allergy	10	100% (0)	2.4/4	20.7/10	5/3	0 (0)	4.8 (.4)
24	CDS - Medication	10	100% (0)	2.4/4	19.1/10	4/3	0 (0)	4.8(.4)
25	CDS - Diagnosis	10	100% (0)	3.1/3	25.4/10	4/3	0 (0)	4.1(.7)
26	Imp. Dev. - Enter ID	10	90% (.3)	3.8/2	70.5/25	5/2	.1 (.32)	2.4(1.11)
27	Imp. Dev. - Save	10	100% (0)	2.4/1	29.8/10	2/1	0 (0)	4.4(.8)
28	Imp. Dev. - Remove	10	100% (0)	1/1	15.1/5	5/3	0 (0)	4.9(.3)

29	CQM-Export one patient	10	100% (0)	5.3/4	31.3/20	6/3	0 (0)	4.1(.8)
30	CQM-Export patient list	10	90% (.3)	8/6	43.2/30	8/4	.1 (.32)	4.3(1.3)
31	CDS – Comp. Rule	10	100% (0)	35 / 27	70 (26)	70 / 45	0 (0)	3.9 (.74)
32	CDS – Provide Feedback	10	100% (0)	4 / 3	39 (23)	39 / 15	0 (0)	4.7 (.48)
33	CDS – Download Feedback	10	100% (0)	2 / 1	15 (9)	15/ 5	0 (0)	4.9 (.31)

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be: **85.5**. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average. The usability score for tests conducted from October 8, 2024 through October 10, 2024 was **4.5** out of 5, 5 being easiest on the Likert scale.

Discussion of the Findings

EFFECTIVENESS

1. The most common source of errors and deviations was the allergy notification alert. In task 1 and task 18, an allergy must be overridden. Nearly all participants failed to read the popup requesting an override comment.
    a. “Allergy warning should be more visible.”

2. Another common deviation was not noticing that orders can be created by typing in the orderable search box. In some cases, this led to searching for another method to order.
3. The third most common deviation was encountered when a warning was issued for a dose change that required a comment.
   Participant Comments:
    a. “Why do I need a comment to change dose?”

4. The fourth common source of deviations was a confusion between medication order and an entry in the medication list.
5. Another common frustration was the effort involved in typing in a device identifier.
   “I wouldn’t use this unless I had a barcode scanner” was commented 3 times.
6. Most other deviations seemed to be a result of learning the system. For instance, *Task 2 - Create Medication Order* the average participant path was 3.7 steps while *Task 5 – Create Laboratory Order* had an average participant path of 2.2 steps, indicating that there was more certainty about how to create orders as the participant progressed through the tasks.
    a. “This is easy to use once I know how”

    b. “It’s easy to make orders.”
    c. “It would be nice to have a dropdown for dose.”
    d. “This is very much like what I do at work now, but easier”
7. A similar learning effect is found between tasks for allergies and medications, where the optimal paths are very similar. *Task 19 – Medication List – Change* had an average path length of 3.5 .97) while *Task 22 - Allergy List – Change* – had an average path length of 3.0 (0)
    a. “I was expecting a dropdown for hives”
8. Most users were confused about task *33 CDS – Provide Feedback*. Concerns included: “Who are we providing feedback to?”

EFFICIENCY

1. Task times for accessing records (Tasks 1,4,7,11,14,17,20) were relatively small (5-10 seconds) and the variation between participants was low (2.3-16 second SD)
2. Task time was independent of computer experience and age. Some older users accomplished tasks more efficiently than younger “digital-native” users.
3. Education and professional role had little statistical effect on task efficiency.
4. Tasks with the highest average completion times were also rated with the lowest usability scores.

SATISFACTION

Subjective

Positive Comments

“This is easy to use once I know how”.

“I’m not good at computers, but I like this system because I can peck around and find things… very easy to figure out.”

“It’s easy to make orders”

“This is very much like what I do at work now, but easier.”

“I am colorblind and this is still easy to use.”

Negative Comments

“I think a problem should be active by default.” (Problem List)

“I was expecting a dropdown for hives” (Allergy type, medication route)

“The button to save is not obvious” (Demographics)

“I can’t find language and ethnicity” (Demographics)

“Requires too many clicks” (Demographics)

“Allergy warning should be more visible”

“Order dropdowns are hard to find”

“I didn’t know I could type in orderable box”

“I wouldn’t use this without a barcode scanner”

“The Decision support site could look better”

“I don’t understand who we are providing feedback to”

Objective

The average usability rating of all completed tasks was 4.1 (5=very easy).

For tasks 31, 32 and 33, the average usability score was 3.9, 4.7 and 4.9, respectively.

As in appendix 4, each participant anonymously filled out the Likert usability score to judge overall system usability for initial testing (tasks 1-30). The *System Usability Score* was 85.5 with a maximum of 100. The usability score for tests conducted from October 8, 2024 through October 10, 2024 (Tasks 31, 32 and 33) was **4.5** out of 5, 5 being easiest on the Likert scale.

MAJOR FINDINGS

1. Overall, participants could easily navigate and perform tasks in Ankhos.
2. Once tasks were completed and learned, similar tasks were easy to complete.
3. Most users had problems in the same areas (e.g. Detailed Demographics, adding an order with a pre-existing allergy).
4. Most users expected dropdowns for reaction types and medication doses.
5. Popups were largely ignored the first time by all users who encountered them.
6. Some areas need larger messaging or higher contrast to stand out (new order categories)
7. Calendar format makes accessing orders very fast.
8. Some aspects of the chart details are not as discoverable as they should be. Some items seemed to be tucked away, adding two to three unnecessary clicks (e.g. Demographics)
9. Most users were confused by the difference between the SNOMED-CT problem list and an ICD10 problem list.

10. Users were confused as to how they would use the CDS – provide feedback feature.
11. The “download all feedback” link was not obvious.

AREAS FOR IMPROVEMENT

1. Make allergy interaction details clearer and provide a better way to provide feedback on what items need to be fixed to continue.
2. Consider adding dropdowns for common reaction descriptions (e.g. Hives, Shortness of breath).
3. Consider alternative methods of conveying error statuses other than popups, such as inline text or highlighting the part of the form that needs correction.
4. Reconsider the need for additional information in some cases (e.g. dose change comment)
5. Allow users to customize alert preferences.
6. Make Detailed demographics (language, race) more accessible from the main demographics page.
7. Consider adding descriptions to cross-map between SNOMED-CT and ICD10. While not a direct map, this may help some users understand the difference between the two code sets to more accurately code problems.
8. Make the patient export easier to find.
9. Provide context to motivate CDS feedback

APPENDICES

Appendix 1: Participant Demographics

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

Gender

Men	4
Women	16
Total	20

Occupation/Role

Physician	3
RN/BSN/OCN (Oncology Certified Nurse)	6
Nurse Cancer Navigator	1
Medical Assistant/Technician	3
CPhT (Pharmacy Technician)	3
Cancer Registrar	1
Physician Assistant / Nurse Practitioner	3
Total	20

Years of Experience with EHRT

Total professional experience (total years)	309
Years Experience with EHRUT (total years)	8
All Paper (total years)	150
Some Paper, Some Electronic (total years)	50
All Electronic (total years)	75
Total (Total participants)	20

LIERT

Appendix 1b: Participant Demographics – CDS

The following is a high-level overview of the participants for study conducted Oct 7-Oct 10, 2024

Gender

Men	2
Women	8
Total	10

Occupation/Role

Physician	1
Financial Counselor	1
Physician Assistant	3
Pharmacy Technician	1
Registered Nurse	2
Lab Manager	1
Phlebotomist	1

Experience

Total Professional Experience (years)	204
Total Computer Experience (years)	257
Experience with EHRUT (years)	99

Appendix 2: Informed consent form

Informed Consent

Ankhos Oncology software would like to thank you for participating in this study. The purpose of this study is to evaluate an electronic health records system. If you decide to participate, you will be asked to perform several tasks using the prototype and give your feedback. The study will last about 30 minutes. At the conclusion of the test, you will be compensated for your time.

Agreement

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

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

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

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

Please check one of the following:

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

Name: _____

Signature: _____

Date: _____

Appendix 3: Moderator Test Script

Begins on next page

EHRUT Usability Test

Moderator's guide

Administrator: _____

Date:_____ Time: _____

Participant #:_____

Location: _____

Prior to testing:

Confirm schedule with participants __ Done

Ensure EHRUT lab environment is running properly __Done

Prior to each participant:

Reset Application

Begin study record

Prior to each task

Reset application to starting point for next task

After each participant

Finalize Study record

After all testing

Backup all study records

Orientation (5 minutes)

Thank you for participating in this study. Our session today will last 30 minutes. During that time, you will look at an electronic health record system.

I will ask you to complete a few tasks using this system and answer some questions. We are interested in how easy (or how difficult) this system is to use, what in it would be useful to you, and how we could improve it. You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Do not do anything more than asked. If you get lost or have difficulty I cannot answer help you with anything to do with the system itself. Please save your detailed comments until the end of a task or the end of the session as a whole when we can discuss freely.

Please be honest with your opinions.

The product you will be using today is a demo version of Ankhos, populated with sample data. Some of the data may not make sense as it is placeholder data.

All of the information that you provide will be kept confidential and your name will not be associated with your comments at any time.

Do you have any questions or concerns?

Preliminary Questions (1 minute)

What is your job title / appointment?

How long have you been working in this role? What are some of your main responsibilities?

Tell me about your experience with electronic health records.

First Impressions (30 Seconds)

“This is the application you will be working with. Have you heard of it?” __Yes __No

“If so, tell me what you know about it.”

Show test participant the EHRUT.

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

Notes/comments

1. CPOE - Medications – Access

Access Medication orders on patient calendar.

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

2. CPOE – Medications – Record

Create a medication order for “Decadron 10 mg IV Push”

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

3. CPOE – Medications – Change

Change the dose of the previous order (Decadron) to 5 mg.

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

4. CPOE - Labs – Access

Access Lab orders on patient calendar.

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

5.CPOE – Labs – Record

Create a lab order for “Magnesium (Level)”

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

6. CPOE – Labs – Change

Mark the previous lab order as void

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

7. CPOE - Imaging – Access

Access imaging orders on patient calendar.

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

8. CPOE - Imaging – Record

Create an imaging order for “CT-Chest - Contrasted”

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

9. CPOE - Imaging – Change

After creating the imaging order, set the status to void

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

10. CPOE - Drug-allergy interaction

The patient has an allergy to Decadron. Attempt to order Decadron and observe the alerts and/or restrictions.

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

11. Demographics – Access

Access Patient demographics

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

12. Demographics – Record

Set the gender of the patient to Male

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

13. Demographics – Change

Set the patient preferred language to Spanish

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

14. Problem List – Access

Access SNOMED problem list

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

15. Problem List – Record

Search for Atrial Fibrillation and add it to the patient's problem list

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

16. Problem List – Change

Set the status of the new problem to Void

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

17. Medication List – Access

Access the patient's Medication List

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

18. Medication List – Record

Record a new medication entry for Dexamethasone 0.5 MG Oral Tablet with instructions "Take 1 prior to treatment appointments"

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

19. Medication List – Change

Change the instructions for the previous medication entry to "Take 1 daily"

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

20. Allergy List – Access

Access the patient's allergy list.

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

21. Allergy List – Record

Record a new allergy for the drug class "Sulfonamides" with a reaction of "hives".

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

22. Allergy List – Change

Modify the previous allergy entry to have a description of "rash".

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

23. CDS - Allergy with weight + gender

Request CDS information regarding a patient's allergy and gender from the patient allergy list

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

24. CDS - Medication with weight + gender

Request CDS information regarding a patient's medication and gender from the patient medication list

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

25. CDS - Diagnosis (ICD10) with weight + gender

Request CDS information regarding a patient's medication and gender from the patient ICD10 diagnosis list

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

26. Implant. Dev. - Enter Device ID

Enter a device identifier in the patient's chart under Implantable devices.

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

27. Implant. Dev. - Parse and Save Device

Select the "parse" button to parse and save the device identifier

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

28. Implant. Dev. - Remove device

Remove/archive the device identifier from the chart

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

29. CQM-Export one patient

Using the Downloads/Export CQM/MIPS tab, select a date range and CQM measure for which to download results. Export one patient report.

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

30. CQM-Export patient list

Using the Downloads/Export CQM/MIPS tab, select a date range and CQM measure for which to download results. Export the patient list.

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (5) to Very Difficult (1): ___

31. CDS - Comprehensive rule with new datasets

Create a CDS rule with one of each of the data types: Sexual Orientation, Gender Identity, Health Status and Smoking status (SDOH).

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Task Time: ____ Seconds

Rating from Very Easy (5) to Very Difficult (1): ___

32. CDS - Provide Feedback

When presented with CDS intervention, select the “Submit Feedback option” and provide location information and action taken, as well as any feedback you might have about the intervention

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Task Time: ____ Seconds

Rating from Very Easy (5) to Very Difficult (1): ___

33. CDS - Download All Feedback

Your account has been given permission to download all feedback and rules in a computable format. Click the download link and validate that your feedback was saved and presented in a computable format.

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Task Time: ____ Seconds

Rating from Very Easy (5) to Very Difficult (1): ___

Appendix 4: System Usability Scale Questionnaire

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

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

EHR Usability Test Report of Clinical Information Reconciliation in Ankhos Clinical Oncology Software V 4.0 (Ambulatory)

Report based on ISO/IEC 25062:2006 Common Industry Format for Usability Test Reports and NISTIR 7741 Customized Common Industry Format Template for Electronic Health Record Usability Testing v0.2

Ankhos Clinical Oncology Software, v. 4.0 (Ambulatory EHR)

Date of Usability Test: 06/11/2018-06/18/2018 Date of Report: 06/28/2018

Report Prepared By: Ankhos Oncology Software – Testing Division

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Contents

EXECUTIVE SUMMARY

A usability test of Clinical Information Reconciliation (CIRI) feature in Ankhos Version 4.0 (Ambulatory EHR) was conducted between June 11, 2018 and June 18, 2018 in Hickory, NC and Jefferson, NC by Ankhos Oncology Software. The purpose of these tests was to test and validate the usability of the current user interface and provide evidence of usability of CIRI functionality in the EHR Under Test (EHRUT).

During the usability test, 10 healthcare providers matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks. In this case, the target demographic is comprised of physicians and support staff involved in the care of cancer patients. This study collected performance data on 5 tasks typically conducted when reconciling patient information in an EHR:

1. CIRI – Select Record
2. CIRI – Medications
3. CIRI – Problems
4. CIRI – Allergies
5. CIRI – Save Reconciled List

During the 15 minute, one-on-one usability test, each participant was greeted by the administrator and asked to review and sign an informed consent/release form (included in Appendix 2); they were instructed that they could withdraw at any time. Some participants had prior experience with the EHRUT. Some participants had minimal exposure to the EHRUT. One participant had no knowledge of the EHRUT.

The administrator introduced the test and instructed participants to complete a series of tasks (given one at time) using the EHRUT. During the testing, the administrator timed the test and recorded user performance data on paper and electronically. The administrator did not give the participant assistance in how to complete the task.

The following types of data were collected for each participant:

- Number of tasks successfully completed within the allotted time without assistance
- Time to complete the tasks
- Number and types of errors
- Path deviations

- Participant's verbalizations
- Participant's satisfaction ratings of the system

All participant data was de-identified – no correspondence could be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants were asked to complete a post-test questionnaire (Appendix 4). Various recommended metrics, in accordance with the examples set forth in the *NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records*, were used to evaluate the usability of the Clinical Information Reconciliation functionality of the EHRUT. Following is a summary of the performance and rating data collected on the EHRUT.

Task		N # 10	Task Success Mean % (SD) 100% (0)	Path Deviation Observed/ Optimal 30 / 20	Task Time (Seconds) Mean (SD) 3.0 (1.1)	Task Time (Paths) Observed/ Optimal 14 / 10	Errors Mean (SD) 0.4 (.51)	Task Ratings (5=Easy) Mean (SD) 4.9 (.31)
1	CIRI – Select Record	10	100% (0)	30 / 20	3.0 (1.1)	14 / 10	0.4 (.51)	4.9 (.31)
2	CIRI – Medications	10	100% (0)	35 / 20	3.5 (1.4)	22 / 20	0.2 (.42)	4.7 (.48)
3	CIRI – Problems	10	100% (0)	24 / 20	2.4 (.7)	22 / 20	0.2 (.42)	5 (0)
4	CIRI – Allergies	10	100% (0)	18 / 20	1.8 (.63)	21 / 20	0.1 (.33)	5 (0)
5	CIRI – Save Reconciled List	10	100% (0)	17 / 20	1.7 (.82)	15 / 10	0.5 (.7)	4.9 (.31)

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be **98.0**.

Major Findings

1. Overall, participants could easily navigate and perform CIRI tasks in Ankhos.
2. Most CIRI tasks in Ankhos were intuitive.
3. Some users expressed difficulty in clicking on smaller user interface elements
4. Some users expressed desire for higher visibility of duplicate entries

5. Most users were confused by the difference between the SNOMED-CT problem list and an ICD10 problem list.
6. Multiple users found the final reconcile button hard to find after scrolling.

Areas for improvement

1. Create larger User Interface elements to make item selection easier
2. Create a more visible contrast with entries that already exist
3. Provide a notification mechanism for new incoming documents
4. Provide a link directly from the patient's medication list to reconcile incoming documents.
5. Make the final reconcile button easier to find / not scroll.

INTRODUCTION

The EHRUT tested for this study was Clinical Information Reconciliation functionality of Ankhos v. 4.0 (Ambulatory EHR). Designed to present medical information to healthcare providers in ambulatory clinical oncology and outpatient infusion settings, the EHRUT consists of a browser-based, cloud hosted solution. 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 for Clinical Information Reconciliation and provide evidence of usability in the EHR Under Test (EHRUT).

METHOD

Participants

A total of 10 participants were tested on the EHRUT(s). Participants in the test were healthcare providers. Among them were Physicians, Physician Assistants, medical assistants and pharmacy technicians.

Recruited participants had a mix of backgrounds and demographic characteristics. The following is a table of participants by characteristics, including demographics, professional experience and computing experience. Participant names were replaced with Participant IDs so that an individual's data cannot be tied back to individual identities.

Table 1 – Participant Demographics

ID	Gender	Age	Education	Occupation	Prof. Exp (Months)	Comp. Exp (Months)	Prod. xp. (Months)	Assistive Tech?
1	F	30-39	Master's	Physician Assistant	72	96	36	No
2	F	30-39	Master's	Physician Assistant	120	192	84	No
3	F	50-59	Master's	Pharm. Tech.	300	264	60	No
4	M	60-69	MD	Oncologist	360	120	36	No
5	M	60-69	MD	Oncologist	420	144	0	No
6	F	50-59	Master's	Physician Assistant	96	108	60	No
7	M	60-69	MD	Oncologist	384	420	60	No
8	F	40-49	Asst. deg.	MA/Phlebotomist	48	120	16	No
9	F	30-39	Asst. deg.	MA/Phlebotomist	96	108	60	No
10	F	20-29	CPhT	Pharm. Tech.	12	96	6	No

Ten participants (matching the demographics in the section on Participants) were recruited and 10 participated in the usability test. No participant failed to show for the study.

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

Study Design

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

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

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

Additional information about the various measures can be found in table 2: Usability Metrics.

Tasks

Tasks were constructed that would be realistic and representative of the kinds of activities a user might do with the clinical information reconciliation functionality of the EHRUT, including:

1. CPOE - Medications – Access
2. CPOE – Medications – Record
3. CPOE – Medications - Change
4. CPOE - Labs – Access
5. CPOE – Labs – Record

The tasks selected represent the entirety of the clinical information reconciliation process in Ankhos.

Procedures

Upon arrival, participants were greeted; their identity was verified and matched with a name on the participant schedule. Participants were then given a pre-assigned participant ID. Each participant reviewed and signed an informed consent and release form (See Appendix 2). A representative from the test team witnessed the participant's signature.

The test administrator was an experienced usability engineer with eight years of in-field testing and software development experience. The administrator held a Bachelor's and Master's degree in computer science with a focus on software engineering and user experience. The administrator additionally had training in producing and testing medical software and was familiar with oncology software.

The administrator moderated the session including administering instructions and tasks. The administrator also monitored task times, obtained post-task rating data, and took notes on participant comments. The Administrator served as the data logger and took notes on task success, path deviations, number and type of errors, and comments.

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

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

For each task, the participants were given a written copy of the task. Task timing began once the administrator finished reading the question. The task time was stopped once the participant indicated they had successfully completed the task. Scoring is discussed below on page 12.

Following the session, the administrator gave the participant the post-test questionnaire (e.g., the System Usability Scale, see Appendix 4) and thanked each individual for their participation. Each post-test usability questionnaire was not identified by participant in an effort to provide double-blind usability feedback.

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

Test Location

The tests were conducted in a quiet testing room with a table and computer for the participant. Only the participant and administrator were in the test room. To ensure that the environment was comfortable for users, noise levels were kept to a minimum with the ambient temperature within a normal range. All of the safety instruction and evacuation procedures were valid, in place, and visible to the participants.

Test Environment

The EHRUT would be typically be used in a healthcare office or facility. In this instance, to accommodate the testers' schedule, the testing was conducted in private offices. For testing, the participants used the same laptop running Windows 7. The participants used a keyboard and mouse when interacting with the EHRUT. The test Ankhos environment used a laptop with a resolution of 1920x1080.

The application was set up by the vendor according to the vendor's documentation describing the system set-up and preparation. The application itself was running on a Windows computer using a training database on a LAN connection. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation. Additionally, participants were instructed not to change any of the default system settings (such as control of font size).

Test Forms and Tools

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

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

Examples of these documents can be found in Appendices 1-3 respectively. The Moderator's Guide was devised so as to be able to capture required data.

The participant's interactions with the EHRUT was recorded by the administrator as part of the Moderator's Guide. Additionally, all verbalizations and observed reactions and path deviations were recorded by the administrator on as part of the Moderator's Guide. A video camera and microphone were not used as part of the recording procedure.

Participant Instructions

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

"Thank you for participating in this study. Your input is very important. Our session today will last about 15 minutes. During that time, you will use an instance of an electronic health record.

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

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

Should you feel it necessary you can withdraw at any time during the testing."

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

"For each task, I will read the description to you and say "Begin." At that point, please perform the task and say "Done" once you believe you have successfully completed the task. I would like to request that you not *talk aloud or verbalize while you are doing the tasks. I will ask you your impressions about the task once you are done."*

Participants were then given 5 tasks to complete. Tasks are listed in the moderator's guide in Appendix 3.

Usability Metrics

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

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

Data Scoring

The following table (Table 2]) details how tasks were scored, errors evaluated, and the time data analyzed.

Table 2 - Scoring Metrics

Measures	Rationale and Scoring
Effectiveness: Task Success	A task was counted as a "Success" if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis. The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage. Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency. Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target task times used for task times in the Moderator's Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by some factor 1.25 that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was 20 seconds then allotted task time performance was 25 seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.
Effectiveness: Task Failures	If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as an "Failures." No task times were taken for errors. The total number of errors was calculated for each task and then divided by the total number of times that task was attempted. Not all deviations would be counted as errors. This should also be expressed as the mean number of failed tasks per participant. On a qualitative level, an enumeration of errors and error types should be collected.
Efficiency: Task Deviations	The participant's path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.
	It is strongly recommended that task deviations be reported. Optimal paths (i.e., procedural steps) should be recorded when constructing tasks.

Efficiency: Task Time	Each task was timed from when the administrator said "Begin" until the participant said, "Done." If he or she failed to say "Done," the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation and standard error) were also calculated.
Satisfaction: Task Rating	Participant's subjective impression of the ease of use of the application was measured by administering both a simple post-task question as well as a post-session questionnaire. After each task, the participant was asked to rate "Overall, this task was:" on a scale of 1 (Very Difficult) to 5 (Very Easy). These data are averaged across participants. Common convention is that average ratings for systems judged easy to use should be 3.3 or above. To measure participants' confidence in and likeability of Ankhos overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, "I think I would like to use this system frequently," "I thought the system was easy to use," and "I would imagine that most people would learn to use this system very quickly." See full System Usability Score questionnaire in Appendix 5.

Table [2]. Details of how observed data were scored.

RESULTS

Data Analysis and Reporting

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. Participants who failed to follow session and task instructions had their data excluded from the analyses. In these test sessions, all participants were present and no data were excluded.

The usability testing results for the EHRUT are detailed below (see Table 3). The results should be seen in light of the objectives and goals outlined on page 10 Study Design. The data yielded actionable results that, if corrected, yield material, positive impact on user performance.

Table 3 - Usability Test Results

Task		N # 10	Task Success Mean % (SD) 100% (0)	Path Deviation Observed/ Optimal 30 / 20	Task Time (Seconds) Mean (SD) 3.0 (1.1)	Task Time (Paths) Observed/ Optimal 14 / 10	Errors Mean (SD) 0.4 (.51)	Task Ratings (5=Easy) Mean (SD) 4.9 (.31)
1	CIRI – Select Record	10	100% (0)	30 / 20	3.0 (1.1)	14 / 10	0.4 (.51)	4.9 (.31)
2	CIRI – Medications	10	100% (0)	35 / 20	3.5 (1.4)	22 / 20	0.2 (.42)	4.7 (.48)
3	CIRI – Problems	10	100% (0)	24 / 20	2.4 (.7)	22 / 20	0.2 (.42)	5 (0)
4	CIRI – Allergies	10	100% (0)	18 / 20	1.8 (.63)	21 / 20	0.1 (.33)	5 (0)
5	CIRI – Save Reconciled List	10	100% (0)	17 / 20	1.7 (.82)	15 / 10	0.5 (.7)	4.9 (.31)

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be: **98.0**. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.

Discussion of the Findings

EFFECTIVENESS

1. The most common source of errors was the nature of the scrolling window. Most deviations came from User Interface elemements scrolling out of view. A common comment was “Can you make the save button always visible?”
2. Other common deviations included pausing when determining whether a medication/problem/allergy was a duplicate. A common comment was “Duplicate entries should be more apparent”
3. Most users expressed the ability to transfer learned skills from reconciling medications to problems and allergies. A common comment was “Once I knew how to do medications, the rest were easy”.

Objective

The average usability rating of all completed tasks was 4.9 (5=very easy).

As in appendix 5, each participant anonymously filled out the Likert usability score to judge overall system usability. The *System Usability Score* was 98.0 with a maximum of 100.

MAJOR FINDINGS

1. Overall, participants learned the CIRI functionality quickly
2. Once tasks were completed and learned, similar tasks were easy to complete.
3. Some users had issues with the final reconcile button
4. Most users were used to seeing ICD-10 codes and were confused by the difference between the SNOMED-CT problem list and an ICD10 problem list.
5. Most users reported that the CIRI feature was easy to use.

AREAS FOR IMPROVEMENT

1. Make final reconciliation visible at all times.
2. Make duplicate entries more obvious.
3. Dialog box should auto-close when reconciliation is complete.
4. Consider adding additional information about how ICD-10 corresponds to SNOMED codes.

APPENDICES

Appendix 1: Participant Demographics

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

Gender

Men	3
Women	7
Total	10

Occupation/Role

Physician	3
Physician Assistant / Nurse Practicioner	4
Medical Assistant / Phlebotomist	2
CPhT (Pharmacy Technician)	1
Total	10

Years of Experience with EHRT

Total professional experience (total years)	159
Years Experience with EHRUT (total years)	34
All Paper (total years)	75
Some Paper, Some Electronic (total years)	26
All Electronic (total years)	52
Total (Total participants)	10

Appendix 2: Informed consent form

Informed Consent

Ankhos Oncology software would like to thank you for participating in this study. The purpose of this study is to evaluate an electronic health records system. If you decide to participate, you will be asked to perform several tasks using the prototype and give your feedback. The study will last about 15 minutes.

Agreement

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

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

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

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

Please check one of the following:

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

Name: _____

Signature: _____

Date: _____

Appendix 3: Moderator Test Script

Begins on next page

EHRUT Usability Test

Moderator's guide

Administrator: _____

Date:_____ Time: _____

Participant #:_____

Location: _____

Prior to testing:

Confirm schedule with participants __ Done

Ensure EHRUT lab environment is running properly __Done

Prior to each participant:

Reset Application

Begin study record

Prior to each task

Reset application to starting point for next task

After each participant

Finalize Study record

After all testing

Backup all study records

Orientation (5 minutes)

Thank you for participating in this study. Our session today will last 30 minutes. During that time, you will look at an electronic health record system.

I will ask you to complete a few tasks using this system and answer some questions. We are interested in how easy (or how difficult) this system is to use, what in it would be useful to you, and how we could improve it. You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Do not do anything more than asked. If you get lost or have difficulty I cannot answer help you with anything to do with the system itself. Please save your detailed comments until the end of a task or the end of the session as a whole when we can discuss freely.

Please be honest with your opinions.

The product you will be using today is a demo version of Ankhos, populated with sample data. Some of the data may not make sense as it is placeholder data.

All of the information that you provide will be kept confidential and your name will not be associated with your comments at any time.

Do you have any questions or concerns?

Preliminary Questions (1 minute)

What is your job title / appointment?

How long have you been working in this role? What are some of your main responsibilities?

Tell me about your experience with electronic health records.

First Impressions (30 Seconds)

“This is the application you will be working with. Have you heard of it?” __Yes __No

“If so, tell me what you know about it.”

Show test participant the EHRUT.

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

Notes/comments

1. Clinical Information Reconciliation (CIRI) – Select Record

Select Incoming record to reconcile.

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (1) to Very Difficult (5): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

2. CIRI - Medications

Select Medications to reconcile

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (1) to Very Difficult (5): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

3. CIRI - Problems

Select Problems to reconcile

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (1) to Very Difficult (5): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

4. CIRI - Allergies

Select Allergies to reconcile

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (1) to Very Difficult (5): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

5. CIRI – Save Reconciled List

Save final reconciled list

__ Easily Completed __ With Difficulty __ Not Completed

__ Correct __ Minor Deviations __ Major Deviations

Rating from Very Easy (1) to Very Difficult (5): ___

Task Time: ____ Seconds

Observed Errors and Verbalizations

Appendix 4: System Usability Scale Questionnaire

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

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