

EHR Usability Test Report of PediatricXpress, Version 20

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

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Table of Contents

1	EXECUTIVE SUMMARY	3
2	INTRODUCTION	10
3	METHOD	10
3.1	PARTICIPANTS	10
3.2	STUDY DESIGN	12
3.3	TASKS	13
3.4	RISK ASSESSMENT	14
3.4	PROCEDURE	15
3.5	TEST LOCATION	16
3.6	TEST ENVIRONMENT	16
3.7	TEST FORMS AND TOOLS	17
3.8	PARTICIPANT INSTRUCTIONS	17
3.9	USABILITY METRICS	19
3.10	DATA SCORING	20
4	RESULTS	21
4.1	DATA ANALYSIS AND REPORTING	21
4.2	DISCUSSION OF THE FINDINGS	25
5	APPENDICES	29
5.1	Appendix 1: Participant Demographics	30
5.2	Appendix 2: Informed Consent Form	31
5.3	Appendix 3: Example Moderator's guide	32
5.4	Appendix 4: System Usability Scale questionnaire	43
5.5	Appendix 5: Acknowledgement Form	44



EXECUTIVE SUMMARY

A usability test of PediatricXpress, version 20, ambulatory E.H.R. was conducted on selected features of the PediatricXpress version 20 E.H.R. as part of the Safety-Enhanced Design requirements outlined in 170.315(g)(3) between January 30th, 2019 and February 8, 2019 at 409 2nd Avenue, Collegeville, PA 19426. The purpose of this testing was to test and validate the usability of the current user interface and provide evidence of usability in the EHR Under Test (EHRUT). During the usability test, eleven (11) healthcare providers and/or other intended users matching the target demographic criteria served as participants and used the PediatricXpress E.H.R. in simulated, but representative tasks.

This study collected performance data on sixteen (16) testing tasks typically conducted on PediatricXpress E.H.R. Each task fit into one of the following categories:

- CPOE – Medications (170.315 (a)(1)) – 3 Tasks
- CPOE – Laboratory (170.315 (a)(2)) – 2 Tasks
- CPOE – Imaging (170.315 (a)(3)) – 3 Tasks
- Drug-Drug, Drug-Allergy Interaction (170.315 (a)(4)) – 2 Tasks
- Demographics (170.315 (a)(5)) – 2 Tasks
- Clinical Decision Support (170.315 (a)(9)) – 1 Tasks
- Implantable Device List (170.315 (a)(14)) – 3 Tasks
- CCDA Receive, View and Reconcile (170.315 (b)(2)) – 2 Tasks



Since the certification categories do not necessary align to how users optimally utilize the PediatricXpress E.H.R. system, we developed sections of the user testing that better aligned to how users should use PediatricXpress with each of these sections having at least one and usually multiple tasks. Listed below are the sections that the users received testing of different tasks.

- Enter and edit Demographics for a Patient
- Complete the following medication activities
 - Access, record and change medication orders
 - Act on an allergy and adjust drug allergy severity level
- Access and record a lab order
- Access, Record and Change a diagnostic imaging order
- Use the clinical decision support
- Access and enter an implantable device
- View received CCDA document and reconcile the data appropriately

Appendix 3 provides the details of the tasks associated with each of these sections as well as how each section and task(s) link to the specific certification criteria.

We scheduled and conducted eleven (11), one hour, one-on-one usability tests for this study.

During the 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 1); they were instructed that they could withdraw at any time. Participants had prior experience with the E.H.R.. The administrator introduced the test and instructed participants to complete a series of tasks (given one at a time) using the PediatricXpress E.H.R. During the testing, the administrator timed the test and, along with the data logger(s) 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. No compensation was provided to the participants. 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 PediatricXpress E.H.R.

Following is a summary of the performance and rating data collected on the PediatricXpress E.H.R, Version 20.



Table 1: Performance and Rating Summary

Measure	N	Task Success	Path Deviation	Task Time		Errors	Scenario Ratings (5 = easy)
Task	#	% (SD)	Deviations (Observed/optimal)	Mean (SD) Seconds	Deviations (Observed/optimal)	% (SD)	Mean (SD)
CPOE - Medications							
170.315(a)(1) task 1 – Access CPOE Medication Orders	11	100% (0%)	6/5	193 (31)	120/30	0% (0%)	4.2 (.75)
170.315(a)(1) task 2- Record CPOE Medication Order	11	91% (30%)	30/22			9% (30%)	
170.315(a)(1) task 3 – Change CPOE Medication Order	11	91% (30%)	13/9			9% (30%)	
CPOE - Laboratory							
170.315(a)(2) Task 1 -Record CPOE Laboratory Orders	11	100% (0%)	14/9	39 (11)	38/9	0% (0%)	4.9 (.3)
170.315(a)(2) Task 2 -Access CPOE Laboratory Orders	11	100% (0%)	7/5			0% (0%)	
CPOE – Imaging							
170.315 (a)(3) Task 1 - Access CPOE Imaging Orders	11	100% (0%)	7/5	44 (12)	39/10	0% (0%)	4.8 (.4)
170.315 (a)(3) Task 2 - Record CPOE Imaging Orders	11	100% (0%)	11/9			0% (0%)	
170.315 (a)(3) Task 3 - Change CPOE Imaging Orders	11	100% (0%)	9/7			0% (0%)	
Drug – Drug, Drug -Allergy Interaction							
170.315(a)(4) Task 1 - Adjustments (Drug-Allergy severity level)	11	82% (40%)	12/9	52 (12)	39/11	18% (40%)	4.2 (.75)
170.315(a)(4) Task 2 -Review and act upon Drug-Allergy interaction alert	11	73% (47%)	12/10			27% (47%)	
Demographics							
170.315(a)(5) Task 1 - Access Demographics	11	100% (0%)	6/5	24 (10)	33/8	0% (0%)	5 (0)
170.315(a)(5) Task 2 - Change Demographics	11	91% (30%)	7/6			9% (30%)	
Clinical Decision Support							



170.315(a)(9) Task 1 - Access and set CDS for Vitals related to Weight > 200 lbs.	11	73% (47%)	9/7	60 (21)	51/17	27% (47%)	4.4 (.69)
Implantable Device List							
170.315(a)(14) Task 1 - View all implantable devices	11	100% (0%)	6/5	57 (17)	60/15	0% (0%)	4.5 (.52)
170.315(a)(14) Task 2 - Record and implanted device ID on patient chart	11	100% (0%)	14/11			0% (0%)	
170.315(a)(14) Task 3 - Change implanted device ID on patient chart	11	73% (47%)	15/12			27% (47%)	
CCDA: Receive – View, Receive - Reconcile							
170.315(b)(2) Task 1 –CCDA Receive and View	11	91% (30%)	4/3	32 (9)	25 (8)	9% (30%)	4.4 (.52)
170.315(b)(2) Task 2 – CCDA Receive and Reconcile	11	91% (30%)	6/4	47 (10)	41 (15)	9% (30%)	4.4 (.52)

The primary tasks of study participants included:

Certification Criteria	Task Description
170.315 (a)(1)	Access CPOE Medication Orders
170.315 (a)(1)	Record CPOE Medication Orders
170.315 (a)(1)	Change CPOE Medication Orders
170.315 (a)(2)	Record CPOE Laboratory Orders
170.315 (a)(2)	Access CPOE Laboratory Orders
170.315 (a)(3)	Access CPOE Imaging Orders
170.315 (a)(3)	Record CPOE Imaging Orders
170.315 (a)(3)	Change CPOE Imaging Orders
170.315 (a)(4)	Adjustments (Drug-Allergy severity level)
170.315 (a)(4)	Review and act upon Drug-Allergy interaction alert
170.315 (a)(5)	Access Demographics
170.315 (a)(5)	Change Demographics
170.315 (a)(9)	Access and set CDS for Vitals related to Weight > 200 lbs.
170.315 (a)(14)	View all implantable devices
170.315 (a)(14)	Record and implanted device ID on patient chart
170.315 (a)(14)	Change implanted device ID on patient chart
170.315 (b)(2)	View CCDA received for a patient
170.315 (b)(2)	Reconcile a CCDA for an existing patient



The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 93.4. An average System Usability Scale score is considered to be 68. So a score under 68 is considered below average while a score above 68 is above average. Note that the System usability scale is a simple scale designed to provide a global view of usability of a system. The scale was originally developed by John Brooke of Digital Equipment Corporation during the 1980s as a tool to be used in usability engineering of electronic office systems.

Major Findings

Since most of the users in the study had over six months experience with the application, usability issues seem to surface only for areas of the application that the user was not familiar. The SUS, impression of ease survey and subjective satisfaction survey all show that the users view the application as easy to use overall. All average task ratings were over a 4 in ease of use. The areas of the system rated the highest and easiest to use include the demographic data capture as well as CPOE for Labs and Imaging. There was a range in time to complete tasks that varied based on a number of factors including computer skills and use of multiple parts of the system. Overall impressions of the system included comments such as “Very Easy to Use”, “user Friendly”, “simple layout”. Some comments of what users like most included: “Icons”, “Geared to Pediatricians”, ability to enter vaccine shipments, ease of navigating a chart, “not complicated to use”, information



displayed in patient chart

Comments related to users opinion of comparing this other E.H.R. system to others they have used: “much more user friendly”, “easier to navigate”, “way easier to use”.

Areas for Improvement

While there were no comments requesting a change, there seems to be some opportunity to enhance some aspects of the electronic prescription program and interface with Dr. First. Additionally, there were a few comments that some of icons could be updated to provide a different image and/or better label on the icon.

Overall, participants recruited for this study were pleased with being asked to take part in this study. We will continue to conduct individual and group feedback as we enhance the features and performance of PediatricXpress



INTRODUCTION

The EHRUT tested for this study was PediatricXpress, Version 20 an ambulatory EMR. PediatricXpress E.H.R. was designed to present medical information to healthcare providers in Pediatric office-based ambulatory Pediatric Practices for recoding and managing patient charts.

PediatricXpress consists of many functions to optimize the management of an out-patient Pediatric practice. 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 in accordance with the Safety Enhanced Design requirements for 2015 ONC E.H.R. certification, provide evidence of usability in the EHR Under Test (EHRUT) as well as to collect data for ongoing user-centered design and testing for product development. To this end, measures of effectiveness, efficiency and user satisfaction, such as CPOE entry, changes to demographics were captured during the usability testing.

METHOD

PARTICIPANTS

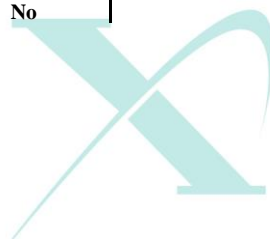
A total of 11 participants, matching our target demographic, were tested on PediatricXpress, version 20. Participants in the test were Doctors of



Medicine, Nurse Practitioner, Registered Nurse and Medical Assistants. No Participants were compensated for their participation. In addition, participants had no direct connection to the development of the E.H.R. and are not connected (e.g. spouse, sibling, family member) to any PhysicianXpress employees or contractors. Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received.

The following is a table of participants by characteristics, including demographics, professional experience, computing experience and user needs for assistive technology. Participant names were replaced with Participant IDs so that an individual’s data cannot be tied back to individual identities.

	Part ID	Gender	Age	Education	Occupation/ role	Professional Experience	Computer Experience	Product Experience	Assistive Technology Needs
1	1	Female	40-49	Doctor of Medicine	Pediatrician	204	125	110	No
2	2	Female	60-69	Doctor of Medicine	Pediatrician	372	145	12	No
3	3	Female	30-39	Some College Credit	Medical Assistant	84	148.8	84	No
4	4	Female	20-29	Some College Credit	Medical Assistant	115.2	156	115	No
5	5	Female	60-69	High School Graduate	Medical Assistant/ Medical Secretary	150	155	120	No
6	6	Female	20-29	Some College Credit	Medical Assistant	14	60	14	No
7	7	Female	60-69	Some College Credit	Medical Assistant/ Medical Secretary	84	276	84	No
8	8	Female	20-29	College and Some Grad School	Medical Assistant	28	65	1	No
9	9	Female	20-29	College and Some Grad School	Medical Assistant	11	65	1	No
10	10	Female	30-39	Some College Credit	Medical Assistant	18	65	18	No
11	11	Female	30-39	Master Degree	Pediatric Nurse Practitioner	24	108	6	No



Eleven (11) participants (matching the demographics in the section on Participants) were recruited and eleven (11) participated in the usability test. Zero participants failed to show for the study.

Participants were scheduled for 60-minute sessions including time for debriefing 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 participant demographic characteristics.

STUDY DESIGN

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

During the usability test, participants interacted with one E.H.R, PediatricXpress, v20. Each participant used the system in the Collegeville office located at 409 2nd avenue, Collegeville, PA 19426 and was provided with the same instructions. The system was evaluated for effectiveness, efficiency and satisfaction as defined by measures collected and analyzed for each participant:

Number of tasks successfully completed within the



allotted time without assistance

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

Additional information about the various measures can be found in Section 3.9 on Usability Metrics.

TASKS

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

- Enter and edit Demographics for a Patient
- Enter a medication and complete the following medication activities
 - Utilize drug-drug and drug-allergy interaction checks
- Enter a lab order in the system using the most common input form for practice
- Use the clinical decision support
- Access and enter an implantable device
- Enter a diagnostic imaging into the diagnostic imaging form
- Receive a CCDA document, view the document and reconcile with a record

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



constructed in light of the study objectives.

RISK ASSESSMENT

PhysicianXpress, Inc. assessed the risk level to patients for all provider workflows included in this test. These workflows were evaluated based on the potential risk for adverse events to the patient and assigned a risk category of high, moderate or low risk. Tasks that were associated with the Medications and associated alerts were determined to be high risk while basic demographic information was low risk. The risk assessment for each task can be seen in the table below.

Section & Task Number	Certification Criteria	Task Description	Risk Assessment
3a, Task 1	170.315 (a)(1)	Access CPOE Medication Orders and make change to medication	High
3a, Task 2	170.315 (a)(1)	Record CPOE Medication Orders	High
3a, Task 3	170.315 (a)(1)	Change CPOE Medication Orders	High
4, Task 1	170.315 (a)(2)	Record CPOE Laboratory Orders	Moderate
4, Task 2	170.315 (a)(2)	Access CPOE Laboratory Orders	Moderate
5, Task 1	170.315 (a)(3)	Access CPOE Imaging Orders	Low
5, Task 2	170.315 (a)(3)	Record CPOE Imaging Orders	Moderate
5, Task 3	170.315 (a)(3)	Change CPOE Imaging Orders	Low
3b, Task 1	170.315 (a)(4)	Adjustments (Drug-Allergy severity level)	High
3b, Task 2	170.315 (a)(4)	Review and act upon Drug-Allergy interaction alert	High
1, Task 1	170.315 (a)(5)	Access Demographics	Low
1, Task 2	170.315 (a)(5)	Change Demographics	Moderate
6, Task 1	170.315 (a)(9)	Access and set CDS for Vitals related to Weight > 200 lbs.	Moderate
7, Task 1	170.315 (a)(14)	View all implantable devices	Low
7, Task 2	170.315 (a)(14)	Record and implanted device ID on patient chart	Moderate
7, Task 3	170.315 (a)(14)	Change implanted device ID on patient chart	Low
8, Task 1	170.315 (b)(2)	View CCDA received for a patient	Low
8, Task 2	170.315 (b)(2)	Reconcile a CCDA for an existing patient	Moderate



PROCEDURES

Participants' identity was verified and matched with a name on the participant schedule. Participants were then assigned a participant ID. Each participant reviewed and signed an informed consent and release form (See Appendix 2). A representative from the test team witnessed/confirmed the participant's signature.

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

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

- As quickly as possible making as few errors 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 an oral information as well as written copy of the task. Task timing began once the administrator finished reading the question. The task time was stopped once the participant indicated they had successfully completed the task. Scoring is discussed below in Section 3.9.

Following the session, the administrator gave the participant the post-test



questionnaire (e.g., the System Usability Scale, see Appendix 4), and thanked each individual for their participation.

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

TEST LOCATION

The test facility was an office environment located at 409 2nd Avenue, Collegeville, PA. The participants had the choice to use a lap top, desk top or tablet device. All observers and the data logger worked in the same facility to record the response to the test. All of the safety instruction and evacuation procedures were valid, in place, and visible to the participants.

TEST ENVIRONMENT

The PediatricXpress E.H.R. would be typically be used in a healthcare office or facility. In this instance, the testing was conducted in an office-based environment. For testing, the computer used was a desk top, lap top or tablet running either windows or apple operating systems. The participants used either a mouse or touch screen when interacting with the EHRUT.

The PediatricXpress E.H.R. used a desk top, lap top or tablet (e.g. IPad) with 'normal settings'. 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 an internet connection using a test database.



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
4. Acknowledgment Form

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 interaction with the EHRUT was captured and recorded digitally with screen capture software running on the test machine.

The test session were electronically transmitted to a nearby observation room where the data logger observed the test session.

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 60 minutes. During that time you will use an instance of PediatricXpress electronic health record system. I will ask you to complete a few tasks using this system and answer some questions. You should complete the tasks as quickly as possible making as few errors as possible. Please try to complete the tasks on your own following the instructions very closely. Please note that we are not testing you we are testing the system, therefore if you have difficulty all this means is that something needs to be improved in the system. I will be here in case you need specific help, but I am not able to instruct you or provide help in how to use the application. Overall, we are interested in how easy (or how difficult) this system is to use, what in it would be useful to you, and how we could improve it. 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 are able to withdraw at any time during the testing.

Following the procedural instructions, participants were shown the E.H.R. 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 twelve (12) 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 PediatricXpress, v20 by measuring participant success rates and errors
2. Efficiency of PediatricXpress, v20 by measuring the average task time and path deviations
3. Satisfaction with PediatricXpress, v20 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.

Measures	Rationale and Scoring
<p>Effectiveness: Task Success</p>	<p>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.</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. 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 that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was (23) seconds then allocated task time performance was (46) seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.</p>
<p>Effectiveness: Task Failures</p>	<p>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.</p>
<p>Efficiency: Task Deviations</p>	<p>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.</p> <p>It is strongly recommended that task deviations be reported. Optimal paths (i.e., procedural steps) should be recorded when constructing tasks.</p>



<p>Efficiency: Task Time</p>	<p>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.</p>
<p>Satisfaction: Task Rating</p>	<p>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.</p> <p>To measure participants’ confidence in and likeability of the PediatricXpress E.H.R. 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.</p>

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

The usability testing results for PediatricXpress V20 are detailed below (see Table 3). The results should be seen in light of the objectives and goals outlined in Section 3.2 Study Design. The data should yield actionable results that, if corrected, yield material, positive impact on user performance.



Table 3: Performance and Rating Summary

Measure	N	Task Success	Path Deviation	Task Time		Errors	Scenario Ratings (5 = easy)
Task	#	% (SD)	Deviations (Observed/optimal)	Mean (SD) Seconds	Deviations (Observed/optimal)	% (SD)	Mean (SD)
CPOE - Medications							
170.315(a)(1) task 1 – Access CPOE Medication Orders	11	100% (0%)	6/5	193 (31)	120/30	0% (0%)	4.2 (.75)
170.315(a)(1) task 2- Record CPOE Medication Order	11	91% (30%)	30/22			9% (30%)	
170.315(a)(1) task 3 – Change CPOE Medication Order	11	91% (30%)	13/9			9% (30%)	
CPOE - Laboratory							
170.315(a)(2) Task 1 -Record CPOE Laboratory Orders	11	100% (0%)	14/9	39 (11)	38/9	0% (0%)	4.9 (.3)
170.315(a)(2) Task 2 -Access CPOE Laboratory Orders	11	100% (0%)	7/5			0% (0%)	
CPOE – Imaging							
170.315 (a)(3) Task 1 - Access CPOE Imaging Orders	11	100% (0%)	7/5	44 (12)	39/10	0% (0%)	4.8 (.4)
170.315 (a)(3) Task 2 - Record CPOE Imaging Orders	11	100% (0%)	11/9			0% (0%)	
170.315 (a)(3) Task 3 - Change CPOE Imaging Orders	11	100% (0%)	9/7			0% (0%)	
Drug – Drug, Drug -Allergy Interaction							
170.315(a)(4) Task 1 - Adjustments (Drug-Allergy severity level)	11	82% (40%)	12/9	52 (12)	39/11	18% (40%)	4.2 (.75)
170.315(a)(4) Task 2 -Review and act upon Drug-Allergy interaction alert	11	73% (47%)	12/10			27% (47%)	
Demographics							
170.315(a)(5) Task 1 - Access Demographics	11	100% (0%)	6/5	24 (10)	33/8	0% (0%)	5 (0)
170.315(a)(5) Task 2 - Change Demographics	11	91% (30%)	7/6			9% (30%)	
Clinical Decision Support							



170.315(a)(9) Task 1 -Access and set CDS for Vitals related to Weight > 200 lbs.	11	73% (47%)	9/7	60 (21)	51/17	27% (47%)	4.4 (.69)
Implantable Device List							
170.315(a)(14) Task 1 - View all implantable devices	11	100% (0%)	6/5	57 (17)	60/15	0% (0%)	4.5 (.52)
170.315(a)(14) Task 2 - Record and implanted device ID on patient chart	11	100% (0%)	14/11			0% (0%)	
170.315(a)(14) Task 3 - Change implanted device ID on patient chart	11	73% (47%)	15/12			27% (47%)	
CCDA: Receive – View, Receive - Reconcile							
170.315(b)(2) Task 1 –CCDA Receive and View	11	91% (30%)	4/3	32 (9)	25 (8)	9% (30%)	4.4 (.52)
170.315(b)(2) Task 2 – CCDA Receive and Reconcile	11	91% (30%)	6/4	47 (10)	41 (15)	9% (30%)	4.4 (.52)

Effectiveness

Some of the factors that determined the degree of success when measuring effectiveness included whether a participant needed assistance in order to successfully complete a task and what degree of assistance was needed or if there were asked by the moderator/administrator to move on to the next task due to difficulty completing an item within the allotted time. Tasks 1, 2 and 3 of the CPOE Medications took the most time and had the largest variation due in part to the different roles and experience levels that participated in the study. Additionally, Tasks 1-3 of CPOE had the most steps and items to complete as part of the study.

Efficiency

The primary measure of efficiency was time of a task/function. For each task, there is an optimal time allotted and clicks per task. This information was populated into a



spread sheet for each task. The demographics tasks were the faster task for the participants to complete.

Satisfaction

Satisfaction was measured by taking results from the written survey and the System Usability Scale scores (SUS) that each participant completed. This information provides both quantitative and qualitative feedback. The results in the SUS as well as written feedback show high user satisfaction with the E.H.R.

Ease of Use

Perceived ease of use ratings were gauged on a 5-point Likert scale. Ease of use was rated per each task set per participant. The scale ranges from 1 (very difficult) to 5 (very Easy). The demographics and laboratory CPOE received the highest scores for ease of use.

Usability

Usability was rated against the application as a whole. The overall application was rated by participants with a SUS score of ; 93.4

Question	Score
1. I think that I would like to use this system frequently	3.5
2.I found the system unnecessarily complex	3.4
3. I thought the system was easy to use	3.6
4.I think that I would need the support of a technical person to be able to use this system	3.6
5.I found the various functions in this system were well integrated	3.6
6.I thought there was too much inconsistency in this system	3.4
7.I would imagine that most people would learn to use this system very quickly	3.6
8.I found the system very cumbersome to use	2.2
9.I felt very confident using the system	3.5
10. I needed to learn a lot of things before I could get going with this system	3.3



System Usability Score (SUS) = (sum of scores for items #1 -10)*2.5 = 37.4*2.5 = 93.4

DISCUSSION OF THE FINDINGS

Effectiveness

Overall, the participants had minimum issues related to effectiveness of using the E.H.R. application. The tasks that had the lowest scores were: tasks 1 and 2 of Drug-Drug and Drug Allergy testing and recording a medication list.

170.315(a)(1) Task 2- Record CPOE Medication Order: From the start (searching and finding a patient) to the completion (ordering the dosage and days supply of lovastatin), there were at least 22 steps for the users to complete. Although the success rate was high, one of the users needed extra time and missed one of the steps. This part of the application is part of a third party (Dr. First) that integrates with PediatricXpress E.H.R. This is an area to enhance training and/or future aspects of this part of the application.

170.315(a)(1) Task 3 – Change CPOE Medication Order - Although the success rate was high, one of the users needed extra time and missed one of the steps. This part of the application is part of a third party (Dr. First) that integrates with PediatricXpress E.H.R. This is an area to enhance training and/or future aspects of this part of the application.

170.315 (a)(4) Task 2 -Review and act upon Drug-Allergy interaction alert. Although the success rate was acceptable, a few of the users needed extra time and missed one of the steps of how to complete this task per the expected result. . This part of the application is part of a third party (Dr. First) that integrates with



PediatricXpress E.H.R. This is an area to enhance training and/or future aspects of this part of the application.

Efficiency:

The challenges with efficiency were most common in creating medications that were not saved as a favorite. For most Pediatric group, they would create a list of favorite Medication orders including dosage and other details to reduce the time to send their common prescriptions. This part of the application is part of a third party (Dr. First) that integrates with PediatricXpress E.H.R.. The primary area to improve would be

170.315 (a)(1) Task 2- Record CPOE Medication Order

Additionally, most users had low knowledge usage of the clinical decision support functions provided in the application. Although users understand the function and how to use the software, they need time to identify how to incorporate this function into their clinical practice.

Satisfaction

System Usability Score (SUS)

The overall application was rated by the participants with a System Usability Score (SUS) score of 93.4. This scale is a common scale utilized in many industries and was originally developed in the 1980s as a scale for usability engineering of electronic office systems. In general across multiple industries, an average SUS score is 68. The score of 93.4 is an above average score.

Impression of Ease survey



Each task received an ease of use rating by the user between 1 (Very Difficult) to 5 (Very Easy). If all users rated a task Very Easy (a 5) then the score would be a 5 while if all users rated a task very difficult (a 1) then the score would be a 1.

The users in the study had a very wide range of experience in their role as well as product experience. Overall, the ease of use for the tasks associated with ten categories (e.g. CPOE Medication) ranged from a 4.2 to a 5.0. Based on this the users in this study rated the application tasks easy to very easy overall.

Subjective satisfaction survey

The user satisfaction survey provided the user an opportunity to write comments of their overall impressions of the system. Overall impressions of the system included comments such as “ Very Easy to Use”, “user Friendly”, “simple layout”. Some comments of what users like most included: “Icons”, “Geared to Pediatricians”, ability to enter vaccine shipments, ease of navigating a chart, “not complicated to use”, information displayed in patient chart

Comments related to users opinion of comparing this other E.H.R. system to others they have used: “much more user friendly”, “easier to navigate”, “way easier to use, no bluff”

Major Findings

Since most of the users in the study had over six months experience with the application, usability issues seem to surface only for areas of the application that the user was not familiar. The SUS, impression of ease survey and subjective satisfaction survey all show



that the users view the application as easy to use overall. All average task ratings were over a 4 in ease of use. The areas of the system rated the highest and easiest to use include the demographic data capture as well as CPOE for Labs and Imaging. There was a range in time to complete tasks that varied based on a number of factors including computer skills and use of multiple parts of the system. Overall impressions of the system included comments such as “Very Easy to Use”, “user Friendly”, “simple layout”. Some comments of what users like most included: “Icons”, “Geared to Pediatricians”, ability to enter vaccine shipments, ease of navigating a chart, “not complicated to use”, information displayed in patient chart

Comments related to users opinion of comparing this other E.H.R. system to others they have used: “much more user friendly”, “easier to navigate”, “way easier to use”.

Areas for Improvement

While there were no comments requesting a change, there seems to be some opportunity to enhance some aspects of the electronic prescription program and interface with Dr. First. Additionally, there were a few comments that some of icons could be updated to provide a different image and/or better label on the icon.

Overall, participants recruited for this study were pleased with being asked to take part in this study. We will continue to conduct individual and group feedback as we enhance the features and performance of PediatricXpress



APPENDICES

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

- 1: Participant demographics
- 2: Informed Consent Form
- 3: Example Moderator's Guide
- 4: System Usability Scale Questionnaire
- 5: Acknowledgment form



Appendix 1: PARTICIPANT DEMOGRAPHICS

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

Gender

Men	0
Women	11
Total (participants)	11

Occupation/Role

RN/BSN	1
Physician	2
Admin Staff/Medical Assistant	8
Total (participants)	11

Years of Experience

Mean Years' experience of EHR	4.7 Years
-------------------------------	-----------

Type of Charting (# per category)

All paper	0
Some paper, some electronic	0
All electronic	11 (100%)
Total (participants)	11



Appendix 2: INFORMED CONSENT FORM

Informed Consent

PhysicianXpress would like to thank you for participating in this study. The purpose of this study is to evaluate the PediatricXpress 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 60 minutes.

Agreement

I understand and agree that as a voluntary participant in the present study conducted by *Physician Xpress, Inc.* I am free to withdraw consent or discontinue participation at any time. I understand and agree to participate in the study conducted and videotaped by the *Physician Xpress, Inc.*.

I understand and consent to the use and release of the videotape by *Physician Xpress, Inc.* I understand that the information and videotape is for research purposes only and that my name and image will not be used for any purpose other than research. I relinquish any rights to the videotape and understand the videotape may be copied and used by *Physician Xpress, Inc.* without further permission.

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

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

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

Please check one of the following:

- YES, I have read the above statement and agree to be a participant.

- No, I choose not to participate in this study.

Signature: _____

Date: _____



Appendix 3: EXAMPLE MODERATOR’S GUIDE

PediatricXpress E.H.R. Usability Test

Moderator’s Guide

Administrator: _____

Data Logger: _____

Date: _____ **Time:** _____

Participant #: _____

Location: _____

Areas for the Usability Test include:

- Enter and edit Demographics for a Patient
- Access and change the patient problem list
- Complete the following medication activities
 - Access, record and change medication orders
 - Access, record and change medication list
 - Access, record, and change medication allergy list
 - Act on an allergy and adjust drug allergy severity level
- Access and record a lab order
- Access, Record and Change a diagnostic imaging order
- Use the clinical decision support
- Access and enter an implantable device

The following table shows the linkage between the section and task number for the tasks completed as part of this study. This table also links the certification criteria and task description.



Section & Task Number	Certification Criteria	Task Description
3a, Task 1	170.315 (a)(1)	Access CPOE Medication Orders and make change to medication
3a, Task 2	170.315 (a)(1)	Record CPOE Medication Orders
3a, Task 3	170.315 (a)(1)	Change CPOE Medication Orders
4, Task 1	170.315 (a)(2)	Record CPOE Laboratory Orders
4, Task 2	170.315 (a)(2)	Access CPOE Laboratory Orders
5, Task 1	170.315 (a)(3)	Access CPOE Imaging Orders
5, Task 2	170.315 (a)(3)	Record CPOE Imaging Orders
5, Task 3	170.315 (a)(3)	Change CPOE Imaging Orders
3d, Task 1	170.315 (a)(4)	Adjustments (Drug-Allergy severity level)
3d, Task 2	170.315 (a)(4)	Review and act upon Drug-Allergy interaction alert
1, Task 1	170.315 (a)(5)	Access Demographics
1, Task 2	170.315 (a)(5)	Change Demographics
6, Task 1	170.315 (a)(9)	Access and set CDS for Vitals related to Weight > 200 lbs.
7, Task 1	170.315 (a)(14)	View all implantable devices
7, Task 2	170.315 (a)(14)	Record and implanted device ID on patient chart
7, Task 3	170.315 (a)(14)	Change implanted device ID on patient chart
8, Task 1	170.315 (b)(2)	View CCDA received for a patient
8, Task 2	170.315 (b)(2)	Reconcile a CCDA for an existing patient



□ **Section 1, Tasks 1 & 2: Enter and edit Demographics for a Patient**

Take the participant to the starting point for the task.

Use the search function to search for “Baby Test”. Open the patient chart, change the middle name to “T” and save the change. View the demographic changes to the chart.

Success:

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

Comments:

Task Time: _____ Seconds

Optimal Path: *Patient Chart.php* → *patients.php (Edit demo)* → *type in middle name* → *“Save Patient” Button* → *Patient Chart (Optimal = 5 Steps (task 1), 6 steps (task 2))*

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

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: _____

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

Administrator / Notetaker Comments:

□ **Section 2, Tasks 1, 2, & 3: Access and change the patient problem list**

Removed



Section 3: Complete the following medication activities

- Section 3A: Access, record and change medication orders (3 tasks)
- Section 3B: Removed
- Section 3C: Removed
- Section 3D: Act on an allergy and adjust drug allergy severity level (2 tasks)

Section 3A: Access, Record and Change Medication orders (3 tasks)

After examining “Test” *Patient*, you have decided to put this patient on a statin – *lovastatin 10 mg*. Three primary tasks, access the medication list for patient, record lovastatin 10 mg as a medication order and then change/modify the order to 20 mg. Note that this is a new medication (Not saved as a favorite) and requires user to enter all steps (versus selecting a pre-completed favorite list)

Success:

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

Comments:

Task Time: _____ Seconds

Optimal Path: *go to patientchart.php and click on medication icon → launch to dr. First medication page → medication list for this patient → prescribe a medication input lovastatin → click on 10 mg formulation → Make a change to finished prescribed medication (Optimal = 5 Steps/fields to complete (task 1), 22 steps/fields to complete (task 2), 9 Steps/fields to complete (Task 3))*

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

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: _____

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

Administrator / Notetaker Comments:



Section 3D: Act on an allergy and adjust drug allergy severity level (2 tasks)

After examining “Test” *Patient*, you will prescribe lovastatin 10 mg for the patient. The previous step you set the allergy to statins with moderate hives as response. You will prescribe the medication then adjust the allergy to mild hives after completion for the tasks.

Success:

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

Comments:

Task Time: _____ Seconds

Optimal Path: go to *patientchart.php* and click on medication icon → launch to dr.
First medication page → prescribe a medication for this patient of lovastatin 10 mg →
act on the allergy warning → complete the task and prescription → Go to the manage
allergy page and adjust the severity to mild (Optimal = 9 Steps/fields to complete (task
1), 10 steps/fields to complete (task 2))

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

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: _____

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

Administrator / Notetaker Comments:



□ **Section 4, Tasks 1 & 2: Access and Record a lab order**

Take the participant to the starting point for the task. Select Baby Test patient and order a “Lipid Panel” using the Quest or LabCorp order form for labs. After examining “Baby Test” Patient, you have decided to order a Lipid panel lab test from LabCorp or quest.

Success:

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

Comments:

Task Time: _____ Seconds

Optimal Path: go to patientchart.php and click on lab icon → launch to lab ordering page for Labcorp or Quest → Select a “lipid panel” and click on “submit order” → go back to patient chart. (Optimal = 9 Steps/fields to complete (task 1), 5 steps/fields to complete (task 2))

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

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: _____

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

Administrator / Notetaker Comments:



□ **Section 5, Tasks 1, 2 and 3: Access, Record and Change a diagnostic imaging order**

Take the participant to the starting point for the task. Enter in a diagnostic image order from the patient's chart for patient "Baby Test".

Search for patient "Baby Test", then select patient and go to the patient chart. From the patient chart, click on "Radiology Forms" button at the bottom of the patient chart (in the Miscellaneous Function Section). Click on "Record a Form" button at the bottom of the page. Select MRI of Head, Spine and Neck. Hit the "submit Button"

Success:

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

Comments:

Task Time: _____ Seconds

Optimal Path: go to patient search → type last name (Test) and hit "Search"
→ select "Baby Test" and go to patientchart.php → scroll to bottom of the page → e
click "Radiology Forms" icon at the bottom of the chart in the section titled
"Miscellaneous Functions" → On the radiologyFormList.php page, scroll to bottom and
click on "Record a Form Button" → Under "MRI" Section click on "Head", "Spine"
and "Neck" scroll down and hit "submit button. (Optimal = 7 Steps/fields to complete
(task 1), 11 steps/fields to complete (task 2) 9 steps/fields to complete (task 3))

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

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: _____

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

Administrator / Notetaker Comments:



□ **Section 6, Task 1:** Use the clinical decision support

Take the participant to the starting point for the task. Develop a clinical decision rule for the practice that will notify users of patients that have a specific condition/situation.

Go to practice admin menu, then select the icon that looks like a “TV with wrench”. On the right side of screen is “Manage Clinical Support Decision Rule” (click on this link). Make a criteria that flags all patients greater than 200 lbs.

Success:

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

Comments:

Task Time: _____ Seconds

Optimal Path: go to practice admin home → click on icon that looks like TV → click on link titled “Manage Clinical Support Decision Rule” → under vitals select “weight” then select “>” then type 200 → under gender select “any” → click on “save”.
(Optimal = 7 Steps/fields to complete (task 1))

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

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: _____

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

Administrator / Notetaker Comments:



□ **Section 7, Tasks 1, 2 and 3: View, Record and Change an implantable device ID**

Take the participant to the starting point for the task. Enter in an implantable device for patient “Baby Test”.

Search for patient “Baby Test”, then select patient and go to the patient chart. From the patient chart, click on “edit Demo” then search and enter the device from ABC company, brand “One”, Serial number 123, lot ABC, manufacturer date of 12/15/18 and expiration date of 12/31/2024. Then view the device in the record. Last task is to delete/make an update to the device.

Success:

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

Comments:

Task Time: _____ Seconds

Optimal Path: go to patient search → type last name (Test) of patient and hit “Search” → select “Baby Test” and go to patientchart.php → click ‘Edit demo’ → enter in values for medical device and click on “save patient” (Optimal = 5 Steps/fields to complete (task 1), 11 steps/fields to complete (task 2) 12 steps/fields to complete (task 3))

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

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: _____

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

Administrator / Notetaker Comments:



Section 8, Tasks 1 and 2: Receive a CCDA file and complete a clinical reconciliation for a patient

Go to the provider home page. Scroll down to the bottom and click on “CCDA Documents” hyper link. View most recent CCDA by identifying the date. Use the view to view the CCDA. Then click on import to import the patient. Search for the patient in the system and reconcile information between the CCDA and the system data. Reconcile the Medications, problems and allergies with the patient in the system. Task 1: View a patient, Task 2: Reconcile, Task 3: verify changes in patient record

Success:

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

Comments:

Task Time: _____ Seconds

Optimal Path: *go to inbox.php → scroll to bottom of page and click on “CCDA Documents” → scroll to bottom and view most recent CCDA file – click on View CCDA(confirm the patient and background) – select the back button on browser to then import the CCDA – select Import for the patient – search the patient to see if in PXS – select the appropriate patient – move over a problem from CCDA to PXS – check that change occurred in patient record by going to patientChart.php*

Correct

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

Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was: _____ (1 – 5 Scale: “Very Difficult” (1) to “Very Easy” (5))

Administrator / Note taker Comments:



Final Questions (10 Minutes)

What was your overall impression of this system?

What aspects of the system did you like most?

What aspects of the system did you like least?

Were there any features that you were surprised to see?

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

Compare this system to other systems you have used.

Would you recommend this system to your colleagues?



Appendix 4: SYSTEM USABILITY SCALE QUESTIONNAIRE

	Strongly Disagree				Strongly Agree	
Question	1	2	3	4	5	Score
1. I think that I would like to use this system frequently						3.5
2. I found the system unnecessarily complex						3.4
3. I thought the system was easy to use						3.6
4. I think that I would need the support of a technical person to be able to use this system						3.6
5. I found the various functions in this system were well integrated						3.6
6. I thought there was too much inconsistency in this system						3.4
7. I would imagine that most people would learn to use this system very quickly						3.6
8. I found the system very cumbersome to use						2.2
9. I felt very confident using the system						3.5
10. I needed to learn a lot of things before I could get going with this system						3.3

System Usability Score (SUS) = 37.4*2.5 = 93.4



Appendix 5: Acknowledgement Form

Printed Name: _____

Address: _____

Signature: _____ Date: _____

Usability Researcher: _____

Signature of Usability Researcher: _____

Date: _____

Witness: _____

Witness Signature: _____

Date: _____



