



## Safety-Enhanced Design Report



# EHR Usability Test Report of PCIS GOLD<sup>®</sup> EHR Version 2.4

*Report based on NISTIR 7742/ISO/IEC 25062:2006 Customized Common Industry Format Template for Electronic Health Record Usability Testing.*

EHR Under Test (EHRUT): **PCIS GOLD<sup>®</sup> EHR – Version 2.4**

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Report Prepared By:

PCIS GOLD  
Jared Nesbit, Quality Assurance  
801-429-2261  
[jaredn@pcisgold.com](mailto:jaredn@pcisgold.com)

PCIS GOLD  
Mark McEntire, Quality Assurance  
801-429-2304  
[markm@pcisgold.com](mailto:markm@pcisgold.com)

Stance Sampson, Quality Assurance  
801-344-6467  
[stances@pcisgold.com](mailto:stances@pcisgold.com)

Corporate Office: 1525 W 820 N  
Provo, UT 84601

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# 1. EXECUTIVE SUMMARY

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Usability tests of the PCIS GOLD® EHR, Version 2.4 for use in Ancillary/Multi-specialty Clinics were conducted October 2, 2017 – December 1, 2017 in the DHI Computing Service, Inc. testing facility in the corporate offices located at 1525 West 820 North in Provo, Utah.

The purpose of this test was to test and validate the usability of the current user interface and provide evidence of usability in the EHRUT. During the usability test, eleven healthcare providers and other intended users including, but not limited to, RN's, LPN's, and MA's matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks. This study collected performance data on one or more of the following task categories typically conducted in conjunction with the requirements set forth in ONC's 2015 Final Rule Standard 170.315.g.3 – Safety Enhanced Design:

- 170.315(a)(1) CPOE – Medications
- 170.315(a)(2) CPOE – Laboratory
- 170.315(a)(3) CPOE – Diagnostic Imaging
- 170.315(a)(4) Drug-drug, Drug-allergy Interaction Checks for CPOE
- 170.315(a)(5) Demographics
- 170.315(a)(6) Problem List
- 170.315(a)(7) Medication List
- 170.315(a)(8) Medication Allergy List
- 170.315(a)(9) Clinical Decision Support
- 170.315(a)(14) Implantable Device List
- 170.315(b)(2) Clinical Information Reconciliation and Incorporation
- 170.315(b)(3) Electronic Prescribing

During the 60 minute in-person one-on-one usability test, each participant was greeted by the administrator and given a brief overview of what to

expect. They were asked to review and sign an informed consent/release form, a non-disclosure agreement, and an incentive receipt & acknowledgement form (included in Appendices 5.2), and they were instructed that they could withdraw at any time. Some participants did not have prior experience with the EHRUT so they were also given a brief orientation about screen layouts and functional locations. A component of the test was to examine the intuitiveness of the software along with the associated thought processes of persons who had no previous experience with it. We felt that this would produce a better indication of efficiency and effectiveness rather than having people who were already very familiar with the software do testing. That said we did use experienced users of the EHRUT to help establish timing bench marks as well as optimal paths.

The administrator introduced the test and instructed participants to complete a series of tasks using the EHRUT. During the testing, the administrator timed the test and, along with the data logger, recorded user performance data on paper and electronically. Assistance was generally not allowed; however, if the administrator gave assistance to the user, this was noted under the Efficiency section of the data sheet.

Additionally, mouse movements and clicks on the various screens and audio conversations/instructions were recorded and reviewed to ensure accuracy and compliance and for subsequent analysis.

The following types of data were collected for each participant:

- Task effectiveness – successful completion
- Task efficiency – time to complete the tasks
- Task efficiency – errors/deviation from optimal path
- Task satisfaction – ease-of-use ratings
- Participant’s verbalizations (if any)
- Participant’s overall satisfaction ratings of the system

All participant data was de-identified, meaning 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 and a System Usability Questionnaire and were compensated with \$100 for their time as witnessed in the Informed Consent and Acknowledgement Form as shown in Appendix 5.2. 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. A general summary of the results is shown in the following table:

Table 1 – Summary of Results

Scenario	Effectiveness		Efficiency		Satisfaction
	Success	Failures	Path Deviation	Task Time	Task Ratings
	Mean %	Mean %	Mean x.x	Mean :xx	Mean x.x
1 Computerized provider order entry	100	0	4.5	25	4.4
2 Drug-drug, drug-allergy interaction checks	93.7	6.3	4.4	34	4.5
3 Medication list	96.9	3.1	4.8	15	4.8
4 Medication allergy list	96.9	3.1	4.8	17	4.6
5 Clinical decision support	82.8	17.2	3.7	57.5	3.6
6 Electronic prescribing	100	0	4.6	37	4.0
7 Clinical information reconciliation	95.8	4.2	4.3	26	4.3
<b>KEY:</b>	Successes divided by Attempts of all tasks w/in each scenario	Failures divided by Attempts of all tasks w/in each scenario	1 to 5 scale: 1 = could not complete; 5 = completed without deviation	Average time to complete all tasks w/in each scenario	1 to 5 scale: 1 = very difficult; 5 = very easy

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be **83.5**. (See details of the SUS Questionnaire participant responses and score calculation in Appendix 5.4).

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

## Findings

The final System Usability Scale (SUS) results of this study were better than anticipated, but not necessarily unexpected. Because PCIS GOLD strongly believes in including end-user involvement in the early design and development stages as well as later beta testing, we felt that the software would perform well. While providing some satisfaction in the effectiveness of our UCD process on the end-user experience, we are not content as there is still room for improvement. Please refer to Section 4.3 Discussion of the Findings for more specific details in each of the areas tested.

## Areas for improvement

Generally, we were very pleased with the results, although we did find some areas (both from our own observations and from the feedback from the participants) that can be improved to make it even better. Here is a high-level list of improvements:

### PCIS GOLD observations

- There are several screens in the system that have buttons of different sizes, labels, and screen position that are basically used to perform the same function. We should develop one standardized button to be used on all of the screens to make it more consistent and increase user familiarity.
- We should separate the check boxes for inclusion on user



favorites list versus adding to the patient list.

- We should make tabs and links more obvious and easy to identify.
- We should make popup alerts more obvious that they are alerts. Some users thought the alert was the window they were expecting, and they lost time trying to figure out how to use it to perform the next step of the task.
- We should find a way to more fully differentiate the current med list versus adding a new Rx on the combo screen that shows both lists.
- We need to eliminate the <OK> and <Import> buttons on the screen because they are redundant. The functionality is included in the other <OK> button to close the screen.
- We need to enhance the HELP file to include instructions on all of the updates made during the 2015 Meaningful Use certification process.

#### Participant Suggestions

- Add an IntelliSense feature when typing any text, especially search screens.
- Add double-click functionality on the selection screens rather than having to click directly on an icon.
- Set the search default to Full Text rather than having to check the box to select it.
- Make the dropdowns more compatible with keyboard entry using <Tab> and <Enter> keys.
- Shade every other item on the Clinical Decision Support Intervention list to make it easier to distinguish items in the list.
- Don't save the search criteria from a previous search when opening the pharmacy search screen as it requires an extra click to clear it out.
- Enable keyboard entry of text into State field rather than requiring selection from the dropdown list.
- Add a print button to the CCDA screen and have the system give an "are you sure" save prompt when clicking <OK> to exit.

More details about individual comments to specific sections can be found in Section 4.3 Discussion of the Findings.

## 2. INTRODUCTION

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The EHRUT tested for this study PCIS GOLD® EHR, Version 2.4 for use in Ancillary/Multi-Specialty Clinics. The EHRUT was designed to present medical information to healthcare providers in an ambulatory setting. The usability testing attempted to represent realistic exercises and conditions geared specifically to the required test scenarios for each of the EHR technology capabilities submitted for testing and specified in the following criteria:

- 170.315(a)(1) – CPOE Medications
- 170.315(a)(2) – CPOE Laboratory
- 170.315(a)(3) – CPOE Diagnostic Imaging
- 170.315(a)(4) – Drug-drug, Drug-Allergy Interaction Checks for CPOE
- 170.315(a)(5) – Demographics
- 170.315(a)(6) – Problem List
- 170.315(a)(7) – Medication List
- 170.315(a)(8) – Medication Allergy List
- 170.315(a)(9) – Clinical Decision Support
- 170.315(a)(14) – Implantable Device List
- 170.315(b)(2) – Clinical Information Reconciliation and Incorporation
- 170.315(b)(3) – Electronic Prescribing

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 were captured during testing, including participant success rates and errors, the average task time and path deviations, and ease-of-use ratings.

## 3. METHOD

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### 3.1 PARTICIPANTS

A total of eleven participants were used in the sample set and were tested on the EHRUT. Healthcare providers and other intended users including, but not limited to, RNs, LPNs, and MAs, matching the target demographic criteria served as participants and used the EHRUT in simulated but representative tasks. Participants had no direct connection to the development of or organization producing the EHRUT and were not from the testing or supplier organization. Recruited participants were compensated \$100 for their time. Participants were given a brief orientation about the screen layouts and icon definitions but were not given anything close to the level of training as the actual end users would have received.

Recruited participants had a mix of backgrounds and demographic characteristics conforming to the recruiting guidelines. The following is a table of participants by characteristics, including demographics, professional experience, computer experience, and product experience. Per instructions, all participant names were replaced with Participant IDs allowing an individual's data to remain private.

**Table 2 – Participants Demographics Summary:**

	Part ID	Gen	Age Group	Edu- cation	Occupation / Role	Professional Experience	Computer Experience (Months)	EHR Experience
1	P-001	M	20-29	Some College	Emergency Medical Technician	2 Years	120	No previous exposure
2	P-002	M	40-49	Tech trade	Critical care tech	5 Years	240	Minimum
3	P-003	F	30-39	Some College	Licensed Practical Nurse	15 Years	240	Yes
4	P-004	F	20-29	Some college	Registered Nurse	8 Years	180	Yes
5	P-005	F	20-29	High School	A/R Team lead	4 Years	180	No
6	P-006	M	30-39	Masters degree	Operations Manager	9 Years	120	Yes
7	P-007	F	30-39	College/ BSN	Medical Assistant	9 Years	240	Yes
8	P-008	F	20-29	College/ BSN	Registered Nurse	5 Years	240	Yes
9	P-009	F	50-59	Some College	Registered Nurse	19 Years	300	Yes
10	P-010	F	20-29	College/ BSN	Registered Nurse	7 Years	240	Yes
11	P-011	F	20-29	College/ BSN	Registered Nurse	3 Years	180	Yes

A total of eleven participants matching the demographics in the section on Participants were recruited, and all eleven participated in the usability test. No participants failed to show up for the study.

Participants were scheduled for one-hour sessions with short intervals in between each task segment for debriefing by the administrator and data logger and to reset systems to proper test conditions. All tests were kept within the overall time allowed. An online document accessible by all test administrators via the corporate network was used to keep track of the participant schedule.

## 3.2 STUDY DESIGN

Overall, the objective of this test was to uncover areas where the application performed well (i.e., 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 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. A component of the test was to examine the intuitiveness of the software along with the associated thought processes (as determined by observation of mouse movements while completing tasks) of persons who had no previous experience with it. We felt that this would produce a better indication of efficiency and effectiveness rather than having people who were already familiar with the software do testing. That said, we did use experienced users of the EHRUT to help establish timing bench-marks as well as optimal paths.

During the usability test, participants interacted only with the PCIS GOLD® EHR. Each participant used the system in the same on-site location and was provided with the same instructions. The system was evaluated for effectiveness, efficiency, and satisfaction as defined by measures collected and analyzed for each participant:

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

Additional information about the various measures can be found in Section 3.9 Usability Metrics of this report.

### 3.3 TASKS

A number of tasks (27 total) were constructed that would be realistic and representative of the kinds of activities a user might do with this EHR, and to meet the requirements as stated in the ONC 2015 edition certification test, including:

#### 1 CPOE Medications

- Find and update/add/change a medication order

#### 2 CPOE Laboratory

- Find and update/add/change a lab order

#### 3 CPOE Diagnostic Imaging

- Find and update/add/change a radiology order

#### 4 Drug-Drug/Drug-Allergy Interaction Checks

- Prescribe new meds to trigger drug-drug/drug allergy interactions
- Access and display the details for any drug/drug allergy interactions
- Adjust the severity levels for drug/drug allergy interaction

#### 5 Demographics

- Find and update patient sexual orientation
- Find and update patient sexual identification

#### 6 Problem List

- Find and update/add/change a problem list

#### 7 Medication List

- Find and update/add/change a medication in a medication list

#### 8 Medication Allergy List

- Find and update/add/change a medication in a med allergy list

## 9 Clinical Decision Support

- Demographics CDS/HMG Intervention
- Med List CDS/HMG Intervention
- Med Allergy List CDS/HMG Intervention
- Problem List CDS/HMG Intervention
- Lab Test Results CDS/HMG Intervention
- Vitals CDS/HMG Intervention
- Combo CDS/HMG Intervention
- Access and review the Diagnostic and Therapeutic Reference Information associated with CDS/HMG Interventions
- Configuration of CDS interventions by user (may be an admin type function)

## 10 Implantable Devices

- Find and update/add/change implantable device information

## 11 Clinical information Reconciliation

- Reconcile patient's active medications list with medications provided on a CCDA
  - Reconcile patient's active problem list with those provided on a CCDA
- Reconcile patient's active medication allergy list with the med

## 12 Electronic Prescribing

- Create and update/add/change new medication prescriptions
- allergies provided on a CCDA

The specific tasks for each scenario performed by the participants are detailed in the Moderator's Guide in Appendix 5.3.

Tasks were created based on the required test scenarios for each of the EHR technologies capabilities for testing and specified in the following

criteria: 315.a.1-9, 14, 315.b.2-3, and their frequency of use, criticality of function, and those that may be most troublesome for users and were constructed in light of the study objectives. The tasks were prioritized in accordance with the risk associated with user errors. These were ranked and vetted as determined by twelve current users of the PCIS GOLD<sup>®</sup> EHR and are summarized below. (See Appendix 5.5 – Criticalness Survey for more specific details on the survey results.)

### 3.4 PROCEDURE

Upon arrival, participants were greeted and their identity was verified and matched with a name on the participant schedule. Participants were then assigned a participant ID.

Each participant reviewed and signed an informed consent and release form (See sample in Appendix 5.2). A representative from the test team witnessed the participant's signature. An authorized person representing the test team was designated as witness for tests conducted remotely.

To ensure that the test ran smoothly, two staff members participated in this test, the usability administrator and the data logger. The usability testing staff conducting the test has reviewed the requirements and the documentation standards required for this usability test including NISTIR 7742 and ONC 2015 edition certification test methods.

The administrator moderated the session by 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 provided with very basic tutorial instructions needed to familiarize them with screen layout and functionality. However, the training was not to the detailed extent that new a user of the PCIS GOLD® EHR receives nor did it show them how to carry out the task. We wanted to evaluate how intuitive the EHRUT is to someone who has not had previous experience with it. Participants were instructed to perform the tasks in the following manner:

- 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 participants indicated they had successfully completed the task. At no time during the test did the administrator or the data logger provide assistance or instructions on use of PCIS GOLD® EHR specified tasks. Scoring is discussed in detail later in the report.

Following the session, the administrator gave the participant the post-test final questionnaire, the System Usability Scale Questionnaire, compensated them for their time, and thanked each individual for their participation. Participants signed a receipt and acknowledgement form indicating that they had received the compensation. (Samples and additional details can be found in the Appendices 5.2.)

Participants' demographic information, task success rate, time on task,

errors, deviations, verbal responses, and post-test questionnaire were recorded into a spreadsheet for automated calculation purposes and are also included in various tables and appendices 5.1-5.4 of the reports.

### 3.5 TEST LOCATION

ONSITE. The test facility at DHI's corporate headquarters included a quiet testing room with a table, computer for the participant, a speakerphone for recording audio instructions, questions, and comments, and a projector to allow the administrator and data logger to easily see and follow each task. The participant, administrator, and data logger were in the test room. The administrator and the data logger were positioned off to the side of each participant where facial expressions could be monitored as well as the performance steps in completing the task. To ensure that the environment was comfortable for users, noise levels were kept to a minimum with the ambient temperature within a normal range. The room used had no windows, but was very well lit for ease of viewing reference copy of the tasks and satisfaction rating scale. All of the safety instruction and evacuation procedures were in place and visible to the participants.

### 3.6 TEST ENVIRONMENT

The EHRUT would typically be used in a healthcare office or facility. In this instance, the testing sessions were conducted in the facilities described in the previous section.

For testing, the computer used was a Dell Inspiron 7459 PC running the Windows 10 Enterprise operating system. The monitor is 23" and the resolution used was 1920 x 1080 to maximize viewable area of screen and minimize scrolling. The EHRUT application itself was run locally on

the machine but was connected to the test database via a LAN connection. Participants were instructed not to change any of the default system settings (such as control of font size).

Onsite, the participants used the tablet keyboard and a wireless mouse when interacting with the EHRUT. For tests administered in offsite locations, participants used a laptop computer running Windows 8.1 Enterprise.

The application was set up by the vendor according to PCIS documentation describing the system set-up and preparation. Technically, the system performance (i.e., response time) was representative of what actual users would experience in a field implementation. However, it should be noted that timings for task completion were slightly longer because of the delay inherent with a remote connection, but not enough to require adjustment for access method used when compared to those given locally.

### **3.7 TEST FORMS AND TOOLS**

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

1. Participant Demographics Survey
2. Non-disclosure Agreement & Informed Consent Form
3. Moderator's Guide
4. Post-test Final Questionnaire
5. System Usability Scale Questionnaire
6. Incentive Receipt and Acknowledgment Form

Examples of these documents can be found in Appendices 1-7 respectively.

The Moderator's Guide was designed 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. Audio files containing verbal instructions and participant comments were recorded along with the mouse clicks and screen captures.

The test session recordings were saved electronically and analyzed for additional observations and product improvement opportunities.

### 3.8 PARTICIPANT INSTRUCTIONS

The administrator read the following instructions aloud to the each participant (also see the full moderator's guide in Appendix 5.3.)

*Thank you for participating in this study. Your input is very important. Our session today will last about one hour. 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. I did not have any involvement in its creation, so 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 EHR and were provided with very basic tutorial instructions needed to familiarize them with screen layout and functionality. However, the training was not to the detailed extent that new a user of the PCIS GOLD® EHR receives, nor did it demonstrate how to carry out the task. We wanted to evaluate how intuitive the EHRUT is to someone who has not had previous experience with it. 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 27 tasks to complete. Tasks are detailed in the moderator’s guide in Appendix 5.3.

### 3.9 USABILITY METRICS

According to the *NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records*, PCIS GOLD supports a process that provides a high level of usability for all users. The goal is for users to interact with the system effectively, efficiently, and with an acceptable

level of satisfaction. To this end, metrics for effectiveness, efficiency and user satisfaction were captured during the usability testing.

The goals of the test were to assess the following:

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

### 3.10 DATA SCORING

The following Table 5 details how tasks were scored, errors evaluated, and the time-data analyzed.

Table 5 – Data Rationale and Scoring

Measures	Rationale and Scoring
<p><b>Effectiveness:</b> 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><b>Effectiveness:</b> 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 a “Failure.”</p> <p>The total number of errors was calculated for each task and then divided by the total number of times that task was attempted. Not all deviations would be counted as errors. This should also be expressed as the mean number of failed tasks per participant.</p> <p>On a qualitative level, an enumeration of errors and error types were collected.</p>

<p><b>Efficiency:</b> Task Deviations</p>	<p>The participant's steps through the application were 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><b>Efficiency:</b> 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.</p>
<p><b>Satisfaction:</b> 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.</p> <p>To measure participants' confidence in and likeability of the PCIS GOLD EHR 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 5.4.</p>

## 4. RESULTS

### 4.1 DATA ANALYSIS AND REPORTING

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. The usability testing results for the EHRUT are summarized in Table 6 below and detailed in the subsequent tables. (Tables 7-10)

Table 6 – Summarized testing results

Task / Scenario	Effectiveness		Efficiency		Satisfaction
	Success	Failure	Path Deviation	Task Time (sec)	Task Ratings
	%	%	Mean /Optimal	Mean /Optimal	Mean
1	100	0	5.36/4	87/33	4.45
2	100	0	4.18/4	34/28	4.91
3	91	9	4.55/4	59/24	4.73
4	100	0	2.09/2	28/12	4.91
5	100	0	3.45/3	36/23	4.82
6	100	0	6.45/6	36/29	4.82
7	82	18	8.27/7	170/50	3.73
8	91	9	6.45/9	103/65	3.82
9	100	0	4.18/4	34/19	4.91
10	82	18	6.45/6	93/55	4.36
11	100	0	6.45/6	72/32	4.55
12	100	0	5.36/5	34/17	4.64
13	100	0	10.20/10	71/62	5.00
14	91	9	6.45/6	99/40	4.55
15	100	0	4.27/4	42/20	4.82
16	80	20	12.40/12	77/55	4.30
17	100	0	4.45/4	19/17	4.73
18	100	0	6.64/6	64/22	3.91
19	100	0	4.36/4	53/20	4.82
20	100	0	2.27/2	18/10	4.91
21	100	0	8.27/8	53/26	4.91
22	91	9	6.36/6	55/23	4.64
23	100	0	4.55/4	46/14	4.27
24	100	0	6.55/6	47/15	4.36
25	87.5	12.5	9.2/9	61/24	3.5
26	100	0	5.27/5	49/13	5
27	100	0	8.18/8	73/37	4.45



Table 7 – Task Calculations

Data	Format	Parameters	Notes	Calculation Type	Equation Notes
<b>Effectiveness:</b> Task Success	text	S	S = Success – task completed	percentage	Total # successes/ total # tasks attempted
<b>Effectiveness:</b> Task Failure	text	F	F = Failure – task was not completed as directed	percentage	Total # failures/ total # tasks attempted
<b>Efficiency:</b> Path Deviations	number	1 to 5	Measured on a five point scale where 1 = could not complete; 2 = timed out, but would have got there eventually with more time or guidance; 3 = completed eventually within the time, but with many wrong paths or corrections; 4 = completed within the time, but with different path; 5 = completed without major deviations	mean number	
<b>Efficiency:</b> Time	number	seconds		mean number	Observed module task time
<b>Satisfaction:</b> Task Difficulty	number	1 to 5	Measured on a five point scale where 1 = very difficult; 3 = average; and 5 = very easy	mean number	

Table 8 – Task Effectiveness - Success/Failure Detail

TASK	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11
1	S	S	S	S	S	S	S	S	S	S	S
2	S	S	S	S	S	S	S	S	S	S	S
3	S	S	S	S	S	S	S	S	S	F	S
4	S	S	S	S	S	S	S	S	S	S	S
5	S	S	S	S	S	S	S	S	S	S	S
6	S	S	S	S	S	S	S	S	S	S	S
7	S	S	S	S	F	S	S	S	S	S	F
8	S	S	S	S	F	S	S	S	S	S	S
9	S	S	S	S	S	S	S	S	S	S	S
10	S	S	S	S	F	S	S	S	S	S	S
11	S	S	S	S	S	S	S	S	S	S	S
12	S	S	S	S	S	S	S	S	S	S	S
13	F	S	S	S	N/A	F	S	S	S	F	S
14	S	S	S	S	F	S	S	S	S	S	S
15	S	S	S	S	S	S	S	S	S	S	S
16	F	S	S	S	N/A	F	S	S	S	S	S
17	S	S	S	S	S	S	S	S	S	S	S
18	S	S	S	S	S	S	S	S	S	S	S
19	S	S	S	S	S	S	S	S	S	S	S
20	S	S	S	S	S	S	S	S	S	S	S
21	S	S	S	S	S	S	S	S	S	S	S
22	S	S	S	S	S	F	S	S	S	S	S
23	S	S	S	S	S	S	S	S	S	S	S
24	S	S	S	S	S	S	S	S	S	S	S
25	S	F	S	S	N/A	S	S	S	S	S	S
26	S	S	S	S	S	S	S	S	S	S	S
27	S	S	S	S	S	S	S	S	S	S	S

Table 9 – Task Efficiency Rating Detail

TASK	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	Avg.
1	4	4	5	5	3	4	5	4	5	5	5	4.45
2	5	5	5	5	5	5	5	5	5	5	5	4.91
3	4	4	4	5	5	5	5	5	5	5	5	4.73
4	5	4	5	5	5	5	5	5	5	5	5	4.91
5	4	5	4	5	5	5	5	5	5	5	5	4.82
6	5	5	4	5	5	5	4	5	5	5	5	4.82
7	3	3	4	3	4	5	3	4	4	4	4	3.73
8	4	5	5	5	1	5	3	4	3	4	3	3.82
9	5	5	5	5	5	5	4	5	5	5	5	4.91
10	4	4	4	5	4	5	5	4	4	4	5	4.36
11	5	3	4	5	4	5	5	4	5	5	5	4.55
12	5	4	5	5	4	4	5	5	5	4	5	4.64
13	5	1	3	4	N/A	5	5	4	5	2	3	3.70
14	3	4	4	5	5	5	5	4	5	5	5	4.55
15	4	5	5	5	5	5	5	4	5	5	5	4.82
16	5	2	3	5	N/A	5	5	4	4	5	5	4.30
17	5	5	3	4	5	5	5	5	5	5	5	4.73
18	3	2	4	4	5	4	4	3	4	5	5	3.91
19	5	5	4	5	4	5	5	5	5	5	5	4.82
20	5	5	5	5	4	5	5	5	5	5	5	4.91
21	4	5	5	5	5	5	5	5	5	5	5	4.91
22	4	4	4	5	4	5	5	5	5	5	5	4.64
23	5	2	3	5	5	4	3	5	5	5	5	4.27
24	4	3	3	5	5	5	4	5	5	4	5	4.36
25	5	1	3	5	N/A	5	5	4	5	2	5	4.00
26	5	5	5	5	5	5	5	5	5	5	5	5.00
27	4	4	3	5	4	5	5	4	5	5	5	4.45

Table 10 – Task Efficiency Time Detail (in seconds–rounded to the nearest whole second)

TASK	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	Avg
1	32	59	88	111	113	81	128	93	110	76	67	<b>87</b>
2	41	48	63	41	32	58	35	28	79	66	46	<b>49</b>
3	90	70	71	85	42	44	49	32	50	62	54	<b>59</b>
4	32	28	25	58	15	51	20	10	21	32	12	<b>28</b>
5	24	50	64	44	11	40	38	25	47	18	31	<b>36</b>
6	15	42	51	42	37	29	34	23	51	24	44	<b>36</b>
7	96	247	164	524	144	64	142	163	194	93	45	<b>170</b>
8	49	106	59	80	146	111	72	92	229	60	128	<b>103</b>
9	26	40	53	11	20	22	80	18	59	24	20	<b>34</b>
10	78	114	170	110	131	81	41	95	118	53	30	<b>93</b>
11	26	94	72	51	112	74	38	120	96	54	54	<b>72</b>
12	22	51	34	33	33	58	25	26	46	14	19	<b>33</b>
13	43	143	74	67	N/A	69	36	76	120	25	55	<b>71</b>
14	98	104	136	97	112	33	84	56	138	55	147	<b>99</b>
15	31	43	19	72	34	50	28	43	66	44	35	<b>42</b>
16	65	163	63	66	N/A	41	62	49	110	99	48	<b>77</b>
17	45	57	79	90	32	50	44	44	83	61	74	<b>60</b>
18	17	60	60	68	65	104	48	66	82	57	80	<b>64</b>
19	23	100	108	25	67	40	21	53	53	54	36	<b>53</b>
20	10	12	16	11	41	28	15	11	12	36	9	<b>18</b>
21	57	110	37	36	73	36	24	39	74	42	55	<b>53</b>
22	16	79	27	46	99	23	80	45	93	53	39	<b>55</b>
23	79	32	25	77	16	31	107	30	35	20	57	<b>46</b>
24	27	76	50	33	39	72	48	49	65	28	30	<b>47</b>
25	37	179	34	38	N/A	43	37	24	102	87	28	<b>61</b>
26	22	28	45	87	79	47	60	57	59	21	28	<b>49</b>
27	69	83	77	162	88	44	38	88	69	37	53	<b>73</b>

## 4.2 GENERAL COMMENTS FROM PARTICIPANTS

These comments were taken from comments made by participants during testing:

- It is very convenient to have multiple ways to input allergy severity and reactions
- Adding items to problem list and allergy list is a lot easier than other systems I have used
- Prescription writing was a little confusing, but I think if I were a doctor it would be a lot easier
- I wish my doctors would switch to this software, there are by far less clicks involved
- I like that is just a few clicks I can easily see a patient's medication list
- Creating orders was a little more complicated than I thought it should be with having to select procedure, lab, or radiology
- I got a little hung up on changing a patient's demographics since the screens looked so different, probably wouldn't be a problem if I was in the system everyday
- I like the tabs on the side of the chart, makes it very easy to navigate

## 4.3 DISCUSSION OF THE FINDINGS

The final results of this study were better than anticipated, but not necessarily unexpected. Because PCIS GOLD strongly believes in including end-user involvement in the early design and development stages as well as later beta testing, we felt that the software would perform well. We just didn't know upfront how well. Generally, we were very pleased with the results although we did find some areas (both from our own observations and from the feedback from the participants) that can be improved to make it even better. These findings are discussed in the Findings section.

### 4.3.1 EFFECTIVENESS

Based on the success, failure and path deviation data, this area was one in which the software seemed to excel. Each of the eleven participants

attempted to complete 27 tasks. Of the 297 total tasks, only 9 tasks were not completed correctly. Some of those that “failed” were not because participants couldn’t figure out how to complete the task, but because they entered an incorrect description or indicated that they were done with the task when they had one more button to click to officially complete the task, or time expired before task completion. Here is the breakdown of 35 errors as compared to the vetted list prioritized by error risk from the Criticalness Survey:

Function	# of Errors
Drug-Drug & Drug-Allergy Interactions	3
Electronic Prescribing	3
Medication Allergy List	3
Computerized Provider Order Entry	16
Medication List	3
Clinical Decision Support	6
Clinical Information Reconciliation	1

Eighteen of the 27 tasks were successfully completed by all eleven of the participants. There were three tasks that had more than one “failure” which reinforces the conclusion that the system is intuitive and easy to navigate even with limited exposure and instruction. Six participants successfully completed all 27 tasks. One participants completed 26 of 27, three completed 25 of 27, and one completed 23 of 27. Ten of the eleven participants had two or fewer failed tasks. Recognizing that some credit must be given to the skills and intellect of the participants, the high success score helps instill a level of confidence in the design and functionality of the software, especially when dealing with the unfamiliar.

In addition, general comments from the participants on ease of use along with the high success rate seem to substantiate the effectiveness of the PCIS GOLD® EHR.

#### 4.3.2 EFFICIENCY

Times were tracked manually on a smartphone stop watch app. The timer was started when the administrator said “begin” and stopped when the participant said “done.” Given the manual nature, timings are considered to be accurate, but not exact. Here is a breakdown of the number of tasks that fell into the noted average task times:

<15 seconds:	1
16 – 25 seconds	0
26 – 35 seconds	4
36 – 45 seconds	5
46 – 55 seconds	10
>60 seconds	7

Majority of the tasks were finished in less than 60 seconds. It was also noted that even though the mean times of the participants were slightly higher than those recorded earlier by experienced users to help establish benchmarks, there was not a significant difference when using the subjective “optimal” path. The short amount of time needed to complete the tasks had an impact of the perceived ease-of-use and gives a good indication of the efficiency of the PCIS GOLD® EHR.

Regarding path deviation, the software provides several different ways to accomplish each task that are usually selected and used according to user preference. Since it is somewhat subjective, we conducted some preliminary testing with several in-house personnel and other experienced users of the EHR to determine a most commonly used path to use as a basis for the optimal path. Not all participants accomplished

the tasks with the optimal path, but they didn't stray far when they got off path as is indicated by the mean path deviation scores. This seems to reinforce the fact that the screens have been well designed to make it easy to navigate through the assigned tasks.

**SATISFACTION**

The mean satisfaction scores for the individual tasks were categorized by the mean range in the following chart:

Mean Range	# tasks in range
4.67 – 5.0	12
4.34 – 4.66	8
4.1 – 4.33	2
3.7 – 4.0	5
3.0 – 3.6	0
<3	0

As shown, 81% of the tasks (22 of 27) were given a satisfaction rating greater than 4.0, which is considered easy to very easy. 19% (5 of 27) were considered average while only 0% was considered difficult.

Interpretation of these numbers substantiates the intuitiveness of the PCIS GOLD® EHR.

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be



**83.5.** (See Appendix 5.4 for details on how this score was calculated.) Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average. While providing some satisfaction in the effectiveness of our UCD process on the end-user experience, we are not content as there is still room for improvement, specifically in the Clinical Decision Support area. However, these changes would not be considered urgent because the scores for this section for frequency of use and risk for error ratings were 6.0 in both categories on the Criticalness Survey.

#### **4.3.4 FINDINGS**

The narrative interpretation of the quantitative findings for each of the sections are as follows:

##### **CPOE Medications**

All participants were able to successfully complete all tasks in this section with minimal path deviation and minimal errors that did not affect the success of the task. There was an overall very high satisfaction rating.

##### **CPOE Laboratory**

All participants were able to successfully complete all tasks in this section with minimal path deviation and minimal errors that did not affect the success of the task. There was an overall very high satisfaction rating.

##### **CPOE Diagnostic Imaging**

All participants were able to successfully complete all tasks in this section with minimal path deviation and minimal errors that did not affect the success of the task. There was an overall very high satisfaction rating.

##### **Drug-Drug/Drug-Allergy Interaction**

There were three errors committed in this section between the 11 participants. The first was a differentiation of the frequency that was entered even though all of the other components of the task were completed correctly. This did not affect the outcome of the result, but the participant was given a failed mark because it was not done exactly as

requested. The other two errors occurred because the requested task was not completed. Even with the errors that occurred, the tasks in this section were given a mean satisfaction rating of 4.5 which is between easy and very easy.

#### **Medication List**

There were only three errors made in this section resulting in the high success rate. The “failures” were because the participant entered the medication as a new prescription rather than adding it to the current medications list. That said, the tasks in this section received a high mean satisfaction score.

#### **Medication Allergies**

All participants really liked the concept of having a favorites list by user for the most commonly used allergies, codes, phrases, etc. This section had three failures because the participants didn’t click the final <SAVE> button to fully complete the task. The tasks in this section received a high mean satisfaction score.

#### **Clinical Decision Support**

This section of the test failed more than the average of the other tests. Multiple participants who attempted the administrative task in this section did not complete it in the allotted time, but most likely would have if had been given more time or training.

#### **Clinical Reconciliation Findings**

During these tasks there was only one error that occurred between the 11 participants resulting in a high success rate.

#### **e-Prescription**

All participants were able to successfully complete all tasks in this section with minimal path deviation and a high satisfaction rating with only three minor errors.

### **4.3.5 AREAS FOR IMPROVEMENT**

#### **CPOE – Medications**

#### **CPOE – Laboratory**

**CPOE – Diagnostic Imaging**

**Drug-Drug/Drug-Allergy Interaction Checks**

**Demographics**

**Problem List**

**Medication List**

**Medication Allergies List**

**Clinical Decision Support**

**Implantable Device List**

**Clinical Information Reconciliation and Incorporation**

**Electronic Prescribing**

## 5. APPENDICES

The following appendices include supplemental data for this usability test report.

5.1: Participant Demographics Form

5.2: Non-Disclosure Agreement (NDA) & Informed Consent Form

5.3: Moderator's Guide with Detailed Tasks

5.4: System Usability Scale Questionnaire and Results

5.5: Criticalness Survey and Results

5.6: Usability Test Letter of Attestation

5.7: User-centered Design Process Review

## Appendix 5.1 PARTICIPANT DEMOGRAPHICS FORM

This is the form that the participants were asked to fill out and submit.

### General Questions

1). Are you male or female?  Male  Female

2). Have you ever participated in a usability test in the past six months?  Yes  No

3). Which of the following best describes your age?

- |   |  |
|---|--|
| <input type="checkbox"/> <20 Years of Age | <input type="checkbox"/> 50-59             |
| <input type="checkbox"/> 20-29            | <input type="checkbox"/> 60-69             |
| <input type="checkbox"/> 30-39            | <input type="checkbox"/> 70-79             |
| <input type="checkbox"/> 40-49            | <input type="checkbox"/> ≥ 80 Years of Age |

### Professional Demographics

4). What is the highest educational level degree earned?

---

5). What is your current occupation or role title?

---

6). How many years of professional experience do you have in this role?

---

7). How many years of computer experience do you have?

---

8). Have you ever worked with PCIS GOLD EHR?  Yes  No

If yes, how many years have you worked with PCIS GOLD EHR?

---

9). Do you have any assistive technology needs?  Yes  No



### Non-Disclosure Agreement

THIS AGREEMENT is entered into as of \_\_\_\_\_, 2017, between \_\_\_\_\_ ("the Participant") and PCIS GOLD located at 1525 W 820 N, Provo, UT.

The Participant acknowledges his or her voluntary participation in today's usability study may bring the Participant into possession of Confidential Information. The term "Confidential Information" means all technical and commercial information of a proprietary or confidential nature which is disclosed by *PCIS GOLD*, or otherwise acquired by the Participant, in the course of today's study.

By way of illustration, but not limitation, Confidential Information includes trade secrets, processes, formulae, data, know-how, products, designs, drawings, computer aided design files and other computer files, computer software, ideas, improvements, inventions, training methods and materials, marketing techniques, plans, strategies, budgets, financial information, or forecasts.

Any information the Participant acquires relating to this product during this study is confidential and proprietary to *PCIS GOLD* and is being disclosed solely for the purposes of the Participant's participation in today's usability study. By signing this form the Participant acknowledges that s/he will receive monetary compensation for feedback and will not disclose this confidential information obtained today to anyone else or any other organizations.

Participant's printed name: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_



## Informed Consent

*PCIS GOLD* would like to thank you for participating in this study. The purpose of this study is to evaluate our 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. 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 *PCIS GOLD* I am free to withdraw consent or discontinue participation at any time. I understand and agree to participate in the study.

I understand that the information is for research purposes only and that my name and image will not be used for any purpose other than research.

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

I understand and agree that the data collected from this study may be shared outside of *PCIS GOLD* for purposes of EHR certification. 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.

Participant's printed name: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_



## Appendix 5.3 MODERATOR'S GUIDE

Administrator \_\_\_\_\_

Data Logger \_\_\_\_\_

Date \_\_\_\_\_ Time \_\_\_\_\_

Participant # \_\_\_\_\_ Location \_\_\_\_\_

### Orientation

Hi, \_\_\_\_\_. Thank you for participating in this study. My name is \_\_\_\_\_ and I'm going to be walking you through this session today which will last approximately **60 minutes**. During that time you will take a look at an electronic health record system.

Before we begin, I have some information for you and I'm going to read it to make sure that I cover everything. You probably already have a good idea of why we asked you here, but let me go over it again briefly. We're asking people from our target market of medical clinics/group practices to try using an EHR that we have developed, and continue to enhance, so we can see whether it works as intended.

The first thing that I want to make clear right away is that even though we are conducting a usability test, we are testing the software, NOT you. You can't do anything wrong here.

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 since we are interested in how people do when they don't have someone sitting next to them for help. 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. If you need to take a break at any point, just let me know.

Please be honest with your opinions. Don't worry that you're going to hurt our feelings. We're doing this to improve the software program so we need to hear your honest reactions.

The product you will be using today is the **PCIS GOLD® EHR – Version 2.4**. The patient data has been scrambled to comply with HIPAA requirements and to protect divulging personal data.

With your permission, we are going to record our audio conversations and what happens on the screen. The recordings will only be used to help us figure out how to improve the software. And it helps me because I don't have to take as many notes. All of the information that you provide will be kept confidential and your name will not be associated with your comments at any time. If you would, I'm going to ask you to sign a simple permission form for us.

*(Give them the INFORMED CONSENT form and NON-DISCLOSURE Agreement)*

Do you have any questions or concerns?

*(Give brief overview of the basic functionality and layout of the software.)*

Now I'm going to ask you to try doing some specific tasks.

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.

**PHYSICIAN SCENARIO 1:**

Jonathan Jones is a 59-year-old Caucasian male who has hypertension and asthma. He is here today complaining of difficulty breathing. He was discharged from the hospital three days ago, and after being admitted to the emergency department on suspicion of possible heart attack.

**Task 1:**

You review the information from Jonathan’s admission and everything looks good, so you decide to move onto his hypertension management. Jonathan has not been to see you for nearly two years and may be behind on his routine care as recommended by your organization’s protocols. Review the advisory provided by the system, then place and sign all the suggested orders.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 2:**

During Jonathan’s visit your staff informs you of a call that just came in regarding another patient, Sally Harpman. Sally is at the hospital’s emergency department with a sever laceration and cannot remember her medications. The ED physician needs to know whether Sally is on a blood thinner. Open Sally’s chart and verbally state whether or not Sally is currently taking Coumadin.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 3:**

After confirming Sally’s medications, you return to Jonathan’s exam. Jonathan mentioned that he has increasing foot pain that he described as feeling like pins and needles. You performed and documented a foot exam, during which you observed signs of peripheral neuropathy, a new problem. Add peripheral neuropathy to his problem list.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**PHYSICIAN SCENARIO 2:**

Shirley Smith is a 68-year-old established patient or yours who is in today because she is worried about a “barking” cough that she recently developed.

**Task 4:**

Shirley has had an implantable cardioverter defibrillator (ICD) for a few years. She mentions that she lost her ICD ID and is concerned that the battery might run out soon. Check the details of Shirley’s ICD and verbally inform her of its expiration date.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 5:**

You suspect Shirley’s productive cough and fever may be symptoms of pneumonia, so you would like to order a chest X-ray to verify this. Place and send an order of a chest X-ray.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 6:**

The X-ray comes back for bronchitis. Add bronchitis to Shirley’s problem list and mark it as an active problem.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 7:**

You decide to prescribe Azithromycin (Z-Pack). Your system automatically sends prescriptions electronically to the patient’s preferred pharmacy, which has already been specified as SOS Drug. Place an order for 500 mg PO once, then 250 mg once daily for four days, no refills. Assess any possible interactions. Using your clinical judgment and the information provided by the system, either sign the original medication or find an appropriate substitute and sign that order instead.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**PHYSICIAN SCENARIO 3:**

Juan Rivera is an athletic 47-year-old male who has been by your office previously. He is here today concerned about a weeping rash that developed on his legs after a hiking trip in the nearby mountains a few days ago.

**Task 8:**

Juan’s social history shows that he has been an everyday smoker for the past 10 years. Your staff already noted that Juan is ready to stop smoking, and you confirm this with him. Use the information provided by the system to add tobacco dependence to Juan’s problem list and add a patient education document for smoking cessation to his visit today.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 9:**

Juan has a family history of cardiovascular disease but has never had a baseline lipid panel performed. As part of Juan’s general check-up, place an order for a lipid panel.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 10:**

Juan states that the rash is very itchy and keeps him awake at night. You determine that the rash is caused by poison ivy and is localized to his legs. You decide that a topical treatment will be sufficient. Your system automatically sends prescriptions electronically to the patient's preferred pharmacy, which has already been specified as SOS Drug in Springville. Send a prescription for betamethasone cream 0.05%, applied topically to the affected area twice daily for two weeks.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**PHYSICIAN SCENARIO 4:**

Karen Hansen is a 53-year-old female. She is a new patient who is here today because she has a red, swollen eye and was recently exposed to conjunctivitis (pinkeye).

**Task 11:**

In the past, Karen has experienced mild skin irritation around the eye when using Bleph (sulfacetamide sodium), which is documented in her chart. During the exam, she mentions that she recently went to the urgent care for an adverse reaction to an over-the-counter eye drop called naphazoline ophthalmic, and the skin around her eye became swollen with a light rash. Update the reaction and severity of the allergy in Karen's chart.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 12:**

Karen is due for a colonoscopy. Based on the advisory provided by the system, place and sign an order for the suggested procedure.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 13:**

Karen was diagnosed with a peptic ulcer by a specialist at an outside clinic, Sunny Hill Gastroenterology Specialists. Reconcile Karen's problem list by adding the information from Sunny Hills to her chart.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 14:**

Upon further examination of the patient's eye, you have determined that Karen has bacterial conjunctivitis (pinkeye). It is determined an antibiotic will be needed to clear up the bacterial infection. Using your clinical judgement, place and sign the appropriate order to treat Karen's conjunctivitis.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**NURSE SCENARIO 1:**

Your first patient of the day is Lavar Benson. Lavar is a 49-year-old African-American male with peripheral artery disease and struggles with obesity. He has not been very consistent with taking his medications and is behind on his weekly exercise regimen. He is here today complaining of numbness and tingling in his lower legs, feet, and toes.

**Task 1:**

As you review Lavar’s history, he mentions that he is hearing impaired and has difficulty communicating at times. He prefers things written down or to see them on the computer screen. Update his chart to reflect these preferences.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 2:**

While traveling out of the state a few months ago, Lavar experienced a dizzy spell while walking outside the get some exercise, which led to him fainting. He was seen by a physician at the local ER, Pacific Medical Center. This occurrence was added to Lavar’s chart during his ER visit. Reconcile Lavar’s health history by adding the information from Pacific Medical Center to his chart.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 3:**

Upon returning to the nurse’s station after rooming Lavar, you receive a phone call from Dr. Howser, a physician at the ER across town. Earvin Johnson, a regular patient of yours, presented to the emergency room after having a major seizure moments prior. The patient is conscious and with a family member but neither of them can remember which medications he is on. Dr. Howser, the ER physician needs to know which medications Earvin is taking to control his seizures.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**NURSE SCENARIO 2:**

Steven Brown is a 25-year-old male here today for a follow-up on his rheumatoid arthritis. You have previously loaded some of this documentation and history.

**Task 4:**

While charting Steven’s history, he mentions that he is currently in a relationship with a male partner. He states to you that he now identifies as bisexual. Document this in the health record.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 5:**

As you continue with documenting Steven’s health history, he mentions that he now has an allergy to ceftriaxone and that it causes hives and nausea. Update his allergy list with this new information.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 6:**

During Steven’s last visit the doctor wrote a prescription for Chantix (varenicline) for smoking cessation. He tells you that he stopped taking this because it made him nauseous. He is still taking the allopurinol prescribed for occasional gout.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**NURSE SCENARIO 3:**

Kate Smith is an 8 year old healthy girl and her younger brother Hank is 5 years old and also healthy. Their parents are bringing them in for a scheduled well-child visit.

**Task 7:**

As you review Kate’s chart, Dad tells you that the last time he gave children’s ibuprofen to Kate she broke out in hives. Mom says that Hank does not have any allergies that she knows of. Add children’s ibuprofen with a reaction of hives to Kate’s allergy list and mark her allergy list as reviewed. Mark Hank’s allergy list as reviewed.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 8:**

Mom mentions that because Kate developed hives the last time she gave her children’s ibuprofen, she stopped giving it to her right away. Hank hasn’t had any reactions, so Mom has continued to give children’s ibuprofen. Document that Hank is taking children’s ibuprofen as needed. Document that you have reviewed Kate and Hank’s medication list.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 9:**

Dad tells you that Kate is more active again after a wrist fracture. As you review the implant information about the screws, you notice that there is no laterality specified. You confirm with Mom that the screws were implanted in Kate’s left wrist. Add the device laterality to Kate’s chart.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**NURSE SCENARIO 4:**

Toby Owens is a 44-year-old here to establish care with a new Primary Care Physician. You have already begun some of your documentation for him.

**Task 10:**

As you go through Toby’s social history, he informs you that while his sex assigned at birth was female, he identifies as male. Document this information in his chart.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 11:**

Toby’s allergy list from his previous healthcare system is available for you to review. Change his allergy list by adding the information from the previous healthcare system to his chart.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 12:**

You review Toby’s medication list with him. He tells you that he takes one tablet of Advil 200 mg every six hours as needed for headaches. Add Advil to his medication list and indicate that he is currently taking medication.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	

**Task 13:**

You continue taking Toby’s history. He reports that he had a shoulder replaced two years ago and shows you his medical device ID card. Document his device in the chart.

*Overall, how difficult or easy did you find the task?*

Very Difficult					Very Easy
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	



## Appendix 5.4 SYSTEM USABILITY SCALE QUESTIONNAIRE

	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 would need to learn a lot of things before I could get going with this system						
	1	2	3	4	5	

## SUS RESULTS SCALE – Actual questionnaire responses from Participants

Question	P-01	P-02	P-03	P-04	P-05	P-06	P-07	P-08	P-09	P-10	P-11
1.	4	5	1	5	4	5	5	4	5	5	4
2.	2	2	1	1	2	5	3	1	1	1	2
3.	4	5	2	5	4	5	4	5	5	5	4
4.	2	2	1	2	1	3	1	4	1	1	3
5.	4	5	2	5	4	5	4	5	5	5	4
6.	2	1	1	2	1	1	2	1	1	1	2
7.	4	5	5	5	5	5	4	5	5	5	5
8.	2	2	2	1	1	1	3	1	1	1	2
9.	4	4	3	5	3	3	5	4	5	4	5
10.	3	2	2	1	1	3	4	1	1	2	1

Table 12 – SUS CALCULATION

Data	Format	Scale	Notes	Calculation Type	Equation Notes
1. I think that I would like to use this system frequently	number	1 to 5	Measured on a five point agreement scale where a 1 indicates strong disagreement with statement to 5 strong agreement with statement	custom	Scale minus 1
2. I found the system unnecessarily complex	number	1 to 5	Measured on a five point agreement scale where a 1 indicates strong disagreement with statement to 5 strong agreement with statement	custom	5 minus scale
3. I thought the system was easy to use	number	1 to 5	Measured on a five point agreement scale where a 1 indicates strong disagreement with statement to 5 strong agreement with statement	custom	Scale minus 1
4. I think that I would need the support of a technical person to be able to use this system	number	1 to 5	Measured on a five point agreement scale where a 1 indicates strong disagreement with statement to 5 strong agreement with statement	custom	5 minus scale
5. I found the various functions in this system were well integrated	number	1 to 5	Measured on a five point agreement scale where a 1 indicates strong disagreement with statement to 5 strong agreement with statement	custom	Scale minus 1
6. I thought that there was too much inconsistency in this system	number	1 to 5	Measured on a five point agreement scale where a 1 indicates strong disagreement with statement to 5 strong agreement with statement	custom	5 minus scale
7. I would imagine that most people would learn to use	number	1 to 5	Measured on a five point agreement scale where a 1 indicates strong	custom	Scale minus 1

disagreement with statement to 5					strong agreement with statement
8. I found the system very cumbersome to use	number	1 to 5	Measured on a five point agreement scale where a 1 indicates strong disagreement with statement to 5	custom	5 minus scale
9. I felt very confident using the system	number	1 to 5	Measured on a five point agreement scale where a 1 indicates strong disagreement with statement to 5	custom	Scale minus 1
10. I would need to learn a lot of things before I could get going with this system	number	1 to 5	Measured on a five point agreement scale where a 1 indicates strong disagreement with statement to 5	custom	5 minus scale

**Calculation notes:** SUS yields a single number representing a composite measure of the overall usability of the system being studied. Note that scores for individual items are not meaningful on their own. To calculate the SUS score, first sum the score contributions from each item. Each item's score contribution will range from 0 to 4. For items 1, 3, 5, 7, and 9 the score contribution is the scale position minus one. For items 2, 4, 6, 8, and 10, the score contribution is five minus the scale position. Multiply the sum of the scores by 2.5 to obtain the overall value of the SU. SUS scores have a range of 0 to 100.1

**SUS RESULTS SCORES** - Adjusted according to Equation Notes in Table 12

Question	P-01	P-02	P-03	P-04	P-05	P-06	P-07	P-08	P-09	P-10	P-11	Mean
1.	3	4	0	4	3	4	4	3	4	4	3	3.3
2.	3	3	4	4	3	0	2	4	4	4	3	3.1
3.	3	4	1	4	3	4	3	4	4	4	3	3.4
4.	3	3	4	3	4	2	4	1	4	4	2	3.1
5.	3	4	1	4	3	4	3	4	4	4	3	3.4
6.	3	4	4	3	4	4	3	4	4	4	3	3.6
7.	3	4	4	4	4	4	3	4	4	4	4	3.8
8.	3	3	3	4	4	4	2	4	4	4	3	3.5
9.	3	3	2	4	2	2	4	3	4	3	4	3.1
10.	2	3	3	4	4	2	1	4	4	3	4	3.1
											<b>SUM</b>	<b>33.4</b>

Composite SUS Score:  $33.4 \times 2.5 = 83.5$

## Appendix 5.5 CRITICALNESS SURVEY

The following is a survey of certain PCIS GOLD® EHR functions that are required for 2015 certification.

Please rank the order (one through seven) of the following EHR functions in terms of...

A. Frequency users utilize this function within our system where:

1 = Most used

12 = Least used

B. Prioritize in accordance of risk associated with user errors where:

1 = Most risk of a user making a serious error

12 = Least risk of a user making a serious error

### SURVEY RESULTS SUMMARY

(Experts Polled: 10)

	Frequency (mean)	Error Risk (mean)
Computerized Provider Order Entry – Medications	4.80	4.10
Computerized Provider Order Entry – Laboratory	7.60	7.30
Computerized Provider Order Entry – Radiology	9.00	8.30
Drug-Drug, Drug-Allergy Interaction Checks	6.20	3.40
Demographics	4.60	9.20
Problem List	4.30	7.20
Medication List	3.10	6.00
Medication Allergy List	5.00	6.00
Clinical Decision Support	8.50	8.00
Implantable Device List	10.60	7.00
Clinical Information Reconciliation and Incorporation	10.20	8.00
e-Prescribing	4.70	3.50

**SURVEY RESULTS DETAIL (by respondent)**

	R-01		R-02		R-03		R-04		R-05		R-06	
	F	ER	F	ER	F	ER	F	ER	F	ER	F	ER
Computerized Provider Order Entry – Medications	4	6	10	8	2	5	5	1	4	5	7	2
Computerized Provider Order Entry – Laboratory	5	8	9	9	8	6	6	2	5	4	9	3
Computerized Provider Order Entry – Radiology	6	10	11	10	9	9	11	8	6	3	10	4
Drug-Drug, Drug-Allergy Interaction Checks	8	4	4	4	3	2	9	3	7	2	6	7
Demographics	9	7	3	12	4	7	1	11	10	9	4	12
Problem List	10	1	1	11	10	8	7	12	1	6	1	10
Medication List	3	11	2	2	7	4	3	4	2	7	2	11
Medication Allergy List	2	12	6	3	5	1	4	5	3	8	5	9
Clinical Decision Support	11	3	8	5	12	10	10	9	9	10	3	6
Implantable Device List	12	2	12	6	6	11	8	10	12	12	11	8
Clinical Information Reconciliation and Incorporation	7	5	7	7	11	12	12	7	11	11	12	5
e-Prescribing	1	9	5	1	1	3	2	6	8	1	8	1

**SURVEY RESULTS DETAIL** (continued)

	<b>R-007</b>		<b>R-08</b>		<b>R-09</b>		<b>R-10</b>	
	F	ER	F	ER	F	ER	F	ER
Computerized Provider Order Entry – Medications	5	4	3	2	5	7	3	1
Computerized Provider Order Entry – Laboratory	11	9	8	10	7	10	8	12
Computerized Provider Order Entry – Radiology	10	10	9	9	9	11	9	9
Drug-Drug, Drug-Allergy Interaction Checks	4	3	5	4	6	3	10	2
Demographics	3	6	10	12	1	6	1	10
Problem List	7	7	1	1	3	5	2	11
Medication List	2	5	2	11	2	2	6	3
Medication Allergy List	8	8	6	5	4	1	7	8
Clinical Decision Support	9	12	7	6	11	12	5	7
Implantable Device List	12	1	12	7	10	9	11	4
Clinical Information Reconciliation and Incorporation	7	11	11	8	12	8	12	6
e-Prescribing	6	2	4	3	8	4	4	5

Heading Definitions:

F = Frequency

ER = Error Risk

**PCIS GOLD**  
1525 W. 820 N.  
Provo, UT 84601  
801.373.8518  
[www.pcisgold.com](http://www.pcisgold.com)