PulseCheck ED v5.7.1

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Contents

Contents .................................................................................................................................................. 2
1. Executive Summary .......................................................................................................................... 3
2. Introduction ....................................................................................................................................... 5
3. Method ............................................................................................................................................... 5
   A. Participants .................................................................................................................................. 5
      i. Providers ................................................................................................................................. 5
   ii. Registered Nurses .................................................................................................................... 6
   iii. System Administrators ........................................................................................................... 7
4. Study Design .................................................................................................................................... 8
5. Tasks .................................................................................................................................................. 9
   A. Providers .................................................................................................................................... 9
   B. Registered Nurses ..................................................................................................................... 10
   C. System Administrators ............................................................................................................ 10
   D. Procedures ................................................................................................................................ 11
6. Results ............................................................................................................................................... 16
   A. Results and Data Analysis ......................................................................................................... 16
      i. Providers ................................................................................................................................ 16
      ii. Registered Nurses .................................................................................................................. 18
      iii. System Administrators ........................................................................................................ 19
6. Results ............................................................................................................................................... 16
5. Tasks .................................................................................................................................................. 9
   A. Providers .................................................................................................................................... 9
   B. Registered Nurses ..................................................................................................................... 10
   C. System Administrators ............................................................................................................ 10
   D. Procedures ................................................................................................................................ 11
7. Appendices ........................................................................................................................................ 20
   A. Appendix 1: Participant Demographics .................................................................................... 20
   B. Appendix 2: Informed Consent Form ......................................................................................... 21
   C. Appendix 3: Example Moderators Guide .................................................................................. 22
   D. Appendix 4: System Usability Scale Questionnaire ................................................................. 23
   E. Appendix 5: Tasks ........................................................................................................................ 24
   F. Appendix 7: Sample Recruiting Screening Process ................................................................. 37

PulseCheck ED v5.7.1 Summative Test Results Report • 2
1. Executive Summary

A summative usability test of ED PulseCheck version 5.7.1 was conducted 06/24/2019 – 12/13/2019 by the PulseCheck Product Team. The test was conducted remotely using WebEx. The purpose of this test was to provide evidence of usability in the EHR Under Test (EHRUT) and identify areas for incremental usability improvement.

PulseCheck ED’s intended users are healthcare professionals and 22 participants (10 providers, 10 registered nurses, 2 system admins) matching the target demographic criteria participated in the usability test, using the EHR in simulated but representative tasks. Many of the clinicians are also System Administrators.

During the 60-minute one-on-one usability sessions, each participant was greeted by the administrator and asked to confirm their non-disclosure/consent form (see Appendix 2) which was sent to the PulseCheck Product department. Participants were instructed they could withdraw at any time. All participants had prior experience with the EHR.

The administrator introduced the test and instructed participants to complete a series of tasks (presented one at a time) using the EHR and recorded user performance data. The administrator did not give the participant assistance in how to complete the task (and if it became necessary, that task was marked as failed).

<table>
<thead>
<tr>
<th>Area of Certification</th>
<th>Tasks</th>
<th>Physicians</th>
<th>Nurses</th>
<th>System Admin</th>
</tr>
</thead>
<tbody>
<tr>
<td>§170.315(a)(1)</td>
<td>Computerized provider order entry - medications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>Record, modify, and access medication orders</td>
<td>✔️</td>
<td></td>
<td></td>
</tr>
<tr>
<td>§170.315(a)(2)</td>
<td>Computerized provider order entry - laboratory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>Record, modify, and access laboratory orders</td>
<td></td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>§170.315(a)(3)</td>
<td>Computerized provider order entry – diagnostic imaging</td>
<td></td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>Record, modify, and access radiology/imaging order</td>
<td></td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>§170.315(a)(4)</td>
<td>Drug-drug, drug-allergy interaction checks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A4.1</td>
<td>Enter/Approve a medication order with a drug-allergy reaction</td>
<td></td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>A4.2</td>
<td>Enter/Approve a medication order with a drug-drug interaction</td>
<td></td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>A4.3</td>
<td>Adjust the severity level for the drug-drug interaction</td>
<td></td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>§170.313(a)(5)</td>
<td>Demographics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A5</td>
<td>Record, modify, and access patient demographics</td>
<td></td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>§170.315(a)(6)</td>
<td>Problem List</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A6</td>
<td>Record, modify, and access problem list</td>
<td></td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>§170.315(a)(7)</td>
<td>Medication List</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A7</td>
<td>Record, modify, and access medication list</td>
<td></td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>§170.315(a)(8)</td>
<td>Medication Allergy List</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A8</td>
<td>Record, modify, and access medication allergy list</td>
<td></td>
<td>✔️</td>
<td></td>
</tr>
</tbody>
</table>
Each participant’s interactions with the EHR were recorded for subsequent analysis. The following types of data were collected:

- 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 tasks and system

All participant data was de-identified to avoid linking the identity of the participant to the data collected. Following the conclusion of the testing, participants were asked to complete a post-test questionnaire. Providers and Nurses were compensated $100 for their time.
2. Introduction

The EHR tested was PulseCheck ED version 5.7.1, which is an electronic health record (EHR) system offering comprehensive clinical documentation, workflow, and Meaningful Use compliance reporting.

The purpose of this test was to provide evidence of usability in the EHR and identify areas for incremental usability improvement. To this end, measures of effectiveness, efficiency, and user satisfaction (such as task completion, time on task, and task efficiency) were captured during the usability testing.

NIST 7741 standards were followed during the development of PulseCheck ED v5.7.1.

3. Method

A. Participants

A total of 22 participants, consisting of 10 providers, 10 nurses, and 2 administrators were tested on the EHR. All participants were given the same orientation instructions. Providers and Nurses were compensated $100 for their time.

Participants were recruited by the PulseCheck Product Team. All participants currently use or have used the EHR in a professional workplace and were recruited based on job title, gender, and age.

i. Providers

The following table summarizes the characteristics of the providers who participated in the usability test, including demographics, professional experience, computing experience, and use of assistive technology. Participant names were replaced with Participant IDs so that data cannot be tied back to identities.

<table>
<thead>
<tr>
<th>Part ID</th>
<th>Gender</th>
<th>Age</th>
<th>Education</th>
<th>Occupation</th>
<th>Professional Experience</th>
<th>Computer Experience</th>
<th>Product Experience</th>
<th>Assistive Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 P05</td>
<td>Male</td>
<td>40-49</td>
<td>Doctorate Degree</td>
<td>Emergency Physician</td>
<td>252</td>
<td>396</td>
<td>144</td>
<td>Yes</td>
</tr>
<tr>
<td>2 P06</td>
<td>Male</td>
<td>60-69</td>
<td>Doctorate Degree</td>
<td>Chief Medical Information Officer</td>
<td>336</td>
<td>564</td>
<td>204</td>
<td>Yes, Dragon and Fusion Narate</td>
</tr>
<tr>
<td>3 P07</td>
<td>Male</td>
<td>30-39</td>
<td>Doctorate Degree</td>
<td>Emergency Physician</td>
<td>60</td>
<td>360</td>
<td>10</td>
<td>No</td>
</tr>
<tr>
<td>4 P08</td>
<td>Male</td>
<td>40-49</td>
<td>Doctorate Degree</td>
<td>Physician, Clinical Director</td>
<td>120</td>
<td>360</td>
<td>84</td>
<td>No</td>
</tr>
<tr>
<td>5 P17</td>
<td>Female</td>
<td>50-59</td>
<td>Master's Degree</td>
<td>Nurse Practitioner</td>
<td>120</td>
<td>312</td>
<td>132</td>
<td>No</td>
</tr>
</tbody>
</table>
Participants were scheduled for 60-minute sessions. A minimum of 30 minutes was reserved between each session for debrief by the administrator and data logger and to reset systems to proper test conditions.

### ii. Registered Nurses

The following table summarizes the characteristics of the Registered Nurses who participated in the usability test, including demographics, professional experience, computing experience, and use of assistive technology. Participant names were replaced with Participant IDs so that data cannot be tied back to identities.
Participants were scheduled for 60-minute sessions. A minimum of 30 minutes was reserved between each session for debrief by the administrator and data logger and to reset systems to proper test conditions.

### System Administrators

The following table summarizes the characteristics of the System Administrators who participated in the usability test, including demographics, professional experience, computing experience, and use of assistive technology. Participant names were replaced with Participant IDs so that data cannot be tied back to identities.
Participants were scheduled for 30-minute sessions. A minimum of 30 minutes was reserved between each session for debrief by the administrator and data logger and to reset systems to proper test conditions.

4. Study Design

Overall, the objective of this test was to measure how well the application performed with regard to effectiveness, efficiency, and user satisfaction; to identify areas for improvement; and to recommend improvements. Additionally, the data from this test will serve as a baseline for future tests and for comparison with updated versions of the EHR and/or other EHRs. In short, this testing serves as a means to benchmark current usability and to identify areas where improvements can be made.

All participants were given the same orientation instructions and remote testing environment to access the EHR. Three task sets were defined—one for providers, one for nurses, and one for system administrators. All participants used the same test data. The EHR was evaluated using the following measures:

- 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 tasks and system

Additional information about the various measures can be found in the Usability Metrics section of this document.
5. Tasks

Tasks were selected based on how frequently they are used, how critical they are, and how likely they are to be troublesome for users. Task details were defined to be realistic and representative of the kinds of activities users might perform with the EHR. See Appendix 5 for task specifics.

A. Providers

Providers performed the following tasks:

<table>
<thead>
<tr>
<th>Area of Certification</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>§170.315(a)(1) Computerized provider order entry - medications</td>
<td>A1 Record, modify, and access medication orders</td>
</tr>
<tr>
<td>§170.315(a)(2) Computerized provider order entry - laboratory</td>
<td>A2 Record, modify, and access laboratory orders</td>
</tr>
<tr>
<td>§170.315(a)(3) Computerized provider order entry – diagnostic imaging</td>
<td>A3 Record, modify, and access radiology/imaging order</td>
</tr>
<tr>
<td>§170.315(a)(4) Drug-drug, drug-allergy interaction checks</td>
<td>A4.1 Enter/Approve a medication order with a drug-allergy reaction</td>
</tr>
<tr>
<td>§170.315(a)(4) Drug-drug, drug-allergy interaction checks</td>
<td>A4.2 Enter/Approve a medication order with a drug-drug interaction</td>
</tr>
<tr>
<td>§170.315(b)(3) Electronic prescribing</td>
<td>B3.1 Display and respond to a prescription change request from a pharmacy</td>
</tr>
<tr>
<td>§170.315(b)(3) Electronic prescribing</td>
<td>B3.2 Send a prescription cancellation to a pharmacy</td>
</tr>
<tr>
<td>§170.315(b)(3) Electronic prescribing</td>
<td>B3.3 Display the fill status of a prescription</td>
</tr>
</tbody>
</table>
## B. Registered Nurses

Registered Nurses performed the following tasks:

<table>
<thead>
<tr>
<th>Area of Certification</th>
<th>Tasks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>§170.313(a)(5) Demographics</td>
<td>A5</td>
<td>Record, modify, and access patient demographics</td>
</tr>
<tr>
<td>§170.315(a)(6) Problem List</td>
<td>A6</td>
<td>Record, modify, and access problem list</td>
</tr>
<tr>
<td>§170.315(a)(7) Medication List</td>
<td>A7</td>
<td>Record, modify, and access medication list</td>
</tr>
<tr>
<td>§170.315(a)(8) Medication Allergy List</td>
<td>A8</td>
<td>Record, modify, and access medication allergy list</td>
</tr>
</tbody>
</table>

## C. System Administrators

System Administrators performed the following tasks:

<table>
<thead>
<tr>
<th>Area of Certification</th>
<th>Tasks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>§170.313(a)(4) Drug-drug, drug-allergy interaction checks for CPOE</td>
<td>A4.3</td>
<td>Adjust the severity level of drug-drug interaction checks</td>
</tr>
</tbody>
</table>
D. **Procedures**

Upon arrival, participants were greeted and their identity was verified. Participants were then assigned a participant ID. Each participant completed the demographics questions and each participant provided a signed informed consent form. See **Appendix 1: Participant Demographics** for an example of the demographics form. See **Appendix 2: Informed Consent Form** for an example of the informed consent form.

The test was conducted by the administrator and the data logger.

The administrator moderated the session, delivered initial instructions, and took notes on participant comments, path deviations, and errors. The data logger also took notes on task success, path deviations, errors, and comments. The administrator led participants through the tasks. The data logger recorded task times, post-task rating data, post-test satisfaction data, and demographic data.

Participants were instructed to perform the tasks (see the **Participant Instructions** below):

- As quickly as possible making as few errors and deviations as possible
- Without assistance
- Without commenting until they had completed each task (if possible)

The administrator provided participants with instructions before and during each task. Task timing began once the participant was instructed to "Start". Task timing ended once the participant said "Complete". Scoring is discussed in the **Data Scoring** section.

Following the session, the administrator provided a System Usability Scale (SUS) questionnaire. See **Appendix 4: System Usability Scale Questionnaire** for additional information on SUS questionnaires. The administrator told participants to expect to receive compensation in 2-4 weeks.

E. **Test Location**

Tests were conducted remotely, with each individual at their own location. Only the participant, administrator, and data logger were present.

F. **Test Environment**

The EHR typically is used in a clinical, Emergency Department setting. Tests were conducted remotely, using the administrator’s computer to run WebEx. Participants used their own PCs during studies. They were given control of the administrator’s computer to access the application during the session, but used their own mouse, keyboard, and display.

Additionally, participants were also asked to close any applications other than the WebEx session.

The administrator’s computer is a Dell Precision 7520 with an Intel® Core™ i7-7820HQ Processor, 32 GB RAM, running Windows 10 Enterprise. The display resolution was set to 1920 x 1080. This computer ran WebEx screen sharing and Internet Explorer 11 at 125% zoom level. Laptop is connected to a LAN.

The administrator connected to PulseCheck’s internal instance of PulseCheck ED that is used for UCD testing purposes.

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3 The participant’s data has been de-identified to be kept confidential.
G. Test Forms and Tools

During the usability test, the administrator presented various documents, including:

1. Informed Consent
2. Participant Demographic Questionnaire
3. Tasks
4. System Usability Scale Questionnaire

Examples of these documents can be found in Appendix 2: Informed Consent Form, Appendix 3: Example Moderator’s Guide, Appendix 4: System Usability Scale Questionnaire, and Appendix 5: Tasks. Moderator’s Guide was designed to be easy for the data logger.

H. Participant Instructions

Thank you for joining us today; we really appreciate your time. I'm <Name>; I work on the PulseCheck ED product team. I also have <Name> on the line, they'll be helping take notes and recording times.

Before we begin, I'd like to take a moment to describe the study we’re conducting. We’re collecting feedback on PulseCheck ED.

We’re going to ask you to perform a series of tasks. You should know that the tasks were created to be independent of each other and some may sound redundant. You will be asked to complete these tasks on your own, trying to do them as quickly as possible with the fewest possible errors or deviations. Please do not do anything more than the task asks.

You are not being tested on your ability to complete the tasks. We’re evaluating how intuitive the product is to use, so just do your best to complete them as you typically would. Feel free to speak candidly, however, please save your comments until the end of a task, or the end of the session as a whole, when we can then discuss them freely.

We’d ask that you please read the task information aloud, so we can follow along.

I’m going to share my screen with you in the WebEx. You’ll be using PulseCheck on my computer, but I'll give you control of my computer’s mouse and keyboard for the duration of the study. Because we can’t always control the bandwidth between our two locations, you may notice a tiny lag or latency when you’re in control of the mouse and keyboard. However, we don’t anticipate this will affect your ability to use the product.

Before I do that, please quit or close any other applications that are currently running on your computer (email and Instant Messaging), with the exception of your browser and WebEx. Also, please set any mobile devices to silent during the study.

I. 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:
Tasks

1. Effectiveness of the EHR (ED PulseCheck) by measuring participant success rates and errors
2. Efficiency of the EHR by measuring the average task time and path deviations
3. Satisfaction with the EHR by measuring ease-of-use ratings
J. **Data Scoring**

The following table details how the testing team scored the tasks, evaluated the errors, and analyzed the time data.⁴

<table>
<thead>
<tr>
<th>Measures</th>
<th>Rationale and Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effectiveness:</strong></td>
<td></td>
</tr>
<tr>
<td>Task Success</td>
<td>A task was counted as a “Success” if the participant was able to achieve the correct outcome, without assistance, within the time allotted.</td>
</tr>
<tr>
<td></td>
<td>The total number of successes were calculated for each task, and then the results were divided by the total number of times that task was attempted. The results are provided as a percentage.</td>
</tr>
<tr>
<td><strong>Effectiveness:</strong></td>
<td></td>
</tr>
<tr>
<td>Task Failures</td>
<td>If the participant abandoned the task, did not reach the correct answer, or performed it incorrectly, the task was counted as a “Failure.” No task times were taken for errors⁵.</td>
</tr>
<tr>
<td></td>
<td>The total number of errors was calculated for each task, and the results were divided by the total number of times the task was attempted. This was also expressed as the mean number of failed tasks per participant.</td>
</tr>
<tr>
<td><strong>Efficiency:</strong></td>
<td></td>
</tr>
<tr>
<td>Task Deviations</td>
<td>The participant’s path (i.e., steps) through the application was recorded. Deviations occurred if the participant went to a wrong screen, clicked an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. Each participant’s path was compared to the optimal path. The number of steps in the observed path was divided by the number of optimal steps to provide a ratio of path deviation.</td>
</tr>
<tr>
<td></td>
<td>Deviations were defined as:</td>
</tr>
<tr>
<td></td>
<td>- Task Recognition: failure to recognize task or completion of a different task</td>
</tr>
<tr>
<td></td>
<td>- Data Entry: failure to enter complete data or entry of incorrect data</td>
</tr>
<tr>
<td></td>
<td>- Task Completion: failure to take final steps required to complete the task</td>
</tr>
</tbody>
</table>


⁵ Errors were operationally defined by the product team prior to testing.
### Efficiency:

**Task Time**

Each task was timed from when the participant began to when the participant said “complete”. Only completion times for successfully completed tasks were included in the “average task time analysis.” Average times per task and variance measures (standard deviation and standard error) were calculated for each task.

Optimal task performance time was benchmarked by expert performance when constructing the tasks. Target task times were operationally defined by taking multiple measures of optimal performance and multiplying by a factor (1.25) that allows a time buffer because the participants are using the EHR without their normal customizations. Thus, if expert optimal performance on a task was 100 seconds, then allotted task time performance would be 125 seconds. This ratio was aggregated across all the tasks and reported with mean and variance scores.

### Satisfaction:

**Task Rating**

Participant’s subjective impression of the ease-of-use of the application was measured by administering a post-task question and a post-session questionnaire.

After each task, the participant was asked to rate “Overall, this task was:" on a scale of 1 (Very Difficult) to 5 (Very Easy). These data are averaged across participants. Common convention is that average ratings for systems judged easy to use should be 3.3 or above.

To measure participants’ confidence in and satisfaction with the 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 [Appendix 4: System Usability Scale Questionnaire](#) for a complete list of SUS questions.

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7 The SUS survey yields a single number that represents a composite measure of the overall perceived usability of the system. SUS scores have a range of 0 to 100 and the score is a relative benchmark that is used against other iterations of the system.
### 6. Results

#### A. Results and Data Analysis

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

The usability testing results for the EHR are detailed below. The results are presented in the context of the objectives and goals outlined in Study Design. The report includes actionable results that, if corrected, should yield a material, positive impact on user performance.

The following is a summary of the performance and rating data collected on the EHR. The Likert Scale was used for task ratings.

#### i. Providers

<table>
<thead>
<tr>
<th>Task</th>
<th>Measure</th>
<th>N</th>
<th>Task Success</th>
<th>Path Deviation</th>
<th>Task Time</th>
<th>Errors</th>
<th>Task Ratings (5=Easy)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>#</td>
<td>Mean (SD)</td>
<td>Observed #</td>
<td>Optimal #</td>
<td>Mean (SD)</td>
<td>Deviation - Observed</td>
</tr>
<tr>
<td>A1</td>
<td>Record, modify, and access medication orders</td>
<td>10</td>
<td>100% (±0%)</td>
<td>175</td>
<td>130</td>
<td>135 (±60)</td>
<td>1352</td>
</tr>
<tr>
<td>A2</td>
<td>Record, modify, and access laboratory orders</td>
<td>10</td>
<td>100% (±0%)</td>
<td>167</td>
<td>80</td>
<td>154 (±93)</td>
<td>1542</td>
</tr>
<tr>
<td>A3</td>
<td>Record, modify, and access radiology/imaging order</td>
<td>10</td>
<td>100% (±0%)</td>
<td>74</td>
<td>60</td>
<td>57 (±23)</td>
<td>574</td>
</tr>
<tr>
<td>A4.1</td>
<td>Enter/Approve a medication order with a drug-allergy reaction</td>
<td>10</td>
<td>100% (±0%)</td>
<td>81</td>
<td>60</td>
<td>61 (±27)</td>
<td>611</td>
</tr>
<tr>
<td>A4.2</td>
<td>Enter/Approve a medication order with a drug-drug interaction</td>
<td>10</td>
<td>100% (±0%)</td>
<td>61</td>
<td>50</td>
<td>39 (±14)</td>
<td>390</td>
</tr>
<tr>
<td>B3.1</td>
<td>Display and respond to a prescription change request from a pharmacy</td>
<td>10</td>
<td>80% (±40%)</td>
<td>78</td>
<td>48</td>
<td>118 (±5)</td>
<td>945</td>
</tr>
<tr>
<td>B3.2</td>
<td>Send a prescription cancellation to a pharmacy</td>
<td>10</td>
<td>90% (±30%)</td>
<td>151</td>
<td>99</td>
<td>229 (±131)</td>
<td>2063</td>
</tr>
</tbody>
</table>
The System Usability Scale was used to score participants’ subjective satisfaction based on their overall experience with the EHR. The overall score was 90.25 (±9.84).¹

In addition to the performance data, we recorded the following qualitative observations.

**Data Analysis and Reporting**

Two providers were not able to complete the steps/tasks required for B3.1 - Display and respond to a prescription change request from a pharmacy. The PulseCheck team was asked to intervene and assist with the steps.

The provider participants were very effective. The majority of the tasks were completed by all participants. Errors occurred for the CPOE labs and imaging tasks as providers do not usually cancel orders and therefore they are not familiar with the page accessed to cancel orders.

The providers that do not perform ePrescribing in the application were less efficient with the ePrescribing tasks yet some were able to complete the task. Providers also deviated from the optimal path with ePrescribing tasks as providers are not as familiar with changing the pharmacy for a patient.

Per the Likert ratings, providers are satisfied with the tasks performed, including the new tasks.

There were no major findings for the provider tasks.

Recommendations for improvement were given and will be reviewed for future development.

## Results

### Registered Nurses

<table>
<thead>
<tr>
<th>Task</th>
<th>N</th>
<th>Task Success</th>
<th>Path Deviation</th>
<th>Task Time</th>
<th>Errors</th>
<th>Task Ratings (5=Easy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A5 - Record, modify, and access patient demographics</td>
<td>10</td>
<td><strong>100%</strong> (±0%)</td>
<td>434</td>
<td>272 (±118)</td>
<td>2718</td>
<td>1810</td>
</tr>
<tr>
<td>A6 - Record, modify, and access problem list</td>
<td>10</td>
<td><strong>100%</strong> (±0%)</td>
<td>187</td>
<td>125 (±43)</td>
<td>1250</td>
<td>300</td>
</tr>
<tr>
<td>A7 - Record, modify, and access medication list</td>
<td>10</td>
<td><strong>100%</strong> (±0%)</td>
<td>204</td>
<td>128 (±45)</td>
<td>1281</td>
<td>520</td>
</tr>
<tr>
<td>A8 - Record, modify, and access medication allergy list</td>
<td>10</td>
<td><strong>100%</strong> (±0%)</td>
<td>203</td>
<td>82 (±23)</td>
<td>817</td>
<td>490</td>
</tr>
</tbody>
</table>

The System Usability Scale was used to score participants’ subjective satisfaction with the system based on their overall experience with the EHR. The overall score was 93.25 (±7.07).²

In addition to the performance data, we recorded the following qualitative observations.

### Data Analysis and Reporting

The nurse participants were effective as all tasks were completed by all participants. Errors occurred on the demographics page as there are new fields and a few users were confused by how the drop-down menus function.

One of the nurses added any extra clicks/errors as she did not follow the optimal path and used the application as she does at her facility (and not the way most facilities use the application)

The nurses were less efficient with the demographics task as they do not usually enter the information. Each facility typically interfaces the demographics data and nurses have been trained to avoid manually entering the information as it was asked with task A5. Nurses deviated from the optimal path for demographics since they are not familiar with the actions required in the task.

Per the Likert ratings, nurses were mostly satisfied with the functions, including the new tasks. Nurses are highly satisfied with the medication allergy list functionality.

There were no major findings for the nurse tasks.

Recommendations for improvement were given and will be reviewed for future development.

---

### System Administrators

<table>
<thead>
<tr>
<th>Task</th>
<th>N</th>
<th>Task Success</th>
<th>Path Deviation</th>
<th>Task Time</th>
<th>Errors</th>
<th>Task Ratings (5=Easy)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (SD)</td>
<td>Observed #</td>
<td>Optimal #</td>
<td>Mean (SD)</td>
<td>Deviation - Observed</td>
</tr>
<tr>
<td>A4.3 Adjust the severity level of drug-drug interaction checks</td>
<td>10</td>
<td>70% (±45.83 %)</td>
<td>66</td>
<td>42</td>
<td>97 (±71)</td>
<td>677</td>
</tr>
</tbody>
</table>

The System Usability Scale was used to score participants’ subjective satisfaction with the system based on their overall experience with the EHR. The overall score was 92.5 (±8.44).²

In addition to the performance data, we recorded the following qualitative observations.

**Data Analysis and Reporting**

The system administrators were less efficient with the task as they do not usually change the interaction checking level post implementation. This means each user had to refresh their memory during the testing which added time and errors. For this reason, system administrators deviated from the optimal path for since they have not performed the actions required for the tasks in many years.

Per the Likert ratings, system administrators were mostly satisfied with adjusting the severity level of interaction checking.

There were no major findings for the system administrator task.

Recommendations for improvement were given and will be reviewed for future development.

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7. Appendices

A. Appendix 1: Participant Demographics

Participant ID:

1. Gender
   □ Female □ Male

2. Age
   □ 0-9 □ 60-69
   □ 10-19 □ 70-79
   □ 20-29 □ 80-89
   □ 30-39 □ 90-99
   □ 40-49 □ 100+
   □ 50-59

3. What is the highest degree or level of school you have completed?
   □ No high school degree
   □ High school graduate, diploma or the equivalent (for example: GED)
   □ Some college credit, no degree
   □ Trade/technical/vocational training
   □ Associate degree
   □ Bachelor’s Degree
   □ Master’s Degree
   □ Doctorate degree (e.g., MD, DNP, DMD, PhD)

4. What is your current occupation/role?

5. How long have you been a professional (in months)?

6. How long have you used computers (in months)?

7. How long have you used PulseCheck ED (in months)?

8. Do you use assistive technology; such as an enhanced visual display, physically adapted pointing device, or text-to-speech engine; in the workplace?
   □ Yes
   □ No
   If yes, please describe ________________________________
B. Appendix 2: Informed Consent Form

I agree to participate in this study conducted by Picis Clinical Solutions, Inc. (hereinafter referred to as “PulseCheck”).

I understand PulseCheck will record my participation for later review. By signing/acknowledging this form, I give PulseCheck permission to use the data gathered and my comments for the purposes of evaluating the product in the study and showing the results of these evaluations, combined with other participants, to the product team. PulseCheck will not include my name or any identifying characteristics in the results.

Any information I acquire about the product in the study is confidential and proprietary and is being disclosed only so that I can participate in the evaluation. By signing this form, I agree not to talk about this product to anyone. I may only tell others that I helped to evaluate the software. I understand that if I disclose my health information in my comments, I have disclosed it voluntarily, and PulseCheck may use it anonymously for research and evaluation purposes only.

I understand that I can stop participating in this study at any time. I agree to raise any concerns or areas of discomfort with the study moderator.

Name (print): ___________________________________________

Signature: ______________________________________________

Date: _________________________________________________
Thank you for joining us today; we really appreciate your time. I’m <Name>; I work on the PulseCheck ED product team. I also have <Name> on the line, they’ll be helping take notes and recording times.

Before we begin, I’d like to take a moment to describe the study we’re conducting. We’re collecting feedback on PulseCheck ED.

We’re going to ask you to perform a series of tasks. You should know that the tasks were created to be independent of each other and some may sound redundant. You will be asked to complete these tasks on your own, trying to do them as quickly as possible with the fewest possible errors or deviations. Please do not do anything more than the task asks.

You are not being tested on your ability to complete the tasks. We’re evaluating how intuitive the product is to use, so just do your best to complete them as you typically would. Feel free to speak candidly, however, please save your comments until the end of a task, or the end of the session as a whole, when we can then discuss them freely.

We’d ask that you please read the task information aloud, so we can follow along.

After each task I will ask you to rate the task using the Likert Scale. When responding, 1 is “most difficult” and 5 is “easiest”.

I’m going to share my screen with you in the WebEx. You’ll be using PulseCheck ED on my computer, but I’ll give you control of my computer’s mouse and keyboard for the duration of the study. Because we can’t always control the bandwidth between our two locations, you may notice a tiny lag or latency when you’re in control of the mouse and keyboard. However, we don’t anticipate this will affect your ability to use the product.

Before I do that, please quit or close any other applications that are currently running on your computer (email and Instant Messaging), with the exception of your browser and WebEx. Also, please set any mobile devices to silent during the study.

Orientation (1 minute)

Your input is very important. Our session today will last about 60 minutes. During that time you will be using PulseCheck ED. Please be honest with your opinions, any feedback 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.

Before we get started, do you have any questions?

---

Prior to testing
- Confirm schedule with Participants
- Ensure EHRUT lab environment is running properly
- Ensure lab and data recording equipment is running properly

Prior to each participant:
- Reset application
- Start session recordings with tool

Prior to each task:
- Reset application to starting point for next task

After each participant:
- End session recordings with tool

After all testing:
- Back up all video and data files
D. **Appendix 4: System Usability Scale Questionnaire**

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

Participant ID:

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Disagree</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Strongly Agree 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I think I would like to use this product frequently</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. I find this product to be simple</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. I think this product is easy to use</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. I can use this product without the support of a technical person</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. I find the various functions in this product to be well integrated</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. I think there is a lot of consistency in this product</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7. I would imagine that most people would learn to use this product very quickly</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8. I find this product to be very intuitive</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9. I feel very confident using this product</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10. I can use this product without having to learn anything new</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>


E. Appendix 5: Tasks

Task A1  
Record, modify, and access medication orders, 170.315(a)(1)

Role  
Physician with experience entering medication orders

Robert Michael O’Brien was brought to the emergency department for abdominal and chest pain. A patient record has already been created for Robert in PulseCheck ED and assigned to you.

You decide to enter medication orders for Robert.

A few minutes later, you decide to cancel the morphine due to a change in medication plan.

Actions

Enter the following medication orders:

- Aspirin Children’s 81 mg chewable tablet by mouth once
- Morphine 2 mg IV push for pain, every 4 hours as needed
- Nitrostat 0.3 mg sublingual every 5-15 minutes as needed

Cancel the following medication order:

- Morphine 2 mg IV push for pain, every 4 hours as needed
  - Cancel reason: Change in medication plan

Lastly, view Robert’s medication orders.

When you feel you’re done with the task, alert the test administrator by saying “complete”.

Task A2
Record, modify, and access lab orders, 170.315(a)(2)

Role
Physician with experience entering lab orders

Robert Michael O’Brien was brought to the emergency department for abdominal and chest pain. A patient record has already been created for Robert in PulseCheck ED and has been assigned to you.

Enter the lab orders listed below.

You decide to cancel the Hemoglobin order as it is not needed. Cancel the order.

Lastly, view Robert’s lab orders.

Action
Enter the following lab orders:

- Complete blood count (CBC)
- Hemoglobin A1c
- Hepatic panel

Cancel the following lab order:

- Hemoglobin A1c

View Robert’s lab orders.

When you feel you’re done with the task, alert the test administrator by saying “complete.”
Task A3

Record, modify, and access radiology orders, 170.315(a)(3)

Role

Physician with experience entering lab and imaging orders

John Smith was brought to the emergency department for an injury to his right wrist. A patient record was created for John in PulseCheck ED and assigned to you.

John needs a 2 view wrist x-ray.

While entering the wrist x-ray, you notice a chest x-ray was accidentally ordered. Cancel this incorrect order.

Lastly, view the radiology orders.

Action

Order a 2 view wrist x-ray.

Cancel the chest x-ray.

View all radiology orders entered on John.

When you feel you’re done with the task, alert the test administrator by saying “complete”.
Task A4.1  Approve a medication order with a drug-drug interaction, 170.315(a)(4)

Role  Physician with experience entering medication orders

Zackary A Pearson was brought to the emergency department for a fever. A patient record has already been created for Zackary in PulseCheck ED and assigned to you. Zackary is currently taking Hydrochorotheizide. You believe the benefits of taking lithium carbonate outweigh the risks associated with drug interactions.

Actions  Place the following medication order for Zackary with a drug interaction:

- **Medication**: Two (2) lithium carbonate 150mg capsules
- **Interaction override reason**: benefits outweigh the risks

When you feel you’re done with the task, alert the test administrator by saying “complete”.
Task A4.2  Enter/approve a medication order with a drug-allergy reaction, 170.315(a)(4)

Role  Physician with experience entering medication orders

John Smith was brought to the emergency department for an injury to his right wrist. A patient record has already been created for John in PulseCheck ED and assigned to you. John is allergic to Tylenol but has been treated with Vicodin in the past and has responded well with no side effects.

Actions  Enter the following medication order for John with an allergy interaction

- Medication: one (1) tablet of Vicodin ES, 750 mg
- Interaction override reason: tolerated medication in the past

When you feel you’re done with the task, alert the test administrator by saying “complete”.

PulseCheck ED v5.7.1 Summative Test Results Report • 28
Task A4.3 Adjust the severity level of drug-drug interaction checks, 170.315(a)(4)

Role System Administrator familiar with System Admin tasks

The Medical Director requested that you adjust the drug-drug interaction checking from “All” to “Severe only” for prescriptions and medication services.

Actions Change the interactions setting to accommodate the physician’s request.

When you feel you’re done with the task, alert the test administrator by saying “complete”.
Task A5: Record, modify, and access patient demographics, 170.315(a)(5)

Sally Smith is a new patient to the emergency department. Upon her arrival to the ED she provided demographic information. Later in her visit, Sally requests you update her record to “declines” for her demographics.

Actions

Enter the following information to create a new record for Sally.

- Name: Sally Smith
- Birth Sex: F
- Gender Identity: “Identifies as a Female”
- Sexual Orientation: “Straight or heterosexual”
- Preferred Language: “English”
- Race: “White”
- Ethnicity: “Not Hispanic or Latino”
- Date of birth: 11/22/1981

Modify the following information for Sally:

- Gender Identity: “Choose not to disclose”
- Sexual Orientation: “Choose not to disclose”
- Race: “Declined to specify”
- Ethnicity: “Declines to specify”

View the demographic information for Sally.
**Task A6**

Record, modify, and access problem list, 170.315(a)(6)

**Actions**

Add a problem to Alissa’s problem list. Modify a problem on Alissa’s problem list. View Alissa’s problem list.

Alissa Joy came to the emergency department for abdominal pain. While talking to Alissa she mentions she has a history of migraines that started two years ago.

Later in her visit, Alissa Joy mentions that her migraines resolved 2 months ago. Update the problem list so it is accurate.

Enter the following problem list information:

- **Problem name**: migraine unspecified
- **Status**: Active
- **Date Diagnosed**: 2017
- **Date Resolved**: none

Modify the following problem list information to the following:

- **Problem name**: migraine unspecified
- **Status**: Active
- **Date Diagnosed**: 2017
- **Date Resolved**: April 2019

Lastly, view Alissa’s problem list.

When you feel you’re done with the task, alert the test administrator by saying “complete”.

"complete".
Task A7  Record, modify, and access medication list, 170.315(a)(7)

Mary Jackson was brought to the emergency department for vomiting. A patient record has already been created for Mary in PulseCheck ED and has been assigned to you. Mary states she takes one medication each day, at bedtime. Later in the visit, Mary states she is actually taking a different dosage of the medication, at bedtime.

Action  Enter the following daily medication:

- Topiramate 50 mg oral, once a day

Modify the daily medication to the following:

- Topiramate 50 mg oral, once a day (at bedtime)

Access the medication list.

When you feel you’re done with the task, alert the test administrator by saying “complete”.
Task A8

Record, modify, and access medication allergy list, 170.315(a)(8)

Jenny Fisher was brought to the emergency department for tooth pain. A patient record has already been created for Jenny in PulseCheck ED and has been assigned to you. Jenny states she is allergic to aspirin and when she takes it she experiences nausea.

After you enter the information, Jenny states she is allergic to aspirin but the reaction is hives, not nausea, and this is a moderate reaction.

Action

Enter the following medication allergy information:

- **Medication**: Aspirin
- **Reaction**: Nausea
- **Severity**: Mild
- **Source**: Patient

Modify the medication allergy information to the following:

- **Medication**: Aspirin
- **Reaction**: Hives
- **Severity**: Moderate
- **Source**: Patient

Access the medication allergy list.

When you feel you’re done with the task, alert the test administrator by saying “complete”.

Task B3.1
Display and respond to a prescription change request from a pharmacy, 170.315(b)(3)

Role
Physician with ePrescribing experience

Laura Rusty presented to the Emergency Department earlier today complaining of the frequent urge to urinate, burning sensation, lower abdominal pain and a small amount of blood in her urine. After the appropriate tests, she was diagnosed with uncomplicated cystitis and electronically sent a prescription for Macrobid 100 mg capsules, one capsule every 12 hours for seven days.

Later the pharmacy sends message asking to change Rx for Macrobid 100 mg PO to the generic (nitrofurantoin monohydrate/macrocrystals 100 mg capsule)

Action
- Access the prescription for Macrobid
- Respond to the change request
  - Approve the generic substitution

When you feel you’re done with the task, alert the test administrator by saying “complete”.
Task B3.2  
Send a prescription cancellation to a pharmacy, 170.315(b)(3)

Role  
Physician with ePrescribing experience

Samantha Jones was brought to the emergency department for an ear infection. She is initially electronically prescribed Amoxicillin 500 mg TID for 10 days and the prescription is transmitted to a Shollenberger Pharmacy near her home. Samantha asks if the Rx can be sent to a Medi-Blue Rapid Clinic by her work instead. The physician cancels the initial Rx and rewrites the Rx and transmits it to the preferred pharmacy.

Action

- Access the initial electronic prescription for Samantha
  - Amoxicillin 500 mg TID for 10 days to Shollenberger Pharmacy

- Cancel the prescription for Amoxicillin
  - Cancel reason: ‘changing pharmacy’

- Change pharmacy to Medi-Blue Rapid Clinic

- Write new electronic prescription for Samantha
  - Amoxicillin 500 mg TID for 10 days to Medi-Blue Rapid Clinic

**Formulary information is not currently available. You can ignore any message regarding formulary information**

When you feel you’re done with the task, alert the test administrator by saying “complete”.
Task B3.3  
Display the fill status of a prescription, 170.315(b)(3)

Role  
Physician with ePrescribing experience

Samantha Jones was seen in the Emergency Department earlier for an ear infection and received a prescription for Amoxicillin.

Samantha has a history of not filling her prescriptions due to having no insurance and the cost of prescription drugs. The provider knows the receiving pharmacy always returns fill status messages to communicate to the prescriber.

Action  
Access Samantha’s pharmacy record to view the fill status and details of the Amoxicillin prescription.

When you feel you’re done with the task, alert the test administrator by saying “complete”.
F. Appendix 7: Sample Recruiting Screening Process

Initiate email to client contact:

Our Product department is looking for users to help us with User Centered Design testing for our Meaningful Use certification. At this time we need <insert number> nurses, <insert number> providers, and <insert number> system admins. This is a one hour commitment and providers and clinical support staff that participate will receive a gift card.

Participants need to sign and return the attached informed consent. We will work around their schedule in terms of dates and times. I’ll send a WebEx invite and the user will access the application through WebEx meaning I will give them control of my computer which will be showing PulseCheck ED.

Please let me know if you can still help with this and if you have any questions. I look forward to working with you on this.

Once client identifies users, the following email is sent:

Thanks for agreeing to participate in PulseCheck ED’s User Centered Design testing. Here is a little more info on the testing:

We would like to have you participate in a usability testing process for Meaningful Use using the PulseCheck ED application. The test is for us to evaluate the users’ usability of PulseCheck ED. There are no “right” or “wrong” answers. Overall, we are interested in how easy (or difficult) this system is to use and how we can improve it.

We would like to do this testing at your convenience over a WebEx. We believe the testing should take no more than 45 minutes, but we are allowing 60 minutes just in case. We will be recording the process, and you, via WebEx as we step through a detailed usability test. I will be facilitating the testing and providing instructions on each step we need you to complete. All of your feedback will be confidential and not associated with any comments you make. I will ask you to perform the tasks, giving explicit instructions. I will not be able to assist you by answering questions or directing you where to access the information. Again, the goal is to record how our users are using the PulseCheck ED application.

If you are willing to participate in this testing with us, please send me 3 timeslots that work for your availability in the 1-2 weeks.

Please let me know if you have any further questions.