



EHR Usability Test Report of PDSMDsuite Version 8.0

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

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Report Prepared By:	Professional Data Services
	Robert Pierce, MD; Krassy Lyakov; Valerie Musselwhite; Jerry Daugherty
	1 (800) 283-7543
	jdaugherty@pdsmed.com
	1632 E 23rd Ave Hutchinson, KS 67502

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EXECUTIVE SUMMARY

A usability test of **PDSMDsuite version 8.0 ambulatory EHR** was conducted on 5/19/2017-5/30/2017. Six testers performed administrative testing, 9 testers performed regular user testing, and 4 testers performed both. Seven of the regular user tests and one administrative test were conducted live in the practice office. For the remainder, testing was conducted remotely over Remote Desktop Protocol sessions by employees of PDSMDsuite. The purpose of this test was to test and validate the usability of the current user interface and provide evidence of usability in the EHR Under Test (EHRUT). During the usability test, 7 healthcare providers or other intended users matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks.

This study collected performance data on 44 tasks in the following 12 domains typically conducted on an EHR:

- § 170.315(a)(1) - CPOE Medications
- § 170.315(a)(2) - CPOE Laboratory
- § 170.315(a)(3) - CPOE Radiology
- § 170.315(a)(4) - Drug-drug, Drug-allergy Interaction Checks
- § 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) - E-Prescribing

During the 60 minute one-on-one usability test, each participant was greeted by the administrator and asked to review and sign an informed consent/release form (included in Appendix 3); they were instructed that they could withdraw at any time. Participants had prior experience with the EHR. The participants received a brief introduction and standard training on new features in MDsuite version 8.0 prior to testing. The administrator introduced the test, and instructed participants to complete a series of tasks (given one at a time) using the EHRUT. During the testing, the administrator timed the test and, along with the data logger(s) recorded user performance data on paper and electronically using the Morae software from Techsmith. The administrator did not give the participant assistance in how to complete the task. Participant screens and audio were recorded for subsequent analysis.

The following types of data were collected for each participant:

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

User metrics were compared to optimal metrics as determined by measurement of an expert user fully familiar with the EHRUT functionality.

All participant data was de-identified – no correspondence could be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants were asked to complete a post-test questionnaire and system usability score and were compensated with \$0 for their time. Various recommended metrics, in accordance with the examples set forth in the *NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records*, were used to evaluate the usability of the EHRUT. Following Table 1 is a summary of the performance and rating data collected on the EHRUT, PDSMDSuite.

Tasks

	Task Success	Mouse Movement (pixels)	Optimal Mouse Movement (pixels)	Task Time (sec)	Optimal Time (sec)	Task errors (mean)	Task Likert rating
Record a medication order	91	10330	2325	97	32	0.2	1.45
Access the medication orders	100	4115	2257	35	13	0	1
Modify a medication order	90	9414	3427	110	43	0.3	1.67
Record a lab order	90	11261	6127	72	44	0	1.1
Access the lab orders	85	1540	1213	15	6	0	1.9
Modify a lab order	90	8859	2756	66	18	0	1
Record a radiology/imaging order	100	9648	20414	67	79	0.1	1
Access the radiology/imaging orders	92	5037	1520	38	15	0.1	1.8
Modify a radiology/imaging order	90	4889	4184	37	25	0	1
Identify drug-drug interactions during the prescribing workflow	0.1	5403	1459	68	19	0	1.1
Adjust severity of drug-drug interactions	100	15420	7448	211	50	0.22	1.9
Access demographics	100	2475	1537	26	8	0	1
Record demographics - sex and DOB	100	2857	1028	40	16	0	1
Modify demographics - date of birth	100	1713	1941	18	11	0	1
Record demographics - race, ethnicity, preferred language	100	5503	2734	83	38	0	1
Modify demographics - preferred language	100	4321	1849	30	11	0	1
Record demographics - gender identity and sexual orientation	100	1518	1207	23	13	0	1
Modify demographics - gender identity and sexual orientation	100	1338	1249	30	15	0	1
Record a problem	100	6151	2456	69	35	0	1.4
Access the problem list	100	1803	0	18	3	0	1
Modify the problem list	90	8717	4242	84	49	0.2	1.5
Record a medication on the medication list	100	6171	2523	77	33	0	1
Access the medication list	100	4181	1946	29	15	0	1.1
Modify a medication on the medication list	100	16194	7535	121	51	0.1	1.4
Record an allergy	100	6462	4266	63	38	0.1	1.1
Access the allergy list	100	1976	1255	12	5	0	1

Modify an allergy on the allergy list	100	4785	1078	42	13	0	1
Identify CDS reminder and review the recommended interventions (health maintenance)	82	2782	479	29	6	0	1.6
Review the source attributes, intervention, linked referential information	80	2369	525	32	7	0.1	1.8
CDS, Vitals and Demographics - build a CDS rule using vitals and demographics	100	49632	27931	526	212	1.22	2.7
CDS, Medications and Labs - build a CDS rule using medications and labs	100	40299	24532	484	154	1.22	2.4
Activate/enable CDS	100	29569	7753	250	54	0.44	2.2
Identify CDS reminder and review the recommended intervention (medication DDI)	100	5403	1459	68	19	0.1	1.1
Record an implantable device including barcode; parse device detail	100	2772	1527	41	24	0	1.1
Access the implantable device list	100	4598	3298	46	15	0	1
Access UDI, description, identifiers, and device attributes	100	7313	11014	52	51	0	1
Modify the implantable device list	100	8069	2153	72	13	0.09	1.3
Match correct patient and import	79	5423	3583	56	26	0.1	2
Clinical information reconciliation - reconcile problems	79	7803	996	67	20	0.1	1.9
Clinical information reconciliation - reconcile medications	86	4328	2296	32	13	0	1.4
Clinical information reconciliation - reconcile allergies	79	5887	6181	54	28	0	1.5
ePrescribe a medication	90	9414	3427	110	43	0.3	1.7
Obtain a fill history request	90	12296+	5897	109	38	0	1.9
Send an e-Cancel message	92	6439	2511	70	22	0	1.3

Table 1: Summary of usability testing for PDSMDsuite.

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 80.66.

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

Major findings

MDsuite testers find the software to be straightforward and easy to navigate overall. These impressions are generally confirmed by acceptable task effectiveness and satisfaction scores on the vast majority of tasks.

Measures of task efficiency improved compared to earlier versions of PDSMDsuite version 8.0. However, efficiency, as measured by the ratio of task path deviation/target task path deviation and by the ratio of task time/target task time, was reduced for most tasks, possibly in part as a result of the use of “think aloud” technique during the testing.

This version of MDsuite includes one new feature, Implantable Devices. Of the 4 tasks associated with this new feature, three of the tasks had user ratings at or below the median for all tasks, and all four had ratings better than the mean for all tasks. The target task path deviation and time, when compared to the optimal task path deviation and time, were elevated, but not out of proportion to other tasks tested. However, an issue was identified related to display of the implantable device status, and this was corrected prior to release.

“Straightforward,” “easy to use,” “excellent program,” and “solid” were among the general comments. All of the respondents indicated that they would recommend PDSMDsuite to colleagues.

AREAS FOR IMPROVEMENT

User effectiveness in clinical information reconciliation could be improved. However, these tasks were more complex and less familiar to the testers. Clinical decision support tasks were less complex but measures of effectiveness showed room for improvement in these areas.

Efficiency overall was reduced as measured by the ratios of task path deviation/target task path deviation and task time/target task time. No particular task or area of the application stood out with regard to efficiency measures, so we conclude that overall efficiency should continue to be a focus of development.

No particular area of the application was cited as in need of improvement by a majority of users. The following specific changes were identified in EHRUT as areas for improvement:

While one tester commented that it was “fairly simple to use and set up,” others noted that the configuration was complex.

Two testers felt as if the e-prescribing functionality was either not adequately integrated or difficult to use.

One user remarked that the user interface was not “attractive” and requested drag and drop functionality.

INTRODUCTION

The EHRUT(s) tested for this study was MDsuite, version 8.0. Designed to present medical information to healthcare providers in the ambulatory setting, the EHRUT consists of a complete scheduling, billing, and clinical record system. The usability testing attempted to represent realistic exercises and conditions.

The purpose of this study was to test and validate the usability of the current user interface, and provide evidence of usability in the EHR Under Test (EHRUT). To this end, measures of effectiveness, efficiency and user satisfaction, such as task success rate, task error rate, mouse clicks, mouse movement, task time, and task rating, were captured during the usability testing.

METHOD

PARTICIPANTS

A total of 19 participants were recruited for the EHRUTs: 6 for administrative tasks, 9 for typical user tasks, and 4 on both. Participants in the test were, medical assistants (5), nurses (3), physicians (4), other administrators/support staff (6), and respiratory therapist (1). Participants were recruited by Professional Data Services and were compensated \$0 for their time. In addition, participants had no direct connection to the development of or organization producing the EHRUT(s). Participants were not from the testing or supplier organization. Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received.

For the test purposes, test participants were solicited based on typical end-user characteristics as described in the MDsuite User Context.doc. Demographics were collected at user intake and recorded and are summarized in Appendix 2. Recruited participants had a mix of backgrounds and demographic characteristics conforming to the recruitment screener. Participant names were replaced with Participant IDs so that an individual's data cannot be tied back to individual identities.

Participants were scheduled for 60 minutes. Microsoft Outlook was used to keep track of the participant schedule.

Participants' performance was compared to optimal performance for each task. Optimal performance was set based on the performance of each task by a clinician expert fully familiar with the functionality of the EHRUT.

STUDY DESIGN

Overall, the objective of this test was to uncover areas where the application performed well – that is, effectively, efficiently, and with satisfaction – and areas where the application failed to meet the needs of the participants. The data from this test may be compared to that from previous testing as similar methods and tasks were used. Further, this testing serves as a new baseline for future tests, as a means to record or benchmark current usability, and to identify areas where improvements must be made. During the usability test, participants interacted

with one EHR, PDSMDsuite. Each participant used the system their own 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:

- Effectiveness as measured by number of tasks successfully completed within the allotted time without assistance
- Number and types of errors
- Efficiency as measured by mouse movement, mouse clicks, and time to complete task
- Participant’s verbalizations (comments)
- Satisfaction as measured by participant’s satisfaction ratings of the system

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

TASKS

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

1. Medication order
 - 1.1. Record
 - 1.2. Access
 - 1.3. Change
2. Laboratory order
 - 2.1. Record
 - 2.2. Access
 - 2.3. Change
3. Radiology/imaging order
 - 3.1. Record
 - 3.2. Access
 - 3.3. Change
4. Drug-Drug Interactions
 - 4.1. Identify DDI
 - 4.2. *Adjust severity of DDI
5. Demographics
 - 5.1. Access
 - 5.2. Record – sex and DOB
 - 5.3. Change – DOB
 - 5.4. Record – race, ethnicity, language
 - 5.5. Change – race, ethnicity, language
 - 5.6. Record – gender identity and sexual orientation
 - 5.7. Change – gender identity and sexual orientation
6. Problem List
 - 6.1. Record
 - 6.2. Access
 - 6.3. Change
7. Med List
 - 7.1. Record
 - 7.2. Access
 - 7.3. Change
8. Allergies
 - 8.1. Record
 - 8.2. Access
 - 8.3. Change

9. CDS
 - 9.1. Open CDS reminder – non medication
 - 9.2. Review source attributes - intervention, bibliographic citation, intervention developer, funding source, release/revision date
 - 9.3. *Configure CDS – vitals and demographics
 - 9.4. *Configure CDS – medications and labs
 - 9.5. *Activate/enable CDS
 - 9.6. Identify CDS reminder - medication
10. Implantable devices
 - 10.1. Record
 - 10.2. Access list
 - 10.3. Access UDI, description, identifiers, attributes
 - 10.4. Change
11. Clinical Information Reconciliation
 - 11.1. Match correct patient and import
 - 11.2. Problems
 - 11.3. Meds
 - 11.4. Allergies
12. E-prescribing
 - 12.1. E-prescribe a medication
 - 12.2. Obtain a fill history request
 - 12.3. Send e-cancel message

*administrative tasks

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users. The tasks were ordered in a workflow which mirrored the tasks within a series of true clinical encounters with a patient, including visits for problems commonly encountered in primary care. The CDS administrative tasks involved building clinical decision support rules according to existing guidelines published by the [United States Preventive Services Task Force](#) and the [Food and Drug Administration](#).

PROCEDURES

Upon arrival, participants were greeted; 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 Appendix 3).

To ensure that the test ran smoothly, three staff members participated in this test, the usability administrator, the data logger, and an additional observer. The usability testing staff conducting the test was comprised of experienced usability practitioners. The administrator is a physician with 29 years of practice experience, 13 years of EHR user experience, and 6 years of EHR design experience. The data logger has 5.5 years of user centered design experience, including prior experience with summative testing.

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

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

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

For each task, the participants were given the task verbally. Task timing began once the administrator finished reading the question. The task time was stopped once the participant indicated they had successfully completed the task. Scoring is discussed below.

Following the session, the administrator gave the participant the post-test questionnaire (e.g., the System Usability Scale, see Appendix 5) and thanked each individual for their participation. Participants' demographic information, task success rate, time on task, errors, deviations, verbal responses, and post-test questionnaire were recorded into a spreadsheet.

TEST LOCATION

The test facility for the 7 live participants included an interior office which served as a quiet testing room with a table, computer for the participant. The participant, administrator and observer were in the test room. The data logger worked from a separate location where they could see the participant's screen and listen to the audio of the session. 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 testing for the remainder of the participants was conducted remotely. The participant was in their own home or office in a quiet location. The data logger and administrator worked from a separate location where they could see the participant's screen and listen to the audio of the session.

TEST ENVIRONMENT

The EHRUT would typically be used in a healthcare office or facility. In this instance, the testing was conducted remotely over a Remote Desktop Connection. For testing, the computer used was a Dell OptiPlex 3010 (8GB RAM, Intel Core i5-3450 3.2GHz, 500GB SATA HDD, NVIDIA GeForce GT620 Video Card) running 64-Bit Windows 8.1 operating system and remotely connected to the server machine that was running Windows Server 2012 R2 64 bit. The server machine specs also include: 4 virtual processor, Xeon E5-2630 2.4Ghz, 16GB RAM, 150GB Virtual Disk. The participants used a mouse and keyboard when interacting with the EHRUT.

The MDsuite EHR used a 24 inch monitor running 1920x1080 resolution with color settings at 32 bit rate. The application was set up by PDSMDsuite, according to the vendor's documentation describing the system set-up and preparation. The application itself was running on the server machine on a LAN connection and used a test database operating on SQL Server 2016 Standard. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation. Additionally, participants were instructed not to change any of the default system settings (such as control of font size).

TEST FORMS AND TOOLS

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

1. Informed Consent
2. Pretest Questionnaire

3. Moderator's Guide
3. Post-test Questionnaire

Examples of these documents can be found in Appendices 1, 3-5 respectively. The Moderator's Guide was devised so as to be able to capture required data. The participant's interaction with the EHRUT was captured and recorded digitally with screen capture software (Morae) running on the test machine. Verbal comments were recorded over the telephone. The test session were electronically transmitted to the PDSMed, Inc office where the data logger and observer monitored the test session.

PARTICIPANT INSTRUCTIONS

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

Thank you for participating in this study. Our session today will last about 60 minutes. During that time you will take a look at an electronic health record system. I will ask you to complete tasks using MDsuite and answer some questions. We are interested in how easy (or how difficult) the system is to use, what in it would be useful to you, and how we could improve it. You will be asked to complete these tasks on your own trying to do them as quickly as possible with the fewest possible errors or deviations. Do not do anything more than asked. If you get lost or have difficulty I cannot answer help you with anything to do with the system itself. Please save your detailed comments until the end of a task or the end of the session as a whole when we can discuss freely. Please be honest with your opinions.

The product you will be using today is MDsuite, version 7.0. Some of the data may not make sense as it is placeholder data. After each task, we will ask you to rate the difficulty of the task, on a scale from 1 (very easy) to 5 (very difficult). We will also ask you for your comments. We are recording the audio and screenshots of our session today. Please verbalize your thoughts and speak up so that our recording will capture your voice. All of the information that you provide will be kept confidential and your name will not be associated with your comments at any time.

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. 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 as their first task, were given time to review the system and make comments. Once this task was complete, the administrator gave the following instructions:

For each task, I will read the description to you and say "Begin." At that point, please perform the task and say "Done" once you believe you have successfully completed the task.

User participants were then given 30 tasks in 7 domains to complete. Eight elements were tested twice in order that they could be tested across encounters. Tasks are listed in the Moderator's Guide in

Appendix 4.

Administrators were given 5 tasks to complete. Tasks are listed in the Admin Moderator's Guide in Appendix 4.

USABILITY METRICS

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

The goals of the test were to assess:

1. Effectiveness of MDsuite by measuring participant success rates and errors.
2. Efficiency of MDsuite by measuring the average task time, mouse movement, and mouse clicks.
3. Satisfaction with MDsuite by measuring ease of use ratings.

DATA SCORING

The following table details how tasks were scored, errors evaluated, and the time data analyzed.	
<p>Effectiveness: Task Success</p>	<p>A task was counted as a “Success” if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis.</p> <p>The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage under Task Success – Mean (%). The standard deviation for task success is reported as Task Success – Std Dev (%).</p> <p>Task time, mouse click, and mouse movement metrics were calculated for successes.</p>
<p>Effectiveness: Task Failures</p>	<p>If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as a Failure.</p> <p>No task time or mouse movement metrics were calculated for failures.</p> <p>The total number of errors was calculated for each task, divided by the total number of times that task was attempted, and reported as Task Errors Mean (%). Variance was reported as Task Errors – Std Dev (%). Not all deviations would be counted as errors.</p> <p>On a qualitative level, an enumeration of errors and error types were collected.</p>
<p>Efficiency: Task Deviations</p>	<p>The participant’s path through the application was recorded as task time and mouse pixels moved. 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. Multiple paths exist for many workflows in MDsuite. Therefore, task deviations are measured by mouse movement metrics in the Morae software.</p> <p>Only tasks that were successfully completed were included in the mouse movement analysis. Average mouse movement and mouse clicks were calculated for each task and reported under Task Path Deviation – Observed. These were compared to the expert’s performance which was reported under Task Path Deviation – Optimal #.</p> <p>Observed task deviations divided by the target task deviation for each task is a measure of optimal efficiency. Optimal task deviation, as benchmarked by expert performance under realistic</p>

	<p>conditions, was established as part of this EHRUT. Target task deviations were calculated by taking measures of optimal performance and multiplying by some factor [e.g., 1.25] that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was [x] pixels then target task deviation was [x * 1.25] seconds. This ratio was aggregated across tasks and reported with mean and variance scores. Optimal performance were also compared to results from usability testing of earlier versions of MDsuite.</p>
<p>Efficiency: Task Time</p>	<p>Each task was timed from when the administrator said “Begin” until the participant said, “Done.” If he or she failed to say “Done,” the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average task time and task time variance were reported as Task Time – Mean (sec), Task Time Deviation – Mean Observed Seconds and Task Time – Standard Deviation (sec). These were compared to the expert’s performance which was reported under Task Time Deviation – Mean Optimal Seconds. Observed task times divided by the target task time for each task is a measure of optimal efficiency. Optimal task performance time, as benchmarked by expert performance under realistic conditions, was established as part of this EHRUT. Target task times were calculated by taking measures of optimal performance and multiplying by some factor [e.g., 1.25] that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was [x] seconds then target task time performance was [x * 1.25] seconds. This ratio was aggregated across tasks and reported with mean and variance scores. Optimal performance times were also compared to results from usability testing of earlier versions of MDsuite.</p>
<p>Satisfaction: Task Rating</p>	<p>Participant’s subjective impression of the ease of use of the application was measured by administering both a simple post-task Likert 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 Easy) to 5 (Very Difficult). These data are averaged across participants. Common convention is that average ratings for systems judged easy to use should be 2.7 or above. Ratings were reported as Task Rating with variance reported as Task Rating – Standard Deviation.</p> <p>To measure participants’ confidence in and likeability of the MDsuite 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</p>

	Usability Score questionnaire in Appendix 5. The SUS was scored by normalizing each value from 0 to 4 with 4 being the most positive response, then multiplying the converted responses by 2.5 for a possible range of 0 to 100.
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Table 2: Data scoring.

RESULTS

DATA ANALYSIS AND REPORTING

End User Testing

The results of the usability test were calculated according to the methods specified in the Usability Metrics and Data Scoring sections above. Task failures were excluded from the Efficiency metrics. All of the testers returned post-tests.

One task served to represent criteria 170.315(a)(4): Drug-drug interaction checks and 170.315(a)(9): Clinical decision support for medications.

The complete usability test results for the EHRUT, PDSMDsuite, are reported below in Table 3.

Task ID	Task Description	Task Success - Mean (%)	Task Success - Std Dev (%)	Task Path Deviation - Observed #	Task Path Deviation - Optimal #	Task Time - Mean (sec)	Task Time - Std Dev (sec)	Task Time Deviation - Mean Observed (sec)	Task Time Deviation - Mean Optimal (sec)	Task Errors Mean (%)	Task Errors - Std Dev (%)	Task Rating	Task Rating - Std Dev
A1.1	Record a medication order	91	0	10330	2325	97	37	97	32	0.2	0.4	1.45	0.93
A1.2	Access the medication orders	100	0	4115	2257	35	13	35	13	0	0	1	0
A1.3	Modify a medication order	90	0	9414	3427	110	29	110	43	0.3	0.5	1.67	0.97
A2.1	Record a lab order	90	0	11261	6127	72	54	72	44	0	0	1.1	0.3
A2.2	Access the lab orders	85	0	1540	1213	15	8	15	6	0	0	1.9	1.8
A2.3	Modify a lab order	90	0	8859	2756	66	46	66	18	0	0	1	0
A3.1	Record a radiology/imaging order	100	0	9648	20414	67	19	67	79	0.1	0.32	1	0
A3.2	Access the radiology/imaging orders	92	0	5037	1520	38	44	38	15	0.1	0.29	1.8	1.8
A3.3	Modify a radiology/imaging order	90	0	4889	4184	37	27	37	25	0	0	1	0
A4.1	Identify drug-drug interactions during the prescribing workflow	100	0	5403	1459	68	30	68	19	0	0	1.1	0.3
A4.2	Adjust severity of drug-drug interactions	100	0	15420	7448	211	60	211	50	0.22	0.44	1.9	0.8
A5.1	Access demographics	100	0	2475	1537	26	18	26	8	0	0	1	0
A5.2	Record demographics - sex and DOB	100	0	2857	1028	40	21	40	16	0	0	1	0
A5.3	Modify demographics - date of birth	100	0	1713	1941	18	11	18	11	0	0	1	0
A5.4	Record demographics - race, ethnicity, preferred language	100	0	5503	2734	83	44	83	38	0	0	1	0
A5.5	Modify demographics - preferred language	100	0	4321	1849	30	13	30	11	0	0	1	0
A5.6	Record demographics - gender identity and sexual orientation	100	0	1518	1207	23	9	23	13	0	0	1	0
A5.7	Modify demographics - gender identity and sexual orientation	100	0	1338	1249	30	16	30	15	0	0	1	0
A6.1	Record a problem	100	0	6151	2456	69	36	69	35	0	0	1.4	1.26
A6.2	Access the problem list	100	0	1803	0	18	6	18	3	0	0	1	0
A6.3	Modify the problem list	90	0	8717	4242	84	51	84	49	0.2	0.6	1.5	1.27
A7.1	Record a medication on the medication list	100	0	6171	2523	77	32	77	33	0	0	1	0
A7.2	Access the medication list	100	0	4181	1946	29	10	29	15	0	0	1.1	0.32
A7.3	Modify a medication on the medication list	100	0	16194	7535	121	110	121	51	0.1	0.3	1.4	1.26
A8.1	Record an allergy	100	0	6462	4266	63	29	63	38	0.1	0.3	1.1	0.32
A8.2	Access the allergy list	100	0	1976	1255	12	6	12	5	0	0	1	0
A8.3	Modify an allergy on the allergy list	100	0	4785	1078	42	21	42	13	0	0	1	0
A9.1	Identify CDS reminder and review the recommended	82	0	2782	479	29	16	29	6	0	0	1.6	1.2

	interventions (health maintenance)												
A9.2	Review the source attributes, intervention, linked referential information	80	0	2369	525	32	24	32	7	0.1	0.32	1.8	1.4
A9.3	CDS, Vitals and Demographics - build a CDS rule using vitals and demographics	100	0	49632	27931	526	112	526	212	1.22	0.83	2.7	0.7
A9.4	CDS, Medications and Labs - build a CDS rule using medications and labs	100	0	40299	24532	484	161	484	154	1.22	0.67	2.4	1
A9.5	Activate/enable CDS	100	0	29569	7753	250	140	250	54	0.44	0.53	2.2	1.5
A9.6	Identify CDS reminder and review the recommended intervention (medication DDI)	100	0	5403	1459	68	30	68	19	0.1	0.32	1.1	0.3
A14.1	Record an implantable device including barcode; parse device detail	100	0	2772	1527	41	22	41	24	0	0	1.1	0.3
A14.2	Access the implantable device list	100	0	4598	3298	46	8	46	15	0	0	1	0
A14.3	Access UDI, description, identifiers, and device attributes	100	0	7313	11014	52	29	52	51	0	0	1	0
A14.4	Modify the implantable device list	100	0	8069	2153	72	43	72	13	0.09	0.3	1.3	1.2
B2.1	Match correct patient and import	79	0	5423	3583	56	70	56	26	0.1	0.3	2	1.55
B2.2	Clinical information reconciliation - reconcile problems	79	0	7803	996	67	55	67	20	0.1	0.3	1.9	1.38
B2.3	Clinical information reconciliation - reconcile medications	86	0	4328	2296	32	17	32	13	0	0	1.4	1.6
B2.4	Clinical information reconciliation - reconcile allergies	79	0	5887	6181	54	51	54	28	0	0	1.5	1.17
B3.1	ePrescribe a medication	90	0	9414	3427	110	29	110	43	0.3	0.48	1.7	1
B3.2	Obtain a fill history request	90	0	12296	5897	109	99	109	38	0	0	1.9	0.6
B3.3	Send an e-Cancel message	92	0	6439	2511	70	51	70	22	0	0	1.3	1

Table 3: Usability testing results for PDSMDsuite.

Efficiency metrics with comparison to optimal metrics are shown below in Table 4.

Task Identifier	Task Description	Task Path Deviation - Observed #	Task Path Deviation - Optimal #	Task Path Deviation/Target Task Path Deviation	Task Time Deviation - Mean Observed Seconds	Task Time Deviation - Mean Optimal Seconds	Task Time/Target Task Time
A1.1	Record a medication order	10330	2325	3.55	97	32	2.43
A1.2	Access the medication orders	4115	2257	1.46	35	13	2.15
A1.3	Modify a medication order	9414	3427	2.20	110	43	2.05
A2.1	Record a lab order	11261	6127	1.47	72	44	1.31
A2.2	Access the lab orders	1540	1213	1.02	15	6	2.00
A2.3	Modify a lab order	8859	2756	2.57	66	18	2.93
A3.1	Record a radiology/imaging order	9648	20414	0.38	67	79	0.68
A3.2	Access the radiology/imaging orders	5037	1520	2.65	38	15	2.03
A3.3	Modify a radiology/imaging order	4889	4184	0.93	37	25	1.18
A4.1	Identify drug-drug interactions during the prescribing workflow	5403	1459	2.96	68	19	2.86
A4.2	Adjust severity of drug-drug interactions	15420	7448	1.66	211	50	3.38
A5.1	Access demographics	2475	1537	1.29	26	8	2.60
A5.2	Record demographics - sex and DOB	2857	1028	2.22	40	16	2.00
A5.3	Modify demographics - date of birth	1713	1941	0.71	18	11	1.31
A5.4	Record demographics - race, ethnicity, preferred language	5503	2734	1.61	83	38	1.75
A5.5	Modify demographics - preferred language	4321	1849	1.87	30	11	2.18
A5.6	Record demographics - gender identity and sexual orientation	1518	1207	1.01	23	13	1.42
A5.7	Modify demographics - gender identity and sexual orientation	1338	1249	0.86	30	15	1.60
A6.1	Record a problem	6151	2456	2.00	69	35	1.58
A6.2	Access the problem list	1803	0	#DIV/0!	18	3	4.80
A6.3	Modify the problem list	8717	4242	1.64	84	49	1.37
A7.1	Record a medication on the medication list	6171	2523	1.96	77	33	1.87
A7.2	Access the medication list	4181	1946	1.72	29	15	1.55
A7.3	Modify a medication on the medication list	16194	7535	1.72	121	51	1.90
A8.1	Record an allergy	6462	4266	1.21	63	38	1.33
A8.2	Access the allergy list	1976	1255	1.26	12	5	1.92
A8.3	Modify an allergy on the allergy list	4785	1078	3.55	42	13	2.58
A9.1	Identify CDS reminder and review the recommended interventions (health maintenance)	2782	479	4.65	29	6	3.87
A9.2	Review the source attributes, intervention, linked referential information	2369	525	3.61	32	7	3.66

A9.3	CDS, Vitals and Demographics - build a CDS rule using vitals and demographics	49632	27931	1.42	526	212	1.98
A9.4	CDS, Medications and Labs - build a CDS rule using medications and labs	40299	24532	1.31	484	154	2.51
A9.5	Activate/enable CDS	29569	7753	3.05	250	54	3.70
A9.6	Identify CDS reminder and review the recommended intervention (medication DDI)	5403	1459	2.96	68	19	2.86
A14.1	Record an implantable device including barcode; parse device detail	2772	1527	1.45	41	24	1.37
A14.2	Access the implantable device list	4598	3298	1.12	46	15	2.45
A14.3	Access UDI, description, identifiers, and device attributes	7313	11014	0.53	52	51	0.82
A14.4	Modify the implantable device list	8069	2153	3.00	72	13	4.43
B2.1	Match correct patient and import	5423	3583	1.21	56	26	1.72
B2.2	Clinical information reconciliation - reconcile problems	7803	996	6.27	67	20	2.68
B2.3	Clinical information reconciliation - reconcile medications	4328	2296	1.51	32	13	1.97
B2.4	Clinical information reconciliation - reconcile allergies	5887	6181	0.76	54	28	1.54
B3.1	ePrescribe a medication	9414	3427	2.20	110	43	2.05
B3.2	Obtain a fill history request	12296	5897	1.67	109	38	2.29
B3.3	Send an e-Cancel message	6439	2511	2.05	70	22	2.55
	Mean			1.96			2.21
	Standard Deviation			1.15			0.90

Table 4: Efficiency metrics and comparison to optimal performance and target performance.

A comparison between the usability testing results for this version of PDSMDsuite, version 8.0, and prior versions, either 7.0 and/or 7.1, can be made for the following tasks:

- Medication order
 - Record
 - Access
 - Change
- Laboratory order
 - Record

- Access
 - Change
- Radiology/imaging order
 - Record
 - Access
 - Change
- Med List
 - Record
 - Access
 - Change
- Allergies
 - Record
 - Access
 - Change
- CDS
 - Open CDS reminder – non medication
 - Review source attributes - intervention, bibliographic citation, intervention developer, funding source, release/revision date
- E-prescribing
 - E-prescribe a medication

The results of these comparisons are shown in Table 5 below.

	V8.0 Task success	V8.0 Mouse movement (pixels)	V7.0 Mouse movement (pixels)	V7.0 – V8.0 Pixels difference	V7.1 Mouse movement	7.1 – V8.0 Pixels difference	V8.0 Task time (sec)	V7.0 Task time (sec)	V7.0 – V8.0 Time difference	V7.1 Task time	V7.1 – V8.0 Time difference	V8.0 Task errors (mean)	V8.0 Task Likert rating	V7.0 Task Likert rating	V7.0 – V8.0 Likert rating difference	V7.1 Task Likert rating	V7.1 – V8.0 Liker rating difference
Record a medication order	91	10330	10362	32	8262	-2068	97	79	-18	117	20	0.2	1.45	1.92	0.47	2.42	0.97
Access the medication orders	100	4115	2179	-1936	3039	-1076	35	13	-22	36	1	0	1	1	0	1	0
Modify a medication order	90	9414	10741	1327	9623	209	110	78	-32	143	33	0.3	1.67	1.83	0.16	3	1.33
Record a lab order	90	11261	12451	1190	19909	8648	72	57	-15	149	77	0	1.1	2.5	1.4	2.17	1.07
Access the lab orders	85	1540	8482	6942	3488	1948	15	33	18	27	12	0	1.9	1.67	-0.23	1.92	0.02
Modify a lab order	90	8859	6696	-2163	6800	-2059	66	32	-34	66	0	0	1	1.58	0.58	2.36	1.36
Record a radiology/imaging order	100	9648	14401	4753	8703	-945	67	77	10	103	36	0.1	1	2.17	1.17	1.21	0.21
Access the radiology/imaging orders	92	5037	10675	5638	9120	4083	38	57	19	122	84	0.1	1.8	4.5	2.7	1.76	-0.04
Modify a radiology/imaging order	90	4889	11068	6179	8933	4044	37	58	21	87	50	0	1	3.17	2.17	1.78	0.78
Record a medication on the medication list	100	6171	8452	2281	8794	2623	77	45	-32	113	36	0	1	2.67	1.67	2.5	1.5
Access the medication list	100	4181	3172	-1009	1170	-3011	29	20	-9	14	-15	0	1.1	1.08	-0.02	1	-0.1
Modify a medication on the medication list	100	16194	9101	-7093	12247	-3947	121	45	-76	117	-4	0.1	1.4	1.83	0.43	2.09	0.69
Record an allergy	100	6462	7998	1536	2895	-3567	63	82	19	45	-18	0.1	1.1	1.67	0.57	1.5	0.4
Access the allergy list	100	1976	1923	-53	785	-1191	12	14	2	8	-4	0	1	1.08	0.08	1	0
Modify an allergy on the allergy list	100	4785	3805	-980	10528	5743	42	27	-15	125	83	0	1	1.33	0.33	3	2
Identify CDS reminder and review the	82	2782	2903	121			29	29	0			0	1.6	1.83	0.23		

recommended interventions (health maintenance)																	
Review the source attributes, intervention, linked referential information	80	2369	1842	-527			32	15	-17			0.1	1.8	1.75	-0.05		
Clinical information reconciliation - reconcile problems	79	7803	19630	11827			67	131	64			0.1	1.9	2.67	0.77		
Clinical information reconciliation - reconcile medications	86	4328	8540	4212			32	87	55			0	1.4	1.83	0.43		
Clinical information reconciliation - reconcile allergies	79	5887	4379	-1508			54	22	-32			0	1.5	1.33	-0.17		
ePrescribe a medication	90	9414	10743	1329	8262	-1152	110	72	-38	117	7	0.3	1.7	1.75	0.05	2.42	0.72

Table 5: Comparison with prior versions of PDSMDsuite. “Difference” equals the earlier version testing result minus the PDSMDsuite version 8.0 result; a negative Difference favors the earlier version, and a positive difference favors PDSMDsuite version 8.0.

Task Failures per participant

The table below shows the task failures per participant.

Tester	A	B	C	D	E	F	H	I	J	K	L	M	N	O	P	Q	R	U	V
Regular tester		x	x	x	x	x	x	x	x	x			x				x	x	x
Admin tester	x	x			x					x	x	x	x	x	x	x			
Tasks (#)	4	43	39	39	43	39	39	39	39	43	4	4	43	4	4	4	39	39	39
Errors	6	6	3	1	1	2	0	2	1	5	4	3	4	1	0	2	0	0	0
Error Rate	1.50	0.14	0.08	0.03	0.02	0.05	0.00	0.05	0.03	0.12	1.00	0.75	0.09	0.25	0.00	0.50	0.00	0.00	0.00

SUS

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be 80.66. This is improved from version 7.0 where the System Usability Scale score was 74.58. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average. Details of SUS results are found in Appendix 6.

Errors and Error Types

User Tasks

The tables below show data on characterization of errors.

Error Severity	#
Mild	26
Moderate	2
Severe	13

Error Type	#
Slip	23
UI issue	5
Workflow	8
System	5

Task	Type	Severity	Description
Task 7: Open Encounter and add Diagnosis	mild	slip, recovered	User selected/interacted with wrong screen
Task 9 (A7.3): Modify Medication List	severe	workflow	User not familiar with task
Task 12 (A1.1): Record Medication Order	moderate	slip, recovered	User selected/interacted with wrong screen
Task 13 (A1.3, B3.1): Change Medication Order/eRx	mild	system	System performance related error
Task 13 (A1.3, B3.1): Change Medication Order/eRx	moderate	system	User not familiar with task
Task 15 (A1.1, B3.1): Record Medication Order/eRx	severe	workflow	User not familiar with task
Task 20 (A9.2): Review Source Attributes - intervention/linked referential CDS	severe	UI problem	User did not find the correct information
Task 24 (A8.1): Record Allergy	mild	system	System performance related error

Task 32 (A6.3): Change Problem List	severe	UI problem	System performance related error
Task 32 (A6.3): Change Problem List	mild	slip, recovered	User made delayed or incorrect selection
Task 34 (A3.2): Access Radiology/Imaging Orders	severe	UI problem	User selected/interacted with wrong screen
Task 35 (A3.3): Modify Radiology/Imaging	severe	UI problem	User selected/interacted with wrong screen
Task 35 (A3.3): Modify Radiology/Imaging	severe	workflow	User not familiar with task
Task 35 (A3.3): Modify Radiology/Imaging	mild	UI problem	User made delayed or incorrect selection
Task 35 (A3.3): Modify Radiology/Imaging	severe	workflow	User not familiar with task
Task 37 (B2.1): Match correct patient	severe	workflow	User not familiar with task
Task 39 (B2.2): Clinical information reconciliation - Medications	severe	system	System performance related error
Task 42 (A14.4): Change status of implanted device	mild	system	System performance related error, resolved
ADMIN Task 2: Adjust Severity of DD interaction checking	mild	slip, recovered	Intended action already completed
ADMIN Task 2: Adjust Severity of DD interaction checking	mild	slip, recovered	Moderator related error
ADMIN Task 3: Activate/Enable CDS - Vital/Demographics	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 3: Activate/Enable CDS - Vital/Demographics	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 3: Activate/Enable CDS - Vital/Demographics	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 3: Activate/Enable CDS - Vital/Demographics	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 3: Activate/Enable CDS - Vital/Demographics	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 3: Activate/Enable CDS - Vital/Demographics	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 3: Activate/Enable CDS - Vital/Demographics	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 3: Activate/Enable CDS - Vital/Demographics	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 3: Activate/Enable CDS - Vital/Demographics	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 3: Activate/Enable CDS - Vital/Demographics	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 3: Activate/Enable CDS - Vital/Demographics	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 3: Activate/Enable CDS - Vital/Demographics	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 4: Activate/Enable CDS - Medications/Labs	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 4: Activate/Enable CDS - Medications/Labs	severe	workflow	User made delayed or incorrect selection
ADMIN Task 4: Activate/Enable CDS - Medications/Labs	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 4: Activate/Enable CDS - Medications/Labs	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 4: Activate/Enable CDS - Medications/Labs	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 4: Activate/Enable CDS - Medications/Labs	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 4: Activate/Enable CDS - Medications/Labs	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 4: Activate/Enable CDS - Medications/Labs	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 4: Activate/Enable CDS - Medications/Labs	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 4: Activate/Enable CDS - Medications/Labs	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 5: Configure CDS	mild	slip, recovered	User made delayed or incorrect selection
ADMIN Task 5: Configure CDS	severe	workflow	User made delayed or incorrect selection
ADMIN Task 5: Configure CDS	severe	workflow	User made delayed or incorrect selection

DISCUSSION OF THE FINDINGS

EFFECTIVENESS

Task success was high overall, with rates at or above 90% for most common regular user tasks. Not surprisingly, more complex tasks had lower success rates. Those involving clinical information reconciliation (CIR) and clinical decision support (CDS), had a lower success rates of 79-86%. The four CIR tasks are more complex. CDS tasks had success rates of 80-82% and while they are relatively simple, they are less commonly performed among this representative set of testers. Of the simple common regular user tasks, accessing the lab orders had the lowest success rate at 85%, and points to the need to make Orders accessible from not only the Chart, but the Encounter as well.

The implantable device feature was new in PDSMDsuite version 8.0. Success rates were excellent at 100% for the four tasks associated with this new feature. However, an issue was identified related to display of the implantable device status, and this was corrected prior to release.

The other new feature was sending of an e-cancel message for prescriptions. The success rate for this task was acceptable at 92%.

EFFICIENCY

Task efficiency in this EHRUT is likely contaminated by the users' verbalizations of their thoughts ("think aloud" technique) as they navigated through the application. This fact will continue to be considered in the design and interpretation of future tests.

For six tasks, the task path deviation, as assessed by comparison to the optimal path, was low, a favorable finding, with a task path deviation/target task path deviation ratio of less than one. For the majority of tasks however, task path deviation exceeded the desired targets. Thirty seven tasks exceeded the allotted target task path deviation with a task path deviation/target task path deviation ratio of greater than one. Twenty-five tasks exceeded the target task path deviation by 50% or more.

Task time, as assessed by comparison to the optimal task time, was favorably low for two tasks, with a task time/target task time ratio of less than one. For the vast majority of tasks however, this ratio was greater than one. For thirty-six tasks the task time was 50% higher than target task time. Three of the four highest task times, as compared to target task time, were related to clinical decision support.

It is likely that both task path deviation and task time, as compared to optimal path and optimal task time, respectively, are to some extent artificially inflated as a result of the use of the "think aloud" technique during testing.

For eighteen tasks, we were able to compare PDSMDsuite version 8.0 to prior versions of the EHRUT. Compared to version 7.0, task path deviations in version 8.0 were better with a mean improvement for each of the 21 comparison tasks of 1528 pixels. Task times were similar with a difference of only -6.29 seconds per task. Sixteen tasks were compared to version 7.1; task path deviations improved by 517 pixels and task time was improved by 24.9 seconds per task.

SATISFACTION

All tasks yielded acceptable task ratings of 2.7 and better. The two tasks with the lowest user ratings of 2.4 and 2.7 were also the most complex, configuration of CDS rules. All but four of the tasks had satisfaction ratings under two.

The overall SUS score was acceptable at 80.66.

MAJOR FINDINGS

MDsuite testers find the software to be straightforward and easy to navigate overall. These impressions are generally confirmed by acceptable task effectiveness and satisfaction scores on the vast majority of tasks.

Measures of task efficiency improved compared to earlier versions of PDSMDsuite version 8.0. However, efficiency, as measured by the ratio of task path deviation/target task path deviation and by the ratio of task time/target task time, was reduced for most tasks, possibly in part as a result of the use of "think aloud" technique during the testing.

This version of MDsuite includes one new features, Implantable Devices. Of the 4 tasks associated with this new feature, three of the tasks had user ratings at or below the median for all tasks, and all four had ratings better than the mean for all tasks. The target task path deviation and time, when compared to the optimal task path deviation and time, were elevated, but not out of proportion to other tasks tested.

“Straightforward,” “easy to use,” “excellent program,” and “solid” were among the general comments. All of the respondents indicated that they would recommend PDSMDsuite to colleagues.

AREAS FOR IMPROVEMENT

User effectiveness in clinical information reconciliation could be improved. However, these tasks were more complex and less familiar to the testers. Clinical decision support tasks were less complex but measures of effectiveness showed room for improvement in these areas.

Efficiency overall was reduced as measured by the ratios of task path deviation/target task path deviation and task time/target task time. No particular task or area of the application stood out with regard to efficiency measures, so we conclude that overall efficiency should continue to be a focus of development.

No particular area of the application was cited as in need of improvement by a majority of users. The following specific changes were identified in EHRUT as areas for improvement:

While one tester commented that it was “fairly simple to use and set up,” others noted that the configuration was complex.

Two testers felt as if the e-prescribing functionality was either not adequately integrated or difficult to use.

One user remarked that the user interface was not “attractive” and requested drag and drop functionality.

Appendix 1: Pretest Questionnaire

MDsuite Usability Testing Pre-test Questionnaire

1. Are you male or female? (circle one)
2. Do you, or does anyone in your home, work in marketing research, usability research, web design? (circle one)
Yes No
3. Do you, or does anyone in your home, have a commercial or research interest in an electronic health record software or consulting company? (circle one)
Yes No
4. Which of the following best describes your age? (circle one)
23 to 39 40 to 59 60 - to 74 75 and older
5. Which of the following best describes your race? (circle one, optional)
White Black or African-American Asian
American Indian or Alaskan Native Hawaiian Island or other Pacific Islander
6. Which of the following best describes your ethnic group? (circle one, optional)
Hispanic Non-hispanic
7. Do you require any assistive technologies to use a computer? (circle one)
Yes No
If so, please describe:

Professional Demographics

8. What is your current position and title? (circle one and note specialty if applicable)
RN: Specialty _____
Physician: Specialty _____
Resident: Specialty _____
Administrative Staff
Other

9. How long have you held this position?

10. Which of the following describes your highest level of education? (circle one)

high school graduate/GED

some college

college graduate

postgraduate (MD/PhD)

other (explain)

Computer Expertise

12. Besides reading email, what professional activities do you do on the computer? (e.g., access EHR, research; reading news; shopping/banking; digital pictures; programming/word processing, etc.)

About how many hours per week do you spend on the computer?

13. What computer platform do you usually use? (e.g., Mac, Windows, etc.)

14. What Internet browser(s) do you usually use? (e.g., Firefox, Internet Explorer, Chrome, Safari)

15. In the last month, how often have you used an electronic health record?

16. How many years have you used an electronic health record?

17. How many EHRs do you use or are you familiar with?

18. How does your work environment patient records? (circle one)

On paper

Some paper, some electronic

All electronic

Contact information:

Name:

Address:

City, State, Zip:

Daytime phone number:

Evening phone number:

Alternate [cell] phone number:

Email address:

Before your session starts, we will ask you to sign a release form allowing us to videotape your session. The videotape will only be used internally for further study if needed. Will you consent to be videotaped?

Appendix 2: Participant Demographics

The report should contain a breakdown of the key participant demographics. A representative list is shown below.

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

Gender	Female	79%
	Male	21%
Age	20-29	16%
	30-39	5%
	40-49	21%
	50-59	47%
	60-69	11%
Education	No high school degree	0%
	High school graduate or GED	5%
	Some college credit, no degree	16%
	Trade, technical, vocational training	21%
	Associate's degree	16%
	Bachelor's degree	16%
	Master's degree	5%
Doctorate degree	21%	

	Mean (months)	Range (months)
Professional Experience	270	48-480
Computer Experience	251	108-480
Product Experience	48	9-108

As an appendix to the report, the full participant breakdown (de-identified) is included below.

Identifier	Gender	Age	Participant Education	Participant Occupation/Role	Participant Professional Experience	Participant Computer Experience	Participant Product Experience	Assistive Technology Needs
Tester M	Male	50-59	Bachelor's Degree	VAR	300	480	9	No
Tester K	Female	50-59	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Pediatrician	300	120	48	No
Tester A	Male	40-49	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Family physician	180	360	36	No
Tester L	Female	50-59	Some college credit, no degree	Office manager	444	360	15	No
Tester B	Female	60-69	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Dermatologist	420	360	60	No
Tester P	Male	50-59	Master's Degree	VAR	240	420	108	No
Tester H	Female	20-29	Associate degree	Respiratory therapist	96	132	48	No
Tester C	Female	20-29	Associate degree	Registered medical asst	84	144	60	No
Tester D	Female	40-49	Some college credit, no degree	Medical asst	252	240	48	No
Tester E	Female	50-59	Bachelor's Degree	RN, Office manager	360	324	60	No
Tester F	Female	50-59	Trade/technical/vocational training	Medical asst	408	108	48	No
Tester I	Female	30-39	Associate degree	Registered medical asst	48	120	48	No
Tester J	Female	50-59	Some college credit, no degree	Medical asst	288	240	60	No
Tester N	Male	40-49	Bachelor's Degree	VAR	276	276	10	No
Tester O	Female	60-69	High school graduate, diploma or the equivalent (for example: GED)	Office manager	480	300	24	No
Tester Q	Female	20-29	Trade/technical/vocational training	Front office referral coordinator	108	180	108	No
Tester R	Female	50-59	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Family physician	336	180	30	No
Tester U	Female	40-49	Trade/technical/vocational training	LPN, Nurse coordinator	276	240	36	No
Tester V	Female	50-59	Trade/technical/vocational training	LPN	240	182	48	No

Appendix 3: Informed Consent Form



PDS MDSUITE
Consent Form.docx

Appendix 4: Moderator's Guides



Moderator's
Guide_8.0.docx



Moderator's
Guide_Admin_8.0.docx

Appendix 5: Posttest and System Usability Questionnaire

MDsuite Usability Testing Post-test

Final Questions

What was your overall impression of this system?

What aspects of the system did you like most?

What aspects of the system did you like least?

Were there any features that you were surprised to see?

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

Compare this system to other systems you have used.

Would you recommend this system to your colleagues?

System Usability Score

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

Appendix 6: SUS Results, Detailed

Tester	A	B	C	D	E	F	H	I	J	K	L	M	N	O	P	Q	R	U	V
Regular UT		x	x	x	x	x	x	x	x	x			x				x	x	x
Admin UT	x	x			x					x	x	x	x	x	x	x			
I would like to use PDS MDSUITE Frequently?	5	5	5	5	4	5	5	5	4	4	5	5	5	3	3	4	5	3	5
I found PDS MDSUITE unnecessarily complex	1	1	2	1	2	1	1	1	2	3	1	2	1	2	1	2	1	3	1
I thought PDS MDSUITE was easy to use	5	5	5	5	4	5	5	5	4	3	4	2	5	3	4	4	5	3	5
I think I would need the support of a technical person to be able to use PDS MDSUITE	3	1	1	1	2	1	1	2	1	2	1	2	1	2	1	2	4	2	3
I found the various functions in PDS MDSUITE were well integrated	5	5	4	5	5	5	5	5	4	3	5	3	5	3	3	3	4	3	5
I thought there was too much inconsistency in PDS MDSUITE	1	1	1	1	1	1	1	1	1	3	1	5	1	2	2	1	1	3	1
I would imagine most individuals would learn to use PDS MDSUITE very quickly	4	5	5	4	4	5	4	5	4	2	5	1	4	3	3	5	4	2	5
I found PDS MDSUITE very cumbersome to use	1	1	1	1	1	1	1	1	2	3	2	3	1	3	2	1	1	4	1
I felt very confident using PDS MDSUITE	4	5	5	5	5	2	4	4	3	4	3	4	5	3	4	3	5	4	5
I needed to learn a lot of things before I could get going with PDS MDSUITE	2	1	1	1	1	3	1	2	1	5	3	3	3	3	1	4	2	2	3
Tester Total	35	40	38	39	35	35	38	37	32	20	34	20	37	23	30	29	34	21	36
Tester SUS Score	87.5	100	95	97.5	87.5	87.5	95	92.5	80	50	85	50	92.5	57.5	75	72.5	85	52.5	90
Total SUS Score																			80.66
SUS Score Standard Deviation																			16.54