

# EHR Usability Test Report of the ACPlus™ MDS V1

Report based on the NISTIR 7741 NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records, November 2010, and reported in NISTIR 7742 Customized Common Industry Format Template for Electronic Health Record Usability Testing , November 2010.

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## EXECUTIVE SUMMARY

A usability test of ACPlus™ MDS V1 application [EHR Under Test (**EHRUT**)] the was conducted on October 10, 2019 in Reno, NV by Accelerated Care Plus. The purpose of this test was to test and validate the usability of the current user interface, and provide evidence of usability in the EHRUT.

During the usability test, 10 healthcare providers [and/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 3 tasks typically conducted on an EHR:

- Record the creation of a new patient and document all demographic fields.
- Change all demographic fields in an existing patient record
- Access and view the demographics of an existing patient record

During the 30 minute one-on-one usability test, each participant was greeted by the administrator and asked to review and sign an informed consent/release form, and they were instructed that they could withdraw at any time. Participants had no prior experience with the EHR. 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. The administrator did not give the participant assistance in how to complete the task.

Participant screens, head shots 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
- Participant's verbalizations
- Participant's satisfaction ratings of the system

All participant data was de-identified – no correspondence could be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants were asked to complete a post-test questionnaire and were compensated with \$25 Starbucks gift card 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 is a summary of the performance and rating data collected on the EHRUT.

Measure	Participants	Task Success	Path Deviation	Task Time (seconds)		Errors	Task Rating (5=Easy)
				Mean (SD)	Deviations (Observed / Optimal)		
Record Demographics	10	90% (30%)	12 / 10	300 (139)	139 / 61	17% (1%)	4.6
Change Demographics	10	100% (0%)	11 / 10	37 (7)	7 / 5	2% (0%)	4.6
Access Demographics	10	100% (0%)	3 / 3	14 (3)	3 / 3	0% (0%)	4.6

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be 92.

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

- Major findings
  - Application performed as expected and users able to record demographics in a reasonable time with little frustration.
- Areas for improvement
  - Consider ways to reduce number of selection options in demographic fields.

## METHOD

The EHRUT tested for this study was ACPlus™ MDS V1. This was designed to present medical information to healthcare providers in long term care facilities and for physical therapist and occupational therapist. 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 EHRUT. To this end, measures of effectiveness, efficiency and user satisfaction, such as task path deviations and task errors were captured during the usability testing.

The usability metrics and testing approach were based on the *NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records* [NISTIR 7741] document. Also, this usability summary report was based on the *Customized Common Industry Format Template for Electronic Health Record Usability Testing* [NISTIR 7742] document. The appendices of NISTIR 7742 was also the source of various other testing material such as informed consent and release form for participants.

## STUDY DESIGN

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

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

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

Additional information about the various measures can be found in [Usability Metrics section](#).

## 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:

1. Record the creation of a new patient into the application to include the following demographic categories: Name, Date of Birth, Race, Ethnicity, Birth Sex, Sexual Orientation, Gender Identity, and Preferred Language. Save and Add patient.
2. Change/modify the patients information to include the following demographic categories: Name, Date of Birth, Race, Ethnicity, Birth Sex, Sexual Orientation, Gender Identity, and Preferred Language. Begin by selecting the "View Profile" button, then the "edit" icon. Once finished updating, tap the "Update" button.
3. Display the patient's changed demographic information by selecting the "View Profile" button. Once you are in the Patient Overview module, tap the "Personal Information" drop down button to display the demographic changes. Then close and exit patient file.

Tasks were selected based on the requirements of the ONC criteria for Demographics (315.a.5).

In discussion with users, patient and safety risk associated with errors for demographics were considered minimal with the demographic data element with high risk consideration is date of birth due to its factor in various clinical considerations.

## 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 NISTIR 7742 Appendix 3). A representative from the test team witnessed the participant's signature.

To ensure that the test ran smoothly, two staff members participated in this test, the usability administrator and the data logger. The usability testing staff conducting the test were ACP personnel.

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

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

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

For each task, the participants were given a written copy of the task. Task timing began once the administrator finished reading the question. The task time was stopped once the participant indicated they had successfully completed the task. Scoring is discussed below in [Results section](#).

Following the session, the administrator gave the participant the post-test questionnaire (e.g., the System Usability Scale, see NISTIR 7742 Appendix 5), compensated them for their time, 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.

Participants were thanked for their time and compensated. Participants signed a receipt and acknowledgement form (NISTIR 7742 Appendix 6) indicating that they had received the compensation.

## **TEST LOCATION**

The test facility included a waiting area and a quiet testing room with a table, computer for the participant, and recording computer for the administrator. Only the participant and administrator were in the test room.

To ensure that the environment was comfortable for users, noise levels were kept to a minimum with the ambient temperature within a normal range. All of the safety instruction and evacuation procedures were valid, in place, and visible to the participants.

## **TEST ENVIRONMENT**

The EHRUT testing was conducted in ACP's office. For testing, the computer used an iPad running current version of iOS. The participants used their hand when interacting with the EHRUT.

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

## **TEST FORMS AND TOOLS**

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

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

Examples of these documents can be found in appendices 3-6 respectively of NISTIR 7742. The Moderator's Guide was devised so as to be able to capture required data of this study.

The participant's interaction with the EHRUT was captured and recorded digitally with screen capture software running on the test machine. A WebEx camera recorded each participant's facial expressions synced with the screen capture, and verbal comments were recorded with a microphone.<sup>8</sup> The test session were electronically transmitted to a nearby observation room where the data logger observed the test session.

## **PARTICIPANT INSTRUCTIONS**

The administrator reads the following instructions aloud to each participant (also see the full moderator's guide in NISTIR 7742 Appendix 4):

*Thank you for participating in this study. Your input is very important. Our session today will last about 20 minutes During that time you will use an instance of an electronic health record.*

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

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

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

Participants were then given 3 tasks to complete as noted in the [Tasks section](#).

## **USABILITY METRICS**

Following NISTIR 7741 the goal of usability design 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 EHRUT by measuring participant success rates and errors
2. Efficiency of EHRUT by measuring the average task time and path deviations
3. Satisfaction with EHRUT by measuring ease of use ratings

## DATA SCORING

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

Measures	Rationale and Scoring
<p>Effectiveness:</p> <p>Task Success</p>	<p>A task was counted as a “Success” if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis.</p> <p>The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage.</p> <p>Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency.</p> <p>Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target task times used for task times in the Moderator’s Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by some factor (e.g., 1.25) performance on a task was 300 seconds then allotted task time performance was 375 seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.</p>
<p>Effectiveness:</p> <p>Task Failures</p>	<p>If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as an “Failures.” No task times were taken for errors.</p> <p>The total number of errors was calculated for each task and then divided by the total number of times that task was attempted. Not all deviations would be counted as errors. This should also be expressed as the mean number of failed tasks per participant.</p> <p>On a qualitative level, an enumeration of errors and error types should be collected.</p>

<p>Efficiency:</p> <p>Task Deviations</p>	<p>The participant’s path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.</p> <p>It is strongly recommended that task deviations be reported. Optimal paths (i.e., procedural steps) should be recorded when constructing tasks.</p>
<p>Efficiency:</p> <p>Task Time</p>	<p>Each task was timed from when the administrator said “Begin” until the participant said, “Done.” If he or she failed to say “Done,” the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation and standard error) were also calculated.</p>
<p>Satisfaction:</p> <p>Task Rating</p>	<p>Participant’s subjective impression of the ease of use of the application was measured by administering both a simple post-task question as well as a post-session questionnaire. After each task, the participant was asked to rate “Overall, this task was:” on a scale of 1 (Very Difficult) to 5 (Very Easy). These data are averaged across participants.</p> <p>Common convention is that average ratings for systems judged easy to use should be 3.3 or above.</p> <p>To measure participants’ confidence in and likeability of the EHRUT overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, “I think I would like to use this system frequently,” “I thought the system was easy to use,” and “I would imagine that most people would learn to use this system very quickly.” See full System Usability Score questionnaire in NISTIR 7742 Appendix 5.</p>

# RESULTS

## PARTICIPANTS

A total of 10 participants were tested on the EHRUT. Participants in the test were those in the long term care background. Participants were recruited by ACP and were compensated with a \$25 Starbucks gift card. for their time. In addition, participants had no direct connection to the development of or organization producing the EHRUT. 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, end-user characteristics were identified and translated into a recruitment screener used to solicit potential participants. An example of a screener is provided in NISTIR 7742 Appendix 1.

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

ID	Gender	Age	Education	Occupation / role	Professional Experience (Months)	Computer Experience (Months)	Product Experience (Months)	Assistive Technology Needs
ID01	Female	20-29	Master's Degree	OTR/L	60	60	0	No
ID02	Female	30-39	Master's Degree	PT	192	144	0	No
ID03	Female	40-49	Bachelor's Degree	OTR/L, DOR	228	180	0	No
ID04	Female	30-39	Bachelor's Degree	COTA/L	24	156	0	No
ID05	Female	60-69	Bachelor's Degree	RN	456	24	0	No
ID06	Female	30-39	Master's Degree	SLP	40	60	0	No
ID07	Female	50-59	Associate degree	PTA	408	180	0	No
ID08	Female	30-39	Trade/technical/vocational	LPN	156	120	0	No
ID09	Female	50-59	Bachelor's Degree	RN, DON	132	120	0	No

ID10	Male	40-49	Bachelor's Degree	RN	264	180	0	No
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10 participants (matching the demographics in the section on [Participants](#)) were recruited and 10 participated in the usability test. 0 participants failed to show for the study.

Participants were scheduled for 20-minute sessions with 10 minutes in between each session for debrief by the administrator(s) and data logger(s), and to reset systems to proper test conditions. A spreadsheet was used to keep track of the participant schedule and included each participant's demographic characteristics as reported by the participant.

**DATA ANALYSIS AND REPORTING**

The results of the usability test were calculated according to the methods specified in the [Usability Metrics](#) section above. Participants who failed to follow session and task instructions had their data excluded from the analyses.

The usability testing results for the EHRUT are detailed below. The results should be seen in light of the objectives and goals outlined in [Study Design](#). The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be: 92. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.

Measure	Participants	Task Success	Path Deviation	Task Time (seconds)		Errors	Task Rating (5=Easy)
				Mean (SD)	Deviations (Observed / Optimal)		
	#	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Mean (SD)
Record Demographics	10	90% (30%)	12 / 10	300 (139)	139 / 61	17% (1%)	4.6
Change Demographics	10	100% (0%)	11 / 10	37 (7)	7 / 5	2% (0%)	4.6
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## **DISCUSSION OF THE FINDINGS**

### **EFFECTIVENESS**

There were only a couple of errors made in the participant testing, and they were able to quickly reassess and ultimately complete the task.

### **EFFICIENCY**

There were only a few deviations from optimal pathways for the recording of demographics requirements. Demographics is a relatively straightforward functionality.

### **SATISFACTION**

Participants rated the application very easy to use, with little complexity, and reported high satisfaction in using it.

### **MAJOR FINDINGS**

The results of the usability testing indicated the system was well designed, and user found it easy and intuitive to use.

### **AREAS FOR IMPROVEMENT**

Participants noted there were numerous selection choices for areas of demographics and asked if there were ways to reduce number of selection options in demographic fields. Some of these choices are required for certification compliance and cannot be changed, but this will be further evaluated after more users experience the system.