

Part 1: UCD Process Applied

NIST 7741 UCD processes was used during the creation of the software for the applicable criteria.

Name: (NISTIR 7741) NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records

Description: NIST guide to the processes approach for improving the usability of electronic health records. One of the main purposes of this guide is to provide practical guidance on methods relating to UCD and usability testing. The intended audiences of this document are those with a role in determining the features and functions contained in the EHR and how those are represented in the user interface.

Citation: InSchumacher, Schumacher, Lowry, & Information Technology Laboratory (National Institute of Standards and Technology), 2010, p. xx

References:

Schumacher, R. M., Schumacher, R. M., Lowry, S. Z., & Information Technology Laboratory (National Institute of Standards and Technology). (2010). NIST guide to the processes approach for improving the usability of electronic health records.

EHR Usability Test Report of eMedicalPractice 2.0

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

eMedicalPractice 2.0

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1 Executive summary

A usability test of eMedicalPractice 2.0, and ambulatory EHR was conducted on 02/12/14 in Delray Beach, FL by Normsoftware QA team. 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 eMedicalPractice. During the usability test, 10 healthcare professionals matching the target demographic criteria served as participants and used the EMEDICALPRACTICE in simulated, but representative tasks.

This study collected performance data on 12 measures typically conducted on an EHR:

- o § 170.315 (a)(1) Computerized provider order entry – medications
- o § 170.315 (a)(2) Computerized provider order entry – laboratory
- o § 170.315 (a)(3) Computerized provider order entry – diagnostic imaging
- o § 170.315 (a)(4) Drug-drug, drug-allergy interaction checks
- o § 170.315 (a)(5) Demographics
- o § 170.315 (a)(6) Problem list
- o § 170.315 (a)(7) Medication list
- o § 170.315 (a)(8) Medication allergy list
- o § 170.315 (a)(9) Clinical decision support
- o § 170.315 (a)(14) Implantable device list
- o § 170.315 (b)(2) Clinical information reconciliation and incorporation
- o § 170.315 (b)(3) Electronic prescribing

During the 60 minutes one-on-one usability test, each participant was greeted by the administrator and asked to review and sign an informed consent/release form, they were instructed that they could withdraw at any time. Participants have prior experience with the EHR

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: 16
- Time to complete the tasks: 35
- Number and types of errors: 0, None
- Path deviations: None
- Participant's verbalizations: Few suggestions
- Participant's satisfaction ratings of the system: 5

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 \$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 EMEDICALPRACTICE. Following is a summary of the performance and rating data collected on the EMEDICALPRACTICE.

2 Introduction

The EMEDICALPRACTICE tested for this study was eMedicalPractice 2.0 and Ambulatory. Designed to present medical information to healthcare providers in outpatient clinics, the EMEDICALPRACTICE consists of Ambulatory EHR 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 (EMEDICALPRACTICE). To this end, measures of effectiveness, efficiency and user satisfaction, such as ease of use and time taken, were captured during the usability testing.

3 Method

This section outlines all methods.

3.1 PARTICIPANTS

A total of 10 participants were tested on the EMEDICALPRACTICE. Participants in the test were a Medical Biller and EHR customer support engineer. Participants were recruited by NormSoftware LLC and were not compensated for their time. 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 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.

Part ID	Gender	Age	Education	Occupation/Role	Professional Experience	Computer Experience	Product Experience	Assistive Technology Needs
1	F	30-39	Some College, no degree	Medical Assistant	96 months	96 months	36 months	N
2	M	60-69	Some College, no degree	Admin Staff	36 months	36 months	36 months	N

3	F	50-59	Associate Degree	Admin Staff	120 months	120 months	8-9 months	N
4	F	20-29	HighSchool graduate with MA Diploma	Medical Assistant	60 months	60 months	36 months	N
5	F	20-29	HighSchool graduate with MA Diploma	AdminStaff	48 months	48 months	53 months	N
6	F	30-39	M.D Doctorate degree	Physician	120 months	120 months	60 months	N
7	F	30-39	Associate Degree	AdminStaff	48 months	48 months	24 months	N
8	F	20-29	HighSchool graduate with MA Diploma	AdminStaff	48 months	48 months	36 months	N
9	F	30-39	HighSchool graduate with MA Diploma	Medical Assistant	72 months	72 months	72 months	N
10	F	40-49	M.D Doctorate degree	Physician	120 months	120 months	120 months	N

10 participants (matching the demographics in the section on Participants) were recruited and 10 participated in the usability test. None of the participants failed to show for the study. Participants were scheduled for 60 minutes sessions with 9:00Am-2:00Pm 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 provided by the recruiting firm. This section outlines all methods.

3.2 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 EHR. 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 Section 3.9 on Usability Metrics.

3.3 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:

Task-1: Demographics

Task-2: Computerized provider order entry – medications

Task-3: Computerized provider order entry – laboratory

Task-4: Computerized provider order entry – diagnostic imaging

Task-5: Problem list

Task-6: Medication list

Task-7: Medication allergy list

Task-8: Implantable device list

Task-9: Clinical decision support

Task-10: Clinical information reconciliation and incorporation

Task-11: Electronic prescribing

Task-12: Drug-drug, drug-allergy interaction checks

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

3.4 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.

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 was experienced usability practitioners with each participant reviewed and signed an informed consent and release form (See Appendix 3). A representative from the test team witnessed the participant's signature.

- 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 Section 3.9.

Following the session, the administrator gave the participant the post-test questionnaire (e.g., the System Usability Scale, see Appendix 5), 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.

3.5 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. All observers and the data logger worked from a separate room where they could see the participant's screen and face shot, 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. All of the safety instruction and evacuation procedures were valid, in place, and visible to the participants.

3.6 TEST ENVIRONMENT

The EMEDICALPRACTICE would be typically be used in a healthcare office or facility. In this instance, the testing was conducted in office location. For testing, the computer used desktop running windows 7.0. The participants used a mouse and keyboard when interacting with the EMEDICALPRACTICE.

The EMEDICALPRACTICE used the monitor screen with resolution of 1366 X 768, with screen display size 21 inches and 32 bit color settings. The application was set up by the test laboratory according to the vendor's documentation describing the system set-up and preparation. The application itself was running on a WINDOWS using a test database on a LAN connection. Technically, the system performance 3-6 seconds 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).

3.7 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

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

3.8 PARTICIPANT INSTRUCTIONS

The administrator reads the following instructions aloud to the each:

Thank you for participating in this study. Your input is very important. Our session today will last about 60 minutes. During that time you will use an instance of an electronic health record. I will ask you to complete a few tasks using this system and answer some questions. You should complete the tasks as quickly as possible making as few errors as possible. Please try to complete the tasks on your own following the instructions very closely. Please note that we are not testing you we are testing the system, therefore if you have difficulty all this means is that something needs to be improved in the system. I will be here in case you need specific help, but I am not able to instruct you or provide help in how to use the application.

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

Following the procedural instructions, participants were shown the EHR and as their first task, were given time 60 minutes to explore the system and make comments. Once this task was complete, the administrator gave the following instructions:

For each task, I will read the description to you and say "Begin." At that point, please perform the task and say "Done" once you believe you have successfully completed the task. I would like to request that you not talk aloud or verbalize while you are doing the tasks. Participants were then given 9 tasks to complete. Tasks are listed in the moderator's guide in Appendix [B4]. I will ask you your impressions about the task once you are done.

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

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

3.9 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 eMedicalPractice 2.0 by measuring participant success rates and errors
2. Efficiency of eMedicalPractice 2.0 by measuring the average task time and path deviations
3. Satisfaction with eMedicalPractice 2.0 by measuring ease of use ratings

Thank you for participating in this study. Your input is very important. Our session today will last about 60 minutes. During that time you will use an instance of 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.

4. RESULTS

The following table (Table 2) details how tasks were scored, errors evaluated, and the time data analyzed.

Measures	Rationale and Scoring
<p>Effectiveness: Task Success</p>	<p>A task was counted as a “Success” if the participant was able to achieve the correct outcome, without assistance, within the time allotted on a per task basis.</p> <p>The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage.</p> <p>Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency.</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] 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 allotted task time performance was [x * 1.25] seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.</p>
<p>Effectiveness: Task Failures</p>	<p>If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as an “Failures.” No task times were taken for errors.</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.¹¹</p> <p>On a qualitative level, an enumeration of errors and error types should be collected.</p>
<p>Efficiency: Task Deviations</p>	<p>The participant’s path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.</p> <p>It is strongly recommended that task deviations be reported. Optimal paths (i.e., procedural steps) should be recorded when constructing tasks.</p>
<p>Efficiency: Task Time</p>	<p>Each task was timed from when the administrator said “Begin” until the participant said, “Done.” If he or she failed to say “Done,” the time was stopped when the participant stopped performing the task. Only task times</p>

	<p>for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation and standard error) were also calculated.</p>
<p>Satisfaction: Task Rating</p>	<p>Participant’s subjective impression of the ease of use of the application was measured by administering both a simple post-task question as well as a post-session questionnaire. After each task, the participant was asked to rate “Overall, this task was:” on a scale of 1 (Very Difficult) to 5 (Very Easy). These data are averaged across participants. ¹² Common convention is that average ratings for systems judged easy to use should be 3.3 or above. To measure participants’ confidence in and likeability of the [EMEDICALPRACTICE] overall, the testing team administered the Likert Scale post-test questionnaire. Questions included, “I think I would like to use this system frequently,” “I thought the system was easy to use,” and “I would imagine that most people would learn to use this system very quickly.” See full System Usability Score questionnaire in Appendix 5.¹³</p>

Table 2- details how tasks were scored, errors evaluated, and the time data analyzed.

4.1 DATA ANALYSIS AND REPORTING

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. Participants who failed to follow session and task instructions had their data excluded from the analyses. The usability testing results for the EMEDICALPRACTICE are detailed below (see Table 3). The results should be seen in light of the objectives and goals outlined in Section 3.2 Study Design. The data should yield actionable results that, if corrected, yield material, positive impact on user performance.

S.No	Task Name	Task Success		Path Deviation		Task Time				Task Errors SD %	Task Errors Mean %	likert scale	
		Mean %	SD%	Observed No. of steps	Optimal No. of steps	Mean (seconds)	SD (seconds)	Optimal (seconds)	Mean Time Deviation (seconds)			Mean Task Ratings 1=Easy	Task Ratings SD %
1	(a)(5) Demographics	100	0.00	5.1	5	80	13.91	80	70.6	0	0	1.2	33.33
2	(a)(1) Computerized provider order entry – medications	90	0.00	5.1	5	90	21.9	90	83.3	0	0	1.7	58.82
3	(a)(2) Computerized provider order entry – laboratory	80	0.01	6.1	6	70	21.46	70	62.2	0	0	1.8	64.44
4	(a)(3) Computerized provider order entry – diagnostic imaging	80	0.50	6	6	85	23.72	85	56.2	0	0	1.7	82.94
5	(a)(4) Drug-drug, drug-allergy interaction checks	100	0.00	5	5	75	30.87	75	62.8	0	0	1.5	61.33
6	(a)(6) Problem list	100	0.00	6	6	90	15.69	90	59.1	0	0	1.4	65.00
7	(a)(7) Medication list	90	0.33	5	5	60	18.85	60	49.5	0	0	1.7	61.18
8	(a)(8) Medication allergy list	80	1.00	5	5	60	37.42	60	60.14	0	0	2.7	55.56
9	(a)(9) Clinical decision support	90	0.33	6	6	90	25.14	90	62.8	0	0	1.6	75.00
10	(a)(14) Implantable device list	90	0.33	6	6	90	27.88	90	88.3	3	10	2.2	50.00
11	(b)(2) Clinical information reconciliation and incorporation	100	0.00	5	5	70	15.83	70	53.1	0	0	1.4	85.71
12	(b)(3) Electronic prescribing	100	0.00	6	6	75	19.7	75	55.7	0	0	1.7	52.94

Table- 3

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

4.2 DISCUSSION OF THE FINDINGS

EFFECTIVENESS:

After the completing the tasks, in our conversation this version is more robust and ease of use. System demonstrates great use of navigation with all options/tabs in plain sight. Allows user to switch between tasks and asks to be "SAVED" where needed.

EFFICIENCY:

With few easy click, end user is able to make a note. Allows the user to accomplish tasks with ease. Allows even the most novice of users to use without complications and/or assistance.

SATISFACTION:

With the given statistics by the users, they have expressed more satisfaction. Provides most mandatory fields to be filed for New Patients and Follow-up visits.

MAJOR FINDINGS:

Major finding is more usage of SNOMED codes, system is driven by SNOMED codes. Allow for data to be entered resulting in a more thorough visit/follow-up check-up.

AREAS FOR IMPROVEMENT:

Most of the items user friendly, always there is a room for improvement. Showing the shot cuts for anything that they need when they are doing the patient notes. Lab Result and lab ordering can use more specifics and Social History can include uses of caffeine and other substances that can alter a patient's norm state being.

5. APPENDICES

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

- 1: Recruiting screener
- 2: Participant demographics
- 3: Non-Disclosure Agreement (NDA) and Informed Consent Form
- 4: Moderator's Guide
- 5: System Usability Scale Questionnaire
- 6: Incentive receipt and acknowledgment form