EHR Usability Test Report of Radekal EHR V5.2

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

Radekal EHR V 5.2

Date of Usability Test: **December 2 2015**
Date of Report: **December 15 2015**
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1. EXECUTIVE SUMMARY

A usability test of Radekal EHR ver 5.2 was conducted on December 2, 2015 in Ridgecrest California by Dr. Russ Rudin. 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 UnderTest (EHRUT). During the usability test, 8 clinical healthcare providers matching the target demographic criteria

served as participants and used the EHRUT in simulated, but representative tasks. This study collected performance data on clinical tasks typically conducted on an EHR:

□ Electronically order a Lab and Radiology Order

□ Trigger a Drug-Drug, Drug Allergy interaction

□ Add a Medication to a patient's chart

□ Add a Medication Allergy to a patient's chart

□ Trigger a Clinical Decision support in a patients chart

□ Send an Electronic Prescription to a pharmacy

□ Reconcile an incoming Medication, Allergy, and Problem list to a patients chart

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 (included in Appendix 3); they were instructed that they could withdraw at any time. Participants did not have 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. The administrator did not give the participant assistance in how to complete the task.

The following types of data were collected for each participant:

▪ Number of tasks successfully completed
▪ Time to complete the tasks
▪ Number and types of errors
▪ Path deviations
▪ 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. 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.

Docpad Users:

Task	N	Success	Path Deviation	Time Task	Time Task	Errors	Rating 5=Easy
	#	Mean (SD)	Deviations (observed / optimal)	Mean (SD)	Deviations (observed / optimal)	Mean (SD)	Mean (SD)
Create a Lab order	8	100%	1.21	16.25 (1.91)	1.16	0	5
Create a Radiology Order	8	100%	1.32	19.1 (2.36)	1.27	0	5
Trigger a Drug-Drug, Drug Allergy interaction	8	100%	1.20	13.5 (0.756)	0.964	0.167 (0.462)	4.38 (0.353)
Sent a prescription electronically	8	100%	1.11	11.0 (1.93)	1.10	0	5
Add a medication to patient's chart	8	100%	1.20	7.88 (1.34)	1.16	0	5
Add an medication allergy to a patient's chart	8	100%	1.19	8.36 (0.916)	1.04	0	5
Create drug-drug and drug-allergy interventions	8	100%	1.11	14.8 (1.91)	1.05	0	5
Trigger a CDS rule	8	100%	1.21	6.25 (1.39)	1.04	0	5
Reconcile patient's active medication list with another source	7	87.5% (0.353)	1.43	47.6 (5.40)	1.27	0.333 (0.516)	3.12 (0.517)
Reconcile patient's active problem list with another source	7	87.5% (0.353)	1.39	40.0 (3.78)	1.21	0.167 (0.462)	4.38 (0.353)
Reconcile patients active medication allergy with another source	8	100%	1.40	41.4 (4.17)	1.18	0	5

Administrators / Records Manager Users:

Task	N	Success	Path Deviation	Errors	Time Task	Time Task	Rating 5=Easy
	#	Mean (SD)	Deviations (observed / optimal)	Mean (SD)	Mean (SD)	Deviations (observed / optimal)	Mean (SD)
Adjust severity level of drug-drug intervention	2	100%	1.0	0	10.5 (0.707)	1.20	5

Configuration of CDS rules.	2	100%	1.0	0	53.0 (4.25)	1.37	5

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 89.

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

Major Findings

The major finding was validation of efficiency and usability of Radekal's graphic-oriented touch/click interface. Tasks were completed quickly and with minimal errors. The workflow was very well received and intuitive.

Areas for Improvement

Reports on the admin module were too difficult to locate. Also, the CDS multi-step process is too tedious and needs to be streamlined.

2. INTRODUCTION

The EHRUT(s) tested for this study was Radekal EHR version 5.2. Designed to present medical information to healthcare providers in an ambulatory setting. The EHRUT consists of modules like Docpad, Administrator, and Records Manager. The usability testing attempted to represent realistic exercises and conditions.

Docpad is the primary focus of the Radekal software system since the physician documents the patient's encounter. Other modules interact and complement the Docpad module.

Administrator module in Radekal forms the basis of setting up the practice, setting up its various master data and creation of various users and configurations that would enhance in customizing the working of the application.

The Records Manager module allows the user to associate a variety of documents to a patient's file. This is used to pass a CDA file to a patients chart so it can be used to reconcile information.

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 time to complete a task, were captured during the usability testing.

3. METHOD

3.1 PARTICIPANTS

A total of 10 participants were tested **(8 physicians & 2 admin)** on the EHRUT(s). Participants in the test were **familiar with ambulatory settings**. Participants were recruited by Russ Rudin. 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.

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.

Participant ID	Gender	Age	Education	Occupation/Role	Professional Experience	Computer Experience	Product Experience	Assistive Technology Needs
P1	M	72	MD	CARDIO	34 yrs	HIGH	LOW	NONE
P2	M	64	MD	SURGEON	28 yrs	LOW	LOW	NONE
P3	M	63	MD	FAMILY	25 yrs	MED	LOW	NONE
P4	M	57	MD	FAMILY	19 yrs	HIGH	LOW	NONE
P5	F	43	MD	PODIATRY	10 yrs	LOW	LOW	NONE
P6	M	56	MD	PAIN MGT	17 yrs	MED	LOW	NONE
P7	M	48	MD	HOSPITALIST	14 yrs	MED	LOW	NONE
P8	F	45	MD	CHIROPRA	18 yrs	HIGH	LOW	NONE
A1	F	36	BA	ADMIN	5 yrs	HIGH	LOW	NONE
A2	F	29	BS	ADMIN	2 yrs	HIGH	LOW	NONE

Participants were scheduled for 30 minute sessions with 30 minutes in between each session for debriefing by the administrator(s) and data logger(s). A spreadsheet was used to keep track of the participant's schedule, and included each participant's demographic characteristics. **All participants matched the criteria of familiarity with ambulatory settings and no direct connection to the development or the organization producing the EHRUT.**

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 one EHR. Participant used the system in two manners. One was on location at the Ridgecrest office with the same instructions and the other was online in a web meeting so we can see the interaction. 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 satisfaction ratings of the system

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:

Users were given a user name and password so they can get started in Radekal's home page.

1. Add a Lab order and a Radiology Order in a patients chart.

2. Review the pending orders and a patient's chart

3. Add two medications that trigger a warning

4. Review the medication list on a patient's chart

5. Add a Medication Allergy to a patient's chart

6. Trigger a Clinical Decision support in a patients chart

7. Send an Electronic Prescription to a pharmacy

8. Reconcile an incoming Medication, Allergy, and Problem list to a patients chart

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.

Each participant reviewed and signed an informed consent and release form. 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 was experienced usability practitioners with 32 years' experience, PhD in Product Development, and professor of Engineering Management at Santa Clara University. 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. 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. **Selection of user path for tasks was prioritized in accordance with identifying the risk associated with any possible user errors.**

3.5 TEST LOCATION

The test was conducted at the Ridgecrest office. A conference room was converted to a test room. All other users has a waiting area outside the conference room. The room was set up with a wireless tablet on the table.

3.6 TEST ENVIRONMENT

The EHRUT testing was conducted using a wireless tablet running Windows operating system. The tablet had the EHR open in a Firefox browser running on full screen.

The participants used a combination of a stylus and fingers when interacting with the EHRUT. The application was set up by Fanestra personnel. Radekal was running on the training version 5.2 with a test database. Technically the systems performance was representative to what actual users would experience in a field of implementation. User were instructed to leave defaults settings as they were

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

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 running on the test machine.

3.8 PARTICIPANT INSTRUCTIONS

The administrator reads the following instructions aloud to the each participant:

Thank you for participating in this study. Your input is very important. Our session today will last about 30 min. 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 15 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. I will ask you your impressions about the task once you are done.

Participants were then given 11 tasks to complete. Tasks are listed in the moderator's guide.

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 Radekal by measuring participant success rates and errors

2. Efficiency of Radekal by measuring the average task time and path deviations

3. Satisfaction with Radekal 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
Effectiveness: Task Success	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. 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. Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency. 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 1.25 min that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was 1.15 minutes then allotted task time performance was x * 1.25 minutes. This ratio should be aggregated across tasks and reported with mean and variance scores.

Effectiveness: Task Failures	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. 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. On a qualitative level, an enumeration of errors and error types should be collected.
Efficiency: Task Deviations	The participant's path 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.
Efficiency: Task Time	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.
Satisfaction: Task Rating	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. 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 Radekal 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." |

4. RESULTS

4.1 DATA ANALYSIS AND REPORTING

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. 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 (table R1) **Effectiveness and efficiency were evaluated and provided results match metrics indicated.**

The results should be seen in light of the objectives and goals outlined in Study Design. The data should yield actionable results that, if corrected, yield material, positive impact on user performance.

Table R1: Results

Task	N	Task success	Path Deviation	Task Time		Error	Task Ratings 5=Easy
	#	Mean (SD)	Deviations (Observed/ optimal)	Mean (SD)	Deviations (Observed/Opt imal)	Mean (SD)	Mean (SD)
Computerized provider order entry	8	100%	1.20	13.2 (2.14)	1.40	0.180 (.268)	4.25 (0.565)
Drug-drug, drug-allergy interaction checks	8	100%	1.15	8.04 (1.92)	1.28	0.125 (0.132)	4.67 (0.436)
Medication list	8	100%	1.28	9.68 (1.70)	1.19	0.180 (0..268)	4.25 (0.565)
Medication allergy list	8	100%	1.35	12.7 (2.22)	1.25	0.189 (0.154)	4.13 (0.674)
Electronic prescribing	8	100%	1.45	12.25 (1.48)	1.37	0.284 (0.311)	3.95 (0.871)
Clinical	8	87.5%	1.80	46.7	1.65	0.367	3.62

information reconciliation		(0.353)		(5.61)			(0.462)	(0.998)
Clinical Decision Support	8	87.5% (0.353)	1.67	53.5 (6.97)	1.59		0.90 (0.218)	4.11 (0.783)

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. **User tasks employed in the study are prioritized in accordance with the risk associated with user.**

4.2 DISCUSSION OF THE FINDINGS

In light of the comments by the participants, we realized a new User Interface is recommended for Medication and allergy list.

4.3 EFFECTIVENESS
An extremely high level of effectiveness was achieved because a high percentage of subjects were able to complete all tasks in the test.

4.4 EFFICIENCY
Task completion times were relatively close to optimal with a highly satisfactory level of path deviations.

4.5 SATISFACTION
Subjects were very enthusiastic about Radekal's graphical user interface and intuitive workflow.

4.6 MAJOR FINDINGS
Radekal is a highly effective and efficient EHR system that has the potential to speed up consults and provide a high level of satisfaction for users.

4.7 AREAS FOR IMPROVEMENT
Reports on the admin module were too difficult to locate. Also, the CDS multi-step process is too tedious and needs to be streamlined.

5. APPENDICES

5.1 Appendix 1: **Non-Disclosure Agreement**

THIS AGREEMENT is entered into as of _____ 2015, between ("the Participant") and the testing organization Test Company located at Address.

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

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

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

Participant's printed name:_____

Signature:_____ Date:_____

5.2 Apendix 2. **PARTICIPANT DEMOGRAPHICS**

GENDER	
Men	
Women	
Total	

Occupation/Role	
RN/BSN	
Physician	
Admin Staff	
Total	

Years of Experience	
Years experience	
Facility use of EHR	
Some paper, some electronic	
All electronic	
Total	

5.3 Appendix 3: RECRUITING SCREENER

Hello, my name is _____, calling from [Insert name of recruiting firm]. We are recruiting individuals to participate in a usability study for an electronic health record. We would like to ask you a few questions to see if you qualify and if would like to participate. This should only take a few minutes of your time. This is strictly for research purposes. If you are interested and qualify for the study, you will be paid to participate. Can I ask you a few questions?

1. Are you male or female? [Recruit a mix of participants]
2. Have you participated in a focus group or usability test in the past xx months? [If yes, Terminate]
3. Do you, or does anyone in your home, work in marketing research, usability research, web design [...etc.]? [If yes, Terminate]
4. Do you, or does anyone in your home, have a commercial or research interest in an electronic health record software or consulting company? [If yes, Terminate]
5. Which of the following best describes your age? [23 to 39; 40 to 59; 60 - to 74; 75 and older] [Recruit Mix]
6. Which of the following best describes your race or ethnic group? [e.g., Caucasian, Asian, Black/African-American, Latino/a or Hispanic, etc.]
7. Do you require any assistive technologies to use a computer? [if so, please describe]
8. Professional Demographics: What is your current position and title? (Must be healthcare provider)
   a. RN: Specialty
   b. Physician: Specialty
   c. Resident: Specialty
   d. Administrative Staff
9. How long have you held this position?
10. Besides reading email, what professional activities do you do on the computer?
11. What computer platform do you usually use? [e.g., Mac, Windows, etc.]
12. What Internet browser(s) do you usually use? [e.g., Firefox, IE, AOL, etc.]

Contact Information:

Those are all the questions I have for you. Your background matches the people we're looking for. Would you be able to participate on December 2, 1025 at 10:00 am?

May I get your contact information?

- Name of participant:
- 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? This study will take place at Ridgecrest Office. I will confirm your appointment a couple of days before your session and provide you with directions to our office. What time is the best time to reach you?

5.4 Appendix 4: Tasks

Task 1: Prescribe Medication:

Take the participant to the starting point for the task. Ensure that this patient has a drug-drug and a drug-food allergy to the drug chosen. This will put force the participant to find other drugs and use other elements of the application.

After examining Patient, you have decided to put this patient on a statin – drug name. Check for any interactions and place an order for this medication.

Success:

☐ Easily completed
☐ Completed with difficulty or help :: Describe below
☐ Not completed
Comments:

Task Time: _____Seconds

Optimal Path:

☐ Correct
☐ Minor Deviations / Cycles :: Describe below
☐ Major Deviations :: Describe below
Comments:

Observed Errors and Verbalizations:

Comments:

Rating:

Overall, this task was:_____

Show participant written scale: "Very Difficult" (1) to "Very Easy" (5)

Administrator / Notetaker Comments:

5.5 Appendix 5: System Usability Scale Questionnaire

Strongly Disagree   Strongly Agree

1	I think that I would like to use this system frequently					
		1	2	3	4	5

2	I found the system unnecessarily complex					
		1	2	3	4	5

3	I thought the system was easy to use					
		1	2	3	4	5

4	I think that I would need the support of a technical person to be able to use this system					
		1	2	3	4	5

5	I found the various functions in this system were well integrated					
		1	2	3	4	5

6	I thought there was too much inconsistency in this system					
		1	2	3	4	5

7	I would imagine that most people would learn to use this system very quickly					
		1	2	3	4	5

8	I found the system very cumbersome to use					
		1	2	3	4	5

9	I felt very confident using the system					
		1	2	3	4	5

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

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Excellence in EHR Software

Radekal EHR V5.2

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For public release:
Fanestra Information Systems used the following usability design industry standard in developing and designing their HIT system, Radekal EHR V5.2: ISO/IEC 25062:2006 Common Industry format for Usability Test Reports.

http://www.iso.org/iso/catalogue_detail.htm?csnumber=43046

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1-8-16