

# EHR Usability Test Report for MDRhythm Version 8

Dates of Usability Test: Oct 1, 2018 to Oct 19, 2018

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Standards used: Testing and Report based on ISO/IEC 25062:2006 Common Industry Standard Format for Usability Test Reports

## EXECUTIVE SUMMARY

Usability test of MDRhythm Version 8 EHR was conducted by ten MDRhythm users in various capacities and based on the ISO/IEC 25062:2006 Common Industry Standard Format for Usability Test Results as outlined in the NISTIR publication 7742, version 0.2. The test was conducted over the internet using a common database over a period of time as noted above.

The purpose of the test was to validate the usability of the current user interface, and to provide evidence of the usability of MDRhythm Version 8. The test participants were similar to the target audience for MDRhythm which includes users from clinics, single and multiple Physician practices in various specialties. During the test, 10 users participated as representative of typical users of MDRhythm Version 8. The participants used MDRhythm Version 8 to perform several simulated tests representative of those required by ONC criteria and standards.

The study collected performance data on the following 46 tasks. A task rating scale of 1-5 (with 1 being difficult and 5 being easy) was used to account for usability performing each of these tasks.

- 170.315(a.1) - CPOE Medications (Add/Access/Edit)
- 170.315(a.2) - CPOE Labs (Add/Access/Edit)
- 170.315(a.3) - CPOE Imaging (Add/Access/Edit)
- 170.315(a.4) - Drug-drug and Drug to Allergy (Review 3 Levels Mild, Moderate, and Severe)
- 170.315(a.5) – Demographics (Add/Access/Edit)
- 170.315(a.6) - Problem List (Add/Access/Edit)
- 170.315(a.7) - Medication List (Add/Access/Edit)
- 170.315(a.8) - Medication Allergy List (Add/Access/Edit)
- 170.315(a.9) - Clinical Decision Support (Add/Access/Edit)
- 170.315(a.14) - Implantable Device List (Add/Access/Edit)
- 170.315(b.2) - Clinical Information (Add/Access/Edit)
- 170.315(b.3) - Electronic Prescribing (transmit to Surescripts)

Each participant joined the Web meeting for the usability test. Each participant was informed of the test guidelines and requirements and how to record their experience. A demonstration was given to the participants for each of the test requirements and guidelines including ability to withdraw from the testing at any time. All participants were current users of MDRhythm including Version 7. However the testing was performed on MDRhythm Version 8.

The participants were introduced to each test and instructed to complete a series of 46 tasks as noted above, one at a time. During the test, the time for each test by each participant was recorded and the participants recorded their own comments. No other assistance was provided. No screen shots, actions, or discussions were recorded. The following types of data were collected for each participant:

- Number of tasks successfully completed without errors
- Time to complete each task
- Number and types of errors for each task
- Path deviations based upon visual as well as participant comments
- Participant satisfaction ratings of the system based on all the tasks.

All participant data has been de-identified. Following the conclusion of the testing each participant was asked to complete a post-test questionnaire. No participant was compensated for their time. Various recommended metrics in accordance with the example set forth in the *NIST Guide to Processes Approach*, for improving the usability of electronic health records were used to evaluate the usability of MDRhythm Version 8.

Below is a summary of the performance and rating data collected on MDRhythm Version 8 for each measure:

**TABLE 1**

Task	Score	Number of participants	Test Success Mean	Design Path Deviation Observed/Optimal	Task Time		Errors Mean %	Task Ratings 1-5 (5=Easy) Mean
					Mean (secs)	Standard Deviation		
Add Medication Order		10	100%	1.1	23.1	7.85	1.5	5.0
Review Medication Order		10	100%	1.0	15.1	5.15	1	5.0
Edit Medication Order		10	100%	1.2	27.7	9.52	1	5.0
Record Lab Order		10	100%	1.6	18.1	3.75	1.6	5.0
Review Lab Order		10	100%	1.0	9.9	3.93	1	5.0
Change Lab Order		10	100%	1.4	19.4	4.72	1	4.0
Record Imaging Order		10	100%	1.6	20.6	5.89	1.6	5.0
Review Imaging Order		10	100%	1.0	17.3	4.52	1	5.0
Change Imaging Order		10	100%	1.4	21.3	4.45	1	4.0
Drug to Drug and Allergy Mild		10	100%	1.7	9.9	3.93	1.6	5.0
Drug to Drug and Allergy Moderate		10	100%	1.0	13	3.74	1	5.0
Drug to Drug and Allergy Severe		10	100%	1.0	15.9	4.07	1	5.0
Add Patient Demographics		10	100%	1.9	59.6	9.0	1.6	4.2
Review Demographics		10	100%	1.0	13.8	3.22	0.0	4.9
change Demographics		10	100%	1.1	41.8	6.84	0	5.0
Add Problems		10	100%	1.4	37.1	6.59	2.6	5.0
Review Problem List		10	100%	1.2	12.4	3.50	1.3	5.0
Change Problem List		10	100%	1.0	19.7	3.83	0	5.0
Add Medication List		10	100%	1.0	35.6	7.75	0	4.4
View Medication List		10	100%	1.2	20.6	5.89	1	4.8
Change Medication List		10	100%	1.0	24.4	7.20	2.5	4.6
Add Allergies		10	100%	1.0	17.2	3.71	1.6	5.0
Review Allergy List		10	100%	1.0	14.3	2.87	1	5.0
Change Allergy List		10	100%	1.0	22.9	5.74	1	5.0
Review CDS – Age criteria		10	100%	1.0	9.9	3.93	1	5.0

Review CDS – Medications	10	100%	1.0	10.4	2.95	1	4.8
Review CDS – Present Problem	10	100%	1.0	41.8	6.84	1	5.0
Review CDS – Allergies	10	100%	1.0	24.4	7.20	1	5.0
Review CDS – Demographics	10	100%	1.0	31.8	6.21	1	5.0
Review CDS – Vital Signs	10	100%	1.0	31.8	6.21	1	5.0
Review CDS – Lab results	10	100%	1.0	31.8	6.21	1	5.0
Review CDS –2 or more criteria	10	100%	1.0	31.8	6.21	1	5.0
Review CDS – References	10	100%	1.0	31.8	6.21	1	5.0
Add List of Implantable Devices	10	100%	1.4	57.7	8.64	1.9	4.5
Review List of Implantable Devices	10	100%	1.0	33.5	6.52	0	5.0
Edit List of Implantable Devices	10	100%	1.0	37.2	6.53	1	4.8
Receive and Review CCDA	10	100%	1.6	31.8	6.21	0	5.0
Reconcile Medications from CCDA	10	100%	1.0	18.4	3.60	1	5.0
Reconcile Allergies from CCDA	10	100%	1.4	15.6	3.53	0	5.0
Reconcile Problems from CCDA	10	100%	1.6	19.7	3.83	1.6	5.0
Reconcile Results from CCDA	10	100%	1.0	31.5	6.82	1.2	5.0
Create new prescription	10	100%	1.6	24.4	7.1	0	5.0
Change prescription	10	100%	1.0	37.1	6.5	1	5.0
Cancel prescription	10	100%	1.4	17.2	3.7	1.4	5.0
Refill prescription	10	100%	1.6	41.8	6.8	1.6	5.0
Request and receive medication history information	10	100%	1.0	21.3	4.4	0	5.0

Notes:

1. Deviations recorded were the total for all participants
2. Errors were all noted as minor
3. Errors recorded in the table above = total errors for all participants/10. Technicians generally deviated from the optimal path more often because of their lack of familiarity with CPOE and looking for historical data which they were not used to doing.

The results from the System Usability Score (the subjective satisfaction with the system based on performance with these tasks) was: **85.75%**

In addition to the performance data, there were a number of qualitative observations were made by the study participants including:

1. Software was easy to use
2. Software was intuitive and I was able to grasp the changes that had been made
3. There really isn't much change in the way we do things with the updated software
4. I am surprised how quickly I can get tasks done
5. I believe I can incorporate the new software into my office with a minimum of disruption

Major findings included:

1. Users were pleasantly surprised with how intuitive the work flow was
2. Minimal key stroke errors
3. Minimal issues participants had finding their way around the software
4. Screen design were clear and easy to grasp
5. Overall the software tested well

## Areas for improvement

1. The addition of online help documentation
2. Making the work flow for medication reconciliation more intuitive
3. Implement tight integration between CPOE and eRX
4. Adding auto save in all areas of the system
5. Difficult to select specific menu from the new pull down menus
6. Contrast is too low – difficult to read screens
7. Miss background coloring

This information is discussed in detail in DISCUSSION OF FINDINGS that can be found on page 9 through 11.

## INTRODUCTION

The electronic health record tested for this study was MDRhythm Version 8. The original version of MDRhythm was developed with the help of practicing physicians, healthcare workers, clinic directors, and various types of users. Since the product has been significantly enhanced and improved incorporating the suggestions of multiple users during field testing and actual hands on use.

The purpose of this study was to test and validate usability of the current version of the user interface of MDRhythm Version 8 as well was to provide evidence of MDRhythm’s overall functionality, efficiency, and usability. To this end, measures of effectiveness, efficiency and user satisfaction were captured during usability testing and are discussed in detail later in this report.

## METHOD

A total of ten participants were tested on the electronic health record under test (MDRhythm Version 8). Participants included in this test were 4 Internal Medicine Provider, 4 Family Practice Provider and 1 administrator/technician, and 1 front desk staff member. Participants were recruited by TechSoft, Inc. and were not compensated for their time. All participants are current users of MDRhythm Version 7. All received the same orientation with Version 8 as all users will receive when they start using this new version of MDRhythm.

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.

**TABLE 2**

ID	Gender	Age	Education	Role	Prof Experience	Computer Experience	EHR Experience
U1	Female	50-59	MD	Provider/Physician	Family Practice	180	40
U2	Female	50-59	Masters	Administrator	Family Practice	150	36
U3	Male	40-49	MD	Provider/Physician	Family Practice	100	36
U4	Female	30-39	MD	Provider/Physician	Family Practice	90	36
U5	Male	50-59	BS	Front Office	Family Practice	160	12
U6	Male	60-69	MD	Provider/Physician	Family Practice	160	20

U7	Female	40-49	MD	Provider/Physician	Internal Medicine	100	24
U8	Male	40-49	MD	Provider/Physician	Internal Medicine	100	30
U9	Male	70-79	MD	Provider/Physician	Internal Medicine	250	50
U10	Female	40-49	MD	Provider/Physician	Internal Medicine	100	60

Each Participant was scheduled for an hour of testing following that they were required to complete the questionnaire.

## STUDY DESIGN

Overall, the objective of this test was to uncover areas where the application performed well – that is, effectively, efficiently, and with user satisfaction as well as 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 for an updated version of the same electronic health record and/or comparison with other electronic health records, provided the same tasks are used. In short, this testing serves as both a means to record or benchmark current usability, as well as to identify areas where improvements must be made.

During the usability test, participants used MDRhythm VERSION 8. Each participant used the system in the similar manner and same instructions. The system was evaluated for effectiveness, efficiency, and satisfaction as defined by the following measures that were 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
- Participants comments
- Participants' satisfaction ratings of the system

Additional information about the various measures can be found in the section on usability metrics.

## TASKS

46 tasks were constructed that would be realistic and representative of activities a user might perform with this electronic health record. These tasks included: entering a patient problem list, checking if a patient had any allergies, finding results of recent lab work, checking Drug-Drug, Drug-Allergy Interaction, and others. Tasks were selected based on the requirements of a CMS and ONC-ATB script and associated guidelines, and *were prioritized in accordance with the risk of user error as follows:*

1. *CPOE*
2. *Medication Interactions*
  - a. *Drug to Drug Interaction*
  - b. *Drug to Allergy Interaction*
3. *Adding Patient Medications*

4. *Adding Patient Allergies*
5. *Clinical Decision Making*
6. *Clinical Information Reconciliation*

Test procedures are described in detail in Appendix C.

## **TEST ENVIRONMENT**

MDRhythm (the EMR under test) is used primarily by Internal Medicine, Family Medicine, and several sub-specialties in an outpatient office or clinic setting.

All testing was done using MDRhythm in cloud setting. Each user used their typical computer or notepad etc. to connect to the software and conduct all testing. Each user was in on audio communication and the test proctors had the ability to view any session on demand.

Subjects logged on to MDRhythm VERSION 8 using a login and password supplied by the test proctor. The look and feel of the application that they were tested on (MDRhythm VERSION 8) had been completely revised from the application that test subjects have been current users of MDRhythm Version 7.

## **PROCEDURES**

Testing was moderated by TechSoft personnel with extensive experience in product development, user training, product use as well as usability testing served as the test proctor for all testing. The proctor began the session providing instructions and tasks to be completed during the testing process. The task times, task failures, and task ratings were noted by each participant.

Participants were instructed as follows:

1. Do one task at a time. Do not deviate from the task instructions.
2. No assistance will be provided for the task to be done. No questions will be entertained during the test. However, participants could ask for clarifications prior to the start of each test.
3. No discussion or other form of communication was allowed during the test.

For each task, the participants were given a copy of the task. Task timing began once the test proctor 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 each participant a post-test questionnaire (see Appendix D) To be completed.

Participants' demographic information, task success rate, time on task, errors, deviations, verbal responses, and post-test questionnaire were recorded in the attached spreadsheet.

## **TEST FORMS AND TOOLS**

During the usability test, various documents and instruments were used, including a moderator's guide and a post-test questionnaire. The moderator's guide was made to capture required data. Each participant received a detailed list of instructions that included screenshots of the tasks to be performed. After receiving initial instructions and being shown how each task was to be performed, the participants were encouraged to review the instruction sheet before beginning each task.

## **PARTICIPANTS INSTRUCTIONS**

The following instructions were provided to each participant:

The purpose of the testing to evaluate usability of the MDRhythm software there your inputs are very important. Our session today will last about an hour. During that time you will use the latest version of MDRhythm software which has been modified to meet the requirements of meaningful use Stage 3. You will be asked to complete a certain tasks using this software, and then answer questions as provided separately. Please complete tasks as quickly as possible but without errors and try to complete the tasks on your own following the instructions very closely. Please note that the intent is not to test your skills or knowledge, it is about testing the MDRhythm software. If you find any task difficult to achieve, this means that improvement to the software is needed. I will be here in case you need specific help, but I am not able to give instructions or provide you information how to use the software. Overall we are interested to assess the ease of use, what changes would be useful to you, and how we can improve the overall functionality. All the information that you provide will be kept confidential and your name will not be associated with your comments. Should you feel it necessary, you are able to withdraw at any time during the testing.

Following the procedural instructions, participants were shown the new updated electronic health record and as their first task were given 5 min. to explore the system and make comments. Once this task was complete the test proctor gave the following instructions:

For each task, description will be read to you, demonstrate exactly what to do and say start. At that point, please perform the task and state done when you believe you have successfully completed the task. I will ask you your impressions about the task when you are done.

Participants were tested in 7 categories detailed above.

## USABILITY METRICS

According to the *NIST Guide to the Processes Approach* for improving the usability of electronic health records, electronic health records 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 usability testing.

The goals of the test were to assess:

1. Effectiveness of MDRhythm by measuring participant success rates and errors.
2. Efficiency of MDRhythm by measuring the average task time and path deviations.
3. Satisfaction with MDRhythm by measuring ease of use settings.

For reporting purposes, we categorized errors into inadvertent errors and gross errors.

Inadvertent errors are defined as an unintended action made while trying to do something on an interface, even though the goal is correct (e.g., a typo). A gross error is defined as an incorrect goal, even if that goal was accomplished.

Examples of Inadvertent errors include;

1. Mistyping a password
2. Accidentally clicking an adjacent icon
3. Accidentally starting to select the wrong medication

Here are examples of some gross errors;

1. Typing first and last name in a first name field
2. Entering address in Line 2 or address leaving line one blank
3. Selecting the wrong medication and complete the task with the incorrect medication.

When observing users in a usability test, the proctor recorded every time an error occurred, even if it was the same error by the same user on the same task. In general, most errors were inadvertent errors with very few considered to be gross errors.

## DATA SCORING METHODOLOGY

### EFFECTIVENESS - TASK SUCCESS

A task was counted as a success if a participant was able to achieve the correct outcome, without assistance, within the time allotted on a per test 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.

The observer recorded the time each participant took to complete each task. These results were recorded and are shown in Tables 1 and 3.

Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target test times were operationally defined by taking multiple measures of optimal performance as performed by one of MDRhythm's trainers and multiplied by 1.50.

#### EFFECTIVENESS - TASK FAILURES

If the participant abandoned the task, did not reach the correct answer or performed incorrectly or did not reach the end of the allotted time for successful completion, the task was counted as a failure. No task times were taken for errors.

The total number of errors were calculated for each task and then divided by the total number of times that task was attempted.

On a quantitative level, an enumeration of errors and error type was also collected.

#### EFFICIENCY - TASK DEVIATIONS

The participant use through the application session was recorded. Deviations that might occur at the participant level included the user going to a wrong screen, clicking an incorrect menu item, following an incorrect item, or interacting incorrectly with an on-screen control. This path was compared to the required path. The number of steps taken in the observed process divided by the number of designed steps to provide ratio of path deviations.

Task deviations were also recorded as gross errors.

#### EFFICIENCY - TASK TIME

Each task was timed from when the test Proctor stated "Please begin" until the participant said done. If the participant failed to say done the time was stopped when the participant stopped performing the task. Average time per task was calculated for each task. Variance measures (standard deviation) were also calculated.

#### SATISFACTION TASK RATING

Participants' subjective impression of the application's ease-of-use of was measured by administering both simple post-test questions as well as a post-session questionnaire. After each task, the participant was asked to rate the task overall on a scale of one (very difficult) to five (very easy). This data was then averaged across participants.

Common convention is that the average ratings for systems judged to be very easy to use should be 3.3 or above.

To measure participants' overall likability of MDRhythm, the system team administered a system

usability scale post-test questionnaire. Questions included: “I think I would like to use the software frequently”, “I thought the system was easy to use”, and “I would imagine that most people would learn to use the system very quickly.” (Appendix A).

## RESULTS

### DATA ANALYSIS AND REPORTING

The results of the usability test were calculated according to the methods specified in the usability metrics section above. No participants failed to follow instructions and no participants were excluded from the results.

Results of the usability testing of MDRhythm software are detailed below. The results should be evaluated based upon the objective goals outlined in the study design.

Following is a summary of the performance and rating data collected on MDRhythm Version 8

**TABLE 3**

Task	Score	Number of participants	Test Success	Design Path Deviation	Task Time		Errors	Task Ratings 1-5 (5=Easy)
					Mean	Standard Deviation		
Add Medication Order		10	100%	1.1	23.1	7.85	1.5	5.0
Review Medication Order		10	100%	1.0	15.1	5.15	1	5.0
Edit Medication Order		10	100%	1.2	27.7	9.52	1	5.0
Record Lab Order		10	100%	1.6	18.1	3.75	1.6	5.0
Review Lab Order		10	100%	1.0	9.9	3.93	1	5.0
Change Lab Order		10	100%	1.4	19.4	4.72	1	4.0
Record Imaging Order		10	100%	1.6	20.6	5.89	1.6	5.0
Review Imaging Order		10	100%	1.0	17.3	4.52	1	5.0
Change Imaging Order		10	100%	1.4	21.3	4.45	1	4.0
Drug to Drug and Allergy Mild		10	100%	1.7	9.9	3.93	1.6	5.0
Drug to Drug and Allergy Moderate		10	100%	1.0	13	3.74	1	5.0
Drug to Drug and Allergy Severe		10	100%	1.0	15.9	4.07	1	5.0
Add Patient Demographics		10	100%	1.9	59.6	9.0	1.6	4.2
Review Demographics		10	100%	1.0	13.8	3.22	0.0	4.9
change Demographics		10	100%	1.1	41.8	6.84	0	5.0
Add Problems		10	100%	1.4	37.1	6.59	2.6	5.0
Review Problem List		10	100%	1.2	12.4	3.50	1.3	5.0
Change Problem List		10	100%	1.0	19.7	3.83	0	5.0
Add Medication List		10	100%	1.0	35.6	7.75	0	4.4
View Medication List		10	100%	1.2	20.6	5.89	1	4.8
Change Medication List		10	100%	1.0	24.4	7.20	2.5	4.6
Add Allergies		10	100%	1.0	17.2	3.71	1.6	5.0
Review Allergy List		10	100%	1.0	14.3	2.87	1	5.0
Change Allergy List		10	100%	1.0	22.9	5.74	1	5.0
Review CDS – Age criteria		10	100%	1.0	9.9	3.93	1	5.0
Review CDS – Medications		10	100%	1.0	10.4	2.95	1	4.8
Review CDS – Present Problem		10	100%	1.0	41.8	6.84	1	5.0
Review CDS – Allergies		10	100%	1.0	24.4	7.20	1	5.0

Review CDS – Demographics	10	100%	1.0	31.8	6.21	1	5.0
Review CDS – Vital Signs	10	100%	1.0	31.8	6.21	1	5.0
Review CDS – Lab results	10	100%	1.0	31.8	6.21	1	5.0
Review CDS –2 or more criteria	10	100%	1.0	31.8	6.21	1	5.0
Review CDS – References	10	100%	1.0	31.8	6.21	1	5.0
Add List of Implantable Devices	10	100%	1.4	57.7	8.64	1.9	4.5
Review List of Implantable Devices	10	100%	1.0	33.5	6.52	0	5.0
Edit List of Implantable Devices	10	100%	1.0	37.2	6.53	1	4.8
Receive and Review CCDA	10	100%	1.6	31.8	6.21	0	5.0
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Change prescription	10	100%	1.0	37.1	6.5	1	5.0
Cancel prescription	10	100%	1.4	17.2	3.7	1.4	5.0
Refill prescription	10	100%	1.6	41.8	6.8	1.6	5.0
Request and receive medication history information	10	100%	1.0	21.3	4.4	0	5.0

Notes:

1. Deviations recorded were the total for all participants
2. Errors were all noted as minor
3. Errors recorded in the table above = total errors for all participants/10
4. Technicians generally deviated from the optimal path more often because of their lack of familiarity with CPOE.

**SYSTEM USABILITY SCALE RESULTS**

The results from the SUS (System Usability Scale) scores the objective satisfaction with the system based on performance with these tasks tested. Broadly interpreted, scores under 60 represent systems with poor usability while usability scores over 80 would be considered above average.

**MDRhythm scored 85.75 on the System Usability Test.**

**DISCUSSION OF FINDINGS**

EFFECTIVENESS

*Task Success*

Participants were able to achieve the correct outcome of all tasks without assistance within the time allotted for each task. The total number of successes for each task was calculated divided by the total number of times that task was attempted. The results are provided as a percentage.

**TOTAL SUCCESS RATIO: 100%**

## Optimal Efficiency Calculation

We then calculated optimal efficiency by taking the observed task times and dividing the optimal time for each task and then aggregating it across all tasks.

To obtain the optimal task performance time, we measured the time it took one of the most experienced trainers to complete each of these tasks. As the trainer knew the system much better than any of the participants, we multiplied his or her time by 1.5. We then calculated the optimal efficiency by taking the observed task times divided by the optimal time for each task as a measure of optimal efficiency, and aggregating the results.

**OPTIMAL EFFICIENCY = 1.28 +/- 0.12**

### *Task Failures*

1. No participant abandoned any task,
2. No participant did any not reach the correct answer
3. No participant was unable to perform any task
4. No participant exceeded the allotted time

TASK FAILURES = 0

EFFICIENCY:

### *Task Deviations*

The participant's path through the application was observed and compared to the optimal path noted when calculating the optimal time. Deviations were noted when a participant went to a wrong screen, clicked an incorrect menu item, followed an incorrect link or interacted incorrectly with an on-screen control. These path deviations were also counted as errors.

The number of steps in the observed path was divided by the number of optimal steps to provide a ratio of path deviation.

PATH DEVIATION FOR ALL PARTICIPANTS IN THE STUDY = 0.14

USER SATISFACTION:

Participants in general were satisfied in the way the software use was designed. They especially commented positively on the quick screen rendering and results of the software, and the speed at which they could complete the tasks. They especially liked the fact that they did not have to save in most cases when moving from field to field or tab to tab.

Finally, in response to the last question on the user questionnaire - all users stated that they would recommend MDRhythm to their colleagues.

## MAJOR TEST FINDINGS

The major findings of this study confirm what the developers of MDRhythm EHR have observed from previous versions -- that the software is very easy to use, and once users are shown how to interact with the system, they are able to grasp the concepts quickly and can execute the tasks required of a complete ophthalmological exam.

Based upon the feedback, no major changes were found to be necessary to allow meeting the stage 3 requirements.

## RISK ANALYSIS

As noted above, errors can be classified into two types – inadvertent errors and gross errors. inadvertent error occur when a user inadvertently types in wrong information or starts to select a wrong link, and a gross error is when the user does something that could have an adverse clinical impact, such as recording the wrong data or selecting an incorrect medication.

All errors noted in this study were classified as inadvertent errors, therefore these were considered to be very low risk in the use of the software.

In addition, there are multiple built-in safeguards to reduce errors in MDRhythm. These include frequent display of pending action before the action is completed as well as the ability to undo significant errors.

Finally, MDRhythm constantly monitors their help desk tickets, as well as onsite feedback at different practices to see how users interact with our software. User suggestions are carefully monitored. With this information, we can make changes to improve usability and reduce user's error.

## AREAS FOR IMPROVEMENT

While users overall were very satisfied with the work flow and how easy it was to grasp how to use the new software, there were several areas where the users felt the work flow could be improved. These included the following:

1. The addition of online help documentation
2. Improvements to workflow in a few areas.
3. Decrease the number of clicks to achieve a particular task
4. Color coding in certain areas for better visual comprehension for the displayed data

## SUMMARY

Testing confirmed that MDRhythm usability is excellent. While there were a few areas that could be more tightly integrated to improve the overall work flow the metrics show that users can use the system efficiently and effectively

**APPENDIX A**

**SYSTEM USABILITY SCALE QUESTIONNAIRE**

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

In 1996, Brooke published a “low cost usability scale that can be used for global assessments of system usability” known as the System Usability Scale or SUS. Computation of the SUS score can be found in Brooke’s paper, in at <http://www.usabilitynet.org/trump/documents/Suschapt.doc> or in Tullis and Albert (2008).

## Bibliography

Brooke, J.: SUS: A “quick and dirty” usability scale. In: Jordan, P. W., Thomas, B., Weerdmeester, B. A., McClelland (eds.) *Usability Evaluation in Industry* pp. 189--194. Taylor & Francis, London, UK (1996). SUS is copyrighted to Digital Equipment Corporation, 1986.

Lewis, J R & Sauro, J. (2009) "The Factor Structure Of The System Usability Scale." in *Proceedings of the Human Computer Interaction International Conference (HCI 2009), San Diego CA, USA*

Nielsen, Jakob, and Landauer, Thomas K.: "A mathematical model of the finding of usability problems," *Proceedings of ACM INTERCHI'93 Conference* (Amsterdam, The Netherlands, 24-29 April 1993), pp. 206-213.

See Tedesco and Tullis (2006) for a comparison of post-task ratings for usability tests. Tedesco, D. & Tullis, T. (2006) A comparison of methods for eliciting post-task subjective ratings in usability testing. *Usability Professionals association Conference*, June 12 – 16, Broomfield, CO.

Tullis, T. & Albert, W. (2008). *Measuring the User Experience*. Burlington, MA: Morgan Kaufman (p. 149). Broadly interpreted, usability scores under 60 represent systems with poor usability; scores over 80 would be considered above average.

Sue Bowman, MJ, RHIA, CCS, FAHIMA. “Impact of Electronic Health Record Systems on Information Integrity: Quality and Safety Implications.” *Perspectives in Health Information Management* (Fall 2013): 1-19.

Siegler, Eugenia, and Ronald Adelman. “Copy and Paste: A Remediable Hazard of Electronic Health Records.” *Journal of the American Medical Association* 122 (2009): 495.

Institute of Medicine, Committee on Patient Safety and Health Information Technology. *Health IT and Patient Safety: Building Safer Systems for Better Care*, 6-1.

## APPENDIX B: PARTICIPANT DEMOGRAPHICS

ID	Gender	Age	Education	Role	Prof Experience	Computer Experience	EHR Experience
U1	Female	50-59	MD	Provider/Physician	Family Practice	180	40
U2	Female	50-59	Masters	Administrator	Family Practice	150	36
U3	Male	40-49	MD	Provider/Physician	Family Practice	100	36
U4	Female	30-39	MD	Provider/Physician	Family Practice	90	36
U5	Male	50-59	BS	Front Office	Family Practice	160	12
U6	Male	60-69	MD	Provider/Physician	Family Practice	160	20
U7	Female	40-49	MD	Provider/Physician	Internal Medicine	100	24
U8	Male	40-49	MD	Provider/Physician	Internal Medicine	100	30
U9	Male	70-79	MD	Provider/Physician	Internal Medicine	250	50
U10	Female	40-49	MD	Provider/Physician	Internal Medicine	100	60

## APPENDIX C: MODERATORS GUIDE

### INTRODUCTION/INSTRUCTIONS

The purpose of the testing to evaluate usability of the MDRhythm software there your inputs are very important. Our session today will last about an hour. During that time you will use the latest version of MDRhythm software which has been modified to meet the requirements of meaningful use Stage 3. You will be asked to complete a certain tasks using this software, and then answer questions as provided separately. Please complete tasks as quickly as possible but without errors and try to complete the tasks on your own following the instructions very closely. Please note that the intent is not to test your skills or knowledge, it is about testing the MDRhythm software. If you find any task difficult to achieve, this means that improvement to the software is needed. I will be here in case you need specific help, but I am not able to give instructions or provide you information how to use the software. Overall we are interested to assess the ease of use, what changes would be useful to you, and how we can improve the overall functionality. All the information that you provide will be kept confidential and your name will not be associated with your comments. Should you feel it necessary, you are able to withdraw at any time during the testing.

Following the procedural instructions, participants were shown the new updated electronic health record and as their first task were given 5 min. to explore the system and make comments. Once this task was complete the test proctor gave the following instructions:

For each task, description will be read to you, demonstrate exactly what to do and say start. At that point, please perform the task and state done when you believe you have successfully completed the task. I will ask you your impressions about the task when you are done.

Prior to testing

1. Internet connectivity was checked
2. Software was checked to make sure it was functioning properly

Prior to testing each participant

1. Application was reset
2. Any data left from previous test was deleted
3. All patient data from previous tests was removed
4. New patient data was appropriate to each test was inserted

Prior to each task

1. Stopwatch was reset
2. Participant was informed as to what the next test would be
3. Application was reset to work view screen

After each task

1. Proctor recorded timing results
2. Proctor recorded any comments participants made during the test
3. Proctor completed work sheet noting:
  - a. Success data
  - b. Task time
  - c. Optimal path information
  - d. Rating

After all testing was completed

1. Proctor reset application
2. Proctor erased all data entered during the test
3. Proctor recorded any comments participants made

## TESTING PROTOCOL

TESTING WAS DONE IN THE FOLLOWING ORDER:

1. Demographics
2. Patient Medications
3. Patient Allergies
4. Problem List
5. CPOE Medications
6. CPOE Laboratory Tests
7. CPOE Imaging (Radiology)
8. Drug – Drug Interactions
9. Drug – Allergy Interactions
10. Clinical Decision Support
11. Implantable Device List
12. Clinical Information Reconciliation

### **a.1 CPOE PATIENT MEDICATIONS**

Test 1 Record Medications

An existing patient comes to the office for review. The total Cholesterol is over 200 and the patient is diabetic.

Task 1: Order Atorvastatin 40 mg OD.

Patient returns to the clinic and the total Cholesterol is less than 80.

Task 2: Change the Atorvastatin to 20 mg OD

Pharmacy calls to confirm that the medication has changed.

Task 3: Review Medication Order (details)

### **a.2 CPOE LABORATORY**

Test 2 Order Laboratory Tests

Provider decides to do CMP. Using CPOE to order CMP. Task 2 Change Laboratory

Test Order

Provider decides he would like to have CMP with fasting. Using CPOE, change order to CMP with fasting.

Task 3 Display changed laboratory order

Provider wants to make sure that new order was placed. Open chart to review current laboratory orders

### **a.3 CPOE IMAGING**

#### Task 1 Order Imaging Study

Mr. Test is complaining of Chest Pain. Provider decides he would like to have regular X-Ray of Chest. Using CPOE, order Chest X-Ray.

#### Task 2 Change Imaging Study

Provider reviews patients chart and decides to change the order from regular Chest X-ray to Four views Chest X-ray. Using CPOE change the order from regular Chest x-ray to four views of Chest x-ray.

#### Task 3 Review Imaging Study

Provider would like to confirm that the order was changed. Open Mr. Test's chart to confirm that the order was actually changed to four views Chest x-ray.

### **a.4 DRUG-DRUG DRUG-ALLERGY TESTING**

As part of your regular routine, you will be checking to make sure that none of the medications that you are ordering will produce a drug or allergic reaction.

This test consists of three parts

1. Testing for a drug-drug interaction when a new medication is prescribed
2. Testing for a drug allergy interaction when a new medication is prescribed
3. Adjusting severity of displayed drug drug interaction

#### Task 1 Adjust severity of displayed drug-drug interaction

1. Go to EMR Default Settings\ Prescription settings\ Set Severity Level
2. Set to Major Interactions only.

#### Task 2 Trigger a drug to drug interaction using CPOE.

1. Using CPOE Order the following medications
  - a. Verapamil
    - i. Show drug to drug interaction alert
  - b. Levothyroxine
    - i. Show drug to drug interaction alert

Task 3 Trigger a drug allergy interaction using CPOE

1. Using CPOE order Penicillin
2. Show drug to allergy alert

## **a.5 DEMOGRAPHICS**

TASK 1: Enter Patient Information

A new patient has called to make an appointment for an Physical examination. He gives you the following information which you will enter into the chart:

1. Name: John Test
2. Date of Birth: 1/1/1990
3. Phone Number (856) 555-1212
4. Gender: Male
5. Sexual Orientation: Gay
6. Gender Identity: Male
7. Race:
8. Ethnicity:

Task 2 Change Demographics

Mr. Test calls to say that he now has a cell phone. Add his new cell phone number 856-125-8888 to his chart. Save the information

Task 3 Access Demographics:

Mrs. Test calls to make sure that his record reflects his new cell phone number. Search for Mr. Test's record and check to see if the phone number she supplies you

## **a.6 PROBLEM LIST**

Task 1 Record a problem to the problem list

Mr. Test arrives at the office for his Physical examination. Initial examination reveals the following problems:

1. Chest Pain
2. Diabetic Mellitus Type 2, no retinopathy
3. Mild Cough

Task 2 Change a problem on the problem list

After provider reviews symptoms, provider goes back to problem list and makes a change to appropriately document Chest Pain.

### Task 3 Display the active problem list

Provider need to review the problem list to communicate back to the patient. Provider goes to EMR Dashboard and reviews active problem list.

Within the same screen, provider can view any past problem to review entire health history as well.

## **a.7 MEDICATION LIST**

### Task 1 Record a medication to the medication list

The technician working up Mr. Test asks him what medications he is taking. He tells him that he is taking the following medications:

1. Lisinopril 20 mg tablet 1 Tab PO Daily
2. Lipitor 10 mg tablet 1 Tab PO Daily
3. Atenolol 25 mg tablet 1 Tab PO Daily

### Task 2 Change a medication on the medication list

Mrs. Test who is also there reminds Mr. Test that at the last visit, the PCP changed his Atenolol to 50 mg daily. The appropriate change in the chart is made.

### Task 3 Display the active medication list

When the physician comes in the room he quickly checks the medication list to see what medications the patient is taking (patient at a glance)

### Task 4 Display the historical medication list

At this point because the patient general health screen lists each patient's complete medical history, the provider can review not only the current medications the patient is on but also is able to see the entire medication history

## **a.8 MEDICATION ALLERGY LIST**

### Task 1 Record a medication history

While taking Mr. Test's history, the technician asks what medications he is on. He tells him that he is allergic to:

1. Bactrim which causes diarrhea
2. Penicillin makes him itch

### Task 2 Change a medication allergy

Mrs. Test reminds him that his PCP said he wasn't allergic to Bactrim that this is just a side effect of the medication. The technician deletes Bactrim from the allergy list

### Task 3 Display the active medication allergy list

When the Physician arrives, he quickly checks the allergy list in the patient general history.

### Task 4 Display the historical medication allergy list

While there he decides to check to see to see if there have been any changes to the patient's allergy list. (Patient General Health/Allergies/Filter All).

## **a.9 CLINICAL DECISION SUPPORT**

1. Enter a number of clinical findings. After entering the finding if an alert pops up. Please note the alert that pops up.
2. Task 1 Problem List Interventions
  - a. Add Diabetes Type 2 without complications to the problem list
  - b. Now go to EMR
  - c. Record the alert
3. Task 2 Medication List Interventions
  - a. Add Atorvastatin to medication list
  - b. Go to EMR
  - c. Record the alert
4. Task 3 Medication Allergy List Interventions
  - a. Add Penicillin to medication allergy list
  - b. Go to EMR
  - c. Record the alert
5. Task 4 Demographics Interventions
  - a. In patient demographics select race as Black or African American
  - b. Go to EMR
  - c. Record the alert
6. Task 5 Lab Tests and Results Interventions
  - a. Go to Lab test orders / results
  - b. Enter results for HbA1C=7.4
  - c. Go to EMR
  - d. Record the alert

7. Task 6 Vital Signs Interventions
  - a. Go to Vitals
  - b. Enter BP = 160/90
  - c. Go to EMR
  - d. Record the alert
  
8. Task 7 Combination of at least 2 elements above
  - a. Go to Demographics – enter African American
  - b. In the Problem list add HTN
  - c. Go to EMR
  - d. Record the alert
  
9. Task 8 Trigger the CDS interventions/resources from CCDA information
  - a. Go to EMR Default Settings
  - b. Set an intervention for Medications.
  - c. Set an intervention for Race
  - d. Set an intervention for Blood Pressure
  - e. From Internal Emails, select CCDA and import data.
  - f. Go To EMR and records the results indicated
  
10. Task 9 Access bibliographic information for hypertension including resource material for data elements in the problem list and medication list
  - a. Go To EMR
  - b. On the CDS alters, select Medication alert
  - c. Click on Source and link for the basis for the CDS rule.

#### **a.14 IMPLANTABLE DEVICE LIST**

Patient states that the patient has an implantable device and gives you a card with the following number on it:

+B066000325011NS1/\$\$420020216LOT123456789012345/SXYZ456789012345678/16D20130202C1

1. Go to Past medical/Surgical history and Record the UDI
  - a. Copy this number into the chart (Medical History/Surgery/UID).
  - b. Click detail
  - c. Then click insert and then save.
2. Change Status of the UDI
  - a. Change status of UDI from Active to Inactive
3. Access UDI device description, identifiers and attributes
  - a. Click on UDI Number
  - b. Click on details
  - c. Review details of the device including Serial Number, Lot Number and any available safety information

## **b.2 CLINICAL INFORMATION RECONCILIATION**

After the patient visit today, the Physician received a summary of care document sent by direct mail about this patient from the specialist. To complete the record, incorporate the findings from the specialist report into the patient's record.

Here are the tasks you will be performing

- Reconcile patient's active medication list with another source
- Reconcile patient's active problem list with another source
- Reconcile patient's active medication allergy list with another source

### Task 1 Incorporate CCDA and reconcile medications

1. Go to Internal Email and then to CCDA
2. Double click on appropriate CCDA mail
3. Click View Details. On the details screen, Click on CCD Reconciliation
4. Click on section to be imported, select medication section.
5. The list of medications that the CCDA has and what is in the patient's medication list are displayed side by side
6. Review Data of medications from patient current medication list
7. Click on reconcile
8. Review Patient's Medication list to verify the medications added to the list.

### Task 2 Incorporate CCDA and reconcile medication allergies

1. Now select Allergies from the dropdown list
2. Follow the same procedure as Medications to import the patient allergy list

### Task 3 – Incorporate CCDA and consolidate and merge two problem lists

1. Select Problem List
2. Merge and consolidate the two problem list as appropriate

## **B.3 E-PRESCRIBING**

### Task 1 Create new prescription

1. Go to Prescription Screen, and select a medication make sure the send mode is electronic.
2. Save the Prescription, and send All

### Task 2 Change prescription

1. Right click on the prescription created in Task 1 above, and select Edit
2. Change the quantity from 1 Tablet to 2 tablets
3. Save the modified prescription, and click on Send All

Task 3 Cancel prescription

1. Select the newly created prescription and right click
2. Select Void Prescription.

Task 4 Refill prescription

1. Select a Prescription, and right click to select Refill Prescription
2. Save and Send All

Task 5 Request and receive medication history information

1. On the Tab Medication History, select Get Medication History
2. Medication history is displayed.

## **APPENDIX D**

### POST TEST QUESTIONNAIRE

1. What was your overall impression of this software?
2. Which tasks of this software did you like most?
3. Which tasks of this software did you like least?
4. Were you surprised to see certain features of the software?
5. Which features you expected to see but did not. What was missing?
6. Would you recommend this software?

## ATTESTATION

I certify that this report is an accurate representation of the usability testing that was performed.

A handwritten signature in black ink, appearing to read "Navin K. Gupta". The signature is stylized with a large initial "N" and "K".

Navin K. Gupta

CEO

November 19, 2018