



VisionWeb Safety Enhanced Design EHR Usability Report

Report based on: NISTIR 7742 Customized Common Industry Format Template for electronic health Record Usability Testing

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Product Version: 3.1
Usability Topic: §170.315(g)(3)
Method: NISTIR 7741
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Report Prepared By: VisionWeb
Betty Barrs, Product Owner
800-874-6601
6500 River Place Blvd Building 3, Suite 100
Austin, Tx 78730

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1) EXECUTIVE SUMMARY

A usability test of Uprise version 3.1, an ambulatory EHR specializing in the Optometry industry, was conducted from Wednesday February 21st, 2018 to Thursday March 1st, 2018 via online one-on-one GoToMeeting sessions with participants. The purpose of this test was to test and validate the usability of the current user interface, and provide evidence of usability in the EHR Under Test (EHRUT). During the usability test, 10 Optometry healthcare professionals matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks. This study collected performance data on 12 measures comprised of 57 tasks typically conducted on an EHR:

- Computerized Provide Order Entry (CPOE)
- Updating demographics
- Managing problems, medications, allergy lists
- Provider Clinical Decision Support (CDS)
- Managing implantable device list
- Clinical reconciliation and incorporation
- E-Prescribing

During the 90 minute one-on-one usability test, each participant had signed a consent/release form before the start of the session and was instructed they could withdraw at any time (included in Appendix 3). Half of the participants (5) had prior experience with the EHR. The administrator introduced the test, and instructed participants to complete a series of tasks one at a time using the EHRUT. During the testing, the data loggers timed the test and recorded user performance data on paper. The administrator did not give the participant assistance in how to complete the task. Participant sessions were recorded for subsequent analysis. The following types of data were collected for each participant:

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

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

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 4.3 out of 5.

After reviewing and analyzing the data, the following conclusions were drawn:

- All participants were able to complete all tasks, including users that are not currently using Uprise
- Participants rating Uprise with above average usability
- Participants performed the following measures best, in terms of time and optimal steps: COPE, problems, allergies, demographics
- Participants faced the most challenges with electronic prescribing

2) INTRODUCTION

The EHRUT tested for this study was Uprise version 3.1, an ambulatory EHR specializing in the Optometry. Designed to present medical information to eye care providers in the optometry practice setting, the EHRUT consists of modules to document patient eye exams and manage medical history, including diagnosis, orders, treatments, patient education and medical coding. The usability testing attempted to represent realistic exercises and conditions with a focus on

clinical workflows.

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 on task, were captured during the usability testing.

3) METHOD

3.1) PARTICIPANTS

A total of 10 participants were tested on the EHRUT. Participants were recruited by internal colleagues (Marketing, Sales, and Product Department) and were compensated for their time. In addition, participants had no direct connection to the development of or organization producing the EHRUT. Participants were not from the testing or supplier organization.

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. Below is a breakdown of participants by occupation/role.

- Optometrist: 6 participants
- Managers (Optician): 2 participants
- Other: 2 Participants

This group includes an Operations Director for Optometry and a Certified Ophthalmic Assistant.

Appendix [3] shows 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. Participants were scheduled for 90 minute sessions. Half of the participants had Uprise experience while the other half served as the 'control' group with no Uprise experience. The rationale is that if the control group could complete the tasks without administrator help then there was sufficient information to perform the task without additional instructions.

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 Uprise version 3.1. This test was performed via online one-on-one GoToMeeting sessions. Each participant used the same test environment and was provided 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

There were a total of 12 measures comprised of 57 tasks assessed during this test. Tasks were realistic and representative of the kinds of activities a user might do with this EHR, in addition to tasks aligning to the certification criteria of the program, including:

- Computerized Provide Order Entry (CPOE)
- Updating demographics
- Managing problems, medications, allergy lists
- Provider Clinical Decision Support (CDS)
- Managing implantable device list
- Clinical reconciliation and incorporation
- E-Prescribing

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users. Below is a breakdown of task descriptions that were tested and association of each task to corresponding certification criteria.

Task	Task Name	Task Description	Related Certification Procedure
A1.1	Record medication via CPOE	Add an order to the patient's record, for a medication (ex: Restasis)	Computerized provider order entry (CPOE) – medications(a)(1)
A1.2	Change medication via CPOE	Change the medication order sig for Restasis	Computerized provider order entry (CPOE) – medications(a)(1)
A1.3	Display changed CPOE medication order	View the changed medication order within the exam order	Computerized provider order entry (CPOE) – medications(a)(1)
A2.1	Record Lab order via CPOE	Add a laboratory order to a patient's record (ex: Lipid Panel)	CPOE – laboratory (a)(2)
A2.2	Change Lab order via CPOE	Change the laboratory order by adding a new LOINC code (57698-3, Lipid panel LDL)	CPOE – laboratory (a)(2)
A2.3	Display changed CPOE Lab order	View the details for changed laboratory order	CPOE – laboratory (a)(2)
A3.1	Record Imaging order via CPOE	Add a diagnostic imaging order test to a patient's record (ex: MRI spectroscopy)	CPOE – diagnostic imaging (a)(3)
A3.2	Change Imaging order via CPOE	Change the diagnostic imaging order test (MRI) to 70555 MRI Brain Functional	CPOE – diagnostic imaging (a)(3)
A3.3	Display changed CPOE Imaging order	View the details for the changed diagnostic imaging order test	CPOE – diagnostic imaging (a)(3)
A4.1	Using CPOE, trigger a drug-drug interaction by entering a new medication order	Trigger a drug-drug interaction by adding an order for a medication the patient has documented as allergic to Lasix 20mg tab	Drug-drug, drug-allergy interaction checks for CPOE (a)(4)
A4.2	Using CPOE, trigger a drug-allergy interaction by entering a new medication order	Trigger a drug-allergy interaction by adding an order for a medication the patient has documented as allergic to Ceftin 250 mg	Drug-drug, drug-allergy interaction checks for CPOE (a)(4)
A4.3	Adjust the severity level of a displayed drug-drug interaction	Adjust the severity level of displaying drug-drug interaction notifications for a patient to hide less severe drug interactions	Drug-drug, drug-allergy interaction checks for CPOE (a)(4)
A5.1	Record a patient's preferred language, date of birth, birth sex, race, ethnicity, sexual orientation, gender identity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	Create a new patient and record the following fields: Date of Birth, Sex, Ethnicity, Race, Sexual Orientation, Gender Identity, Preferred Language	Demographics (a)(5)
A5.2	Change the patient's preferred language, date of birth, birth sex, race, ethnicity, sexual orientation, gender identity, preliminary cause of death (inpatient only), and	Change the following demographic information for a patient: Date of Birth, Sex, Ethnicity, Race, Sexual Orientation, Gender Identity, Preferred Language	Demographics (a)(5)

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	preliminary date of death (inpatient only)		
A5.3	Display the patient's changed preferred language, date of birth, birth sex, race, ethnicity, sexual orientation, gender identity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	You just changed a patient demographic information and want to save and view the updated information	Demographics (a)(5)
A6.1	Record a problem to the problem list	Add a new diagnosis/assessment to the patient's problem list (ex: Headache)	Problem list (a)(6)
A6.2	Change a problem on the problem list	Change the status for the problem Headache to be worse	Problem list (a)(6)
A6.3	Display the active problem list	An established patient returns for a checkup. View the patient's active problem list.	Problem list (a)(6)
A6.4	Display the historical problem list	View the patients historical problem list	Problem list (a)(6)
A7.1	Record a medication to the medication list	Add a medication to the patient's medication list (ex: Bion Tears)	Medication list (a)(7)
A7.2	Change a medication on the medication list	Change the Sig for an existing medication (Bion Tears).	Medication list (a)(7)
A7.3	Display the active medication list	An established patient returns for a checkup. View the patient's active medication list.	Medication list (a)(7)
A7.4	Display the historical medication list	View the patient's historical medication list	Medication list (a)(7)
A8.1	Record a medication allergy	Add a medication allergy to the patient's medication list (ex: Aspirin)	Medication allergy list (a)(8)
A8.2	Change a medication allergy	Change the severity for an existing allergy in the patient's record (Aspirin)	Medication allergy list (a)(8)
A8.3	Display the active medication allergy list	An established patient returns for a checkup. View the patient's active medication allergy list.	Medication allergy list (a)(8)
A8.4	Display the historical medication allergy list	View the patient's historical medication allergy list	Medication allergy list (a)(8)
A9.1	Add a CDS intervention and/or reference resource for each of the required elements: (problem list)	Setup a Clinical Decision Support (CDS) intervention for Problem - Disease management for depression	Clinical decision support (a)(9)
A9.2	Add a CDS intervention and/or reference resource for each of the required elements: (medication list)	Setup a Clinical Decision Support (CDS) intervention for Medication = Quality Management for Warfarin/Aspirin	Clinical decision support (a)(9)
A9.3	Add a CDS intervention and/or reference resource for each of the required elements: (medication allergy list)	Setup a Clinical Decision Support (CDS) intervention for Medication allergy = Quality management for Penicillin	Clinical decision support (a)(9)
A9.4	Add a CDS intervention and/or reference resource for each of the required elements: (at least one demographic)	Setup a Clinical Decision Support (CDS) intervention for Demographics = Preventative services of a mammogram	Clinical decision support (a)(9)
A9.5	Add a CDS intervention and/or reference resource for each of the required elements: (laboratory test)	Setup a Clinical Decision Support (CDS) intervention for Lab Test = Disease management for hemoglobinA1C	Clinical decision support (a)(9)
A9.6	Add a CDS intervention and/or reference resource for each of the required elements: (vital signs)	Setup a Clinical Decision Support (CDS) intervention for Vital Signs = General lifestyle to monitor high BMI	Clinical decision support (a)(9)
A9.7	Add a CDS intervention and/or reference resource for each of the required elements: (a combination of two elements – demographics and vitals)	Setup a Clinical Decision Support (CDS) intervention for combination of 2 data elements - (Preventative services – flu vaccine high risk pt)	Clinical decision support (a)(9)

A9.8	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (problem list)	Trigger Clinical Decision Support (CDS) intervention for Problem list (depression F32.0)	Clinical decision support (a)(9)
A9.9	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (medication list)	Trigger Clinical Decision Support (CDS) intervention for Medication list (Warfarin)	Clinical decision support (a)(9)
A9.10	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (medication allergy list)	Trigger Clinical Decision Support (CDS) intervention for Medication Allergy list (Medication = Amoxicillin)	Clinical decision support (a)(9) Clinical decision support (a)(9)
A9.11	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (at least one demographic)	Trigger Clinical Decision Support (CDS) intervention for Demographics (Female with DOB 1948)	Clinical decision support (a)(9)
A9.12	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (laboratory test)	Trigger Clinical Decision Support (CDS) intervention for Laboratory Test (Lab code =LOINC 17856-6, Value =50)	Clinical decision support (a)(9)
A9.13	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (vital signs)	Trigger Clinical Decision Support (CDS) intervention for Vital Signs (height 60 in, weight 250 lbs)	Clinical decision support (a)(9)
A9.14	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (a combination of two elements – demographics and vitals)	Trigger Clinical Decision Support (CDS) intervention for a combination of 2 elements Demographics (Race American Indian, Age 1948) and vitals (height 60 in, weight 250 lbs)	Clinical decision support (a)(9)
A9.15	View the intervention/resource information using the Infobutton standard for data elements in the problem list	A CDS intervention has triggered, view the resource information using the Info button standards for problems (disease management – depression)	Clinical decision support (a)(9)
A9.16	View the intervention/resource information using the Infobutton standard for data elements in the medication list	A CDS intervention has triggered, view the resource information using the Info button standards for medications (Quality management – Warfarin/aspirin)	Clinical decision support (a)(9)
A9.17	View the intervention/resource information using the Infobutton standard for data elements in demographics	A CDS intervention has triggered, view the resource information using the Info button standards for demographics (Preventative services of a mammogram)	Clinical decision support (a)(9)
A9.18	Trigger the CDS interventions/resources based on data elements in the problem list, medication list, and medication allergy list by incorporating patient information from a transition of care/referral summary	Incorporate a patient's information from a transition of care to trigger CDS intervention for the following data elements: Problems, Medications, and Allergies	Clinical decision support (a)(9)
A9.19	Access the following attributes for one of the triggered CDS interventions/resources:	For a triggered CDS intervention, view the following information for the recommended services: bibliographic citation, developer, funding source,	Clinical decision support (a)(9)

	bibliographic citation, developer, funding source, release/revision date	release/revision date.	
A14.1	Record UDI	Record that a patient has had the implantable device of an Intraocular lens	Implantable device list (a)(14)
A14.2	Change UDI Status	Change the UDI Status	Implantable device list (a)(14)
A14.3	Access UDI, device description, identifiers, and attributes	Access details for the UDI: device description, identifiers and attributes	Implantable device list (a)(14)
B2.1	Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record	Incorporate a patient information from a CCDA and reconcile the medications, medication allergies, and problems to update the patient's current record	Clinical information reconciliation and incorporation (b)(2)
B2.2	Generate a new CCDA with reconciled data	Create a new CCD with the reconciled data	Clinical information reconciliation and incorporation (b)(2)
B3.1	Create new prescription	Add a new prescription for Moxeza for a patient that has Conjunctivitis	Electronic prescribing (b)(3)
B3.2	Change prescription (dosage or duration)	Change the prescription dosage for an existing medication	Electronic prescribing (b)(3)
B3.3	Cancel prescription	Discontinue a prescription for a patient	Electronic prescribing (b)(3)
B3.4	Refill prescription	Refill a prescription for a patient	Electronic prescribing (b)(3)
B3.5	Receive fill status notification	View the fill status from a pharmacy for a medication (Zolof) for a patient	Electronic prescribing (b)(3)
B3.6	Request and receive medication history information	Request and receive medication Fill History from SureScripts for a patient	Electronic prescribing (b)(3)

Table 1: Tasks and Related Certification Procedures

3.4) RISK ASSESSMENT OF TASKS

Each task was prioritized in accordance with the risk associated with user errors. Below is a summary of patient risk associated with the tasks.

Task	Task Name	Risk Level - Rationale
A1.1-1.3	CPOE medications – Record, change, display changed	Medium Risk – Adding, changing, and displaying lab medication is important to treatment of condition. Considering backup scenario of writing prescription by paper.
A2.1-2.3	CPOE laboratory – Record, change, display changed	Medium Risk – Adding, changing, and displaying lab orders is important to overall patient care. Considering backup scenario of ordering by paper.
A3.1-3.3	CPOE diagnostic imaging - Record, change, display changed	Medium Risk – Adding, changing, and displaying diagnostic images is important to treatment of conditions. Considering backup scenario of ordering by paper.
A4.1-4.3	Drug-drug, drug-allergy interaction checks for CPOE - Record, change, display changed	Very High Risk – The impacts of missing interactions could have life threatening consequences.
A5.1-5.3	Demographics - Record, change, display changed	Low Risk – Accurately documenting patient demographics is important for patient verification but has few triggers that impact clinical workflow.
A6.1-6.4	Problem list - Record, change, display active, display historical	High Risk – Ensuring problems are documented correctly and are accessible is critical to patient care. Inaccuracies and misrepresentation of information could negatively impact patient treatment.
A7.1-7.4	Medication list - Record, change, display active, display historical	High Risk – Incorrectly documenting a medication could result in harm to the patient. Medication lists need to be visible and updated to help monitor and treat conditions.
A8.1-8.4	Medication allergy list – Record, change, display active, display historical	Very High Risk – The impacts of incorrectly prescribing a medication the patient is allergic to, due to confusing layout and workflow, could have life threatening consequences.
A9.1-	Clinical Decision Support – Add, trigger, view using	Low Risk – The impacts of missing a recommendation for an

9.19	infobutton standard, trigger from TOC/referral summary, access attributes	order/medication could diminish patient care.
A14.1-14.3	Implantable Device List – Record, change, Access	Medium Risk – Healthcare Professionals need to be aware of patient’s implantable devices for recall purposes, procedures, and medications.
B2.1-2.1	Clinical Info Rec and Incorporation – Incorporate CCDA, Generate new	Low Risk – While interoperability saves time with automatic reconciliation of patient information, considering backup scenarios of manually adding the information to the patient’s chart.
B3.1-3.6	e-Prescribing – Create, change, Cancel, Refill, Receive fill status, request/receive med history	High risk – Incorrectly prescribing a medication and/or inaccurate medication details can adversely affect patient treatment.

Table 2: Tasks Description and Risks

3.5) PROCEDURES

Before the test participants reviewed and signed an informed consent and release form (See Appendix 3). Upon starting the test, the participant’s identity was verified and their demographic information was captured. Participants were then assigned a participant ID. To ensure that the test ran smoothly, three staff members participated in this test, the usability administrator and the data loggers. The administrator moderated the session including administering instructions and tasks. The first data logger monitored task times. A second data logger took notes on task success, path deviations, number and type of errors, post-task rating data, and comments.

Participants were provided with the tasks descriptions to printout and follow along during the session. For each task, the administrator navigated the participant to the starting point and read the task out loud. Task timing began once the administrator finished reading the question and said “Begin”. 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.

The task time was stopped once the participant indicated they had successfully completed the task. Scoring is discussed below in Section 4. Following the session, the administrator gave the participant the post-test questionnaire (see Appendix 5), compensated them for their time, and thanked each individual for their participation. Participants’ demographic information, task success rate, time on task, errors, deviations, verbal responses, and post-test questionnaire were recorded into a spreadsheet.

3.6) TEST LOCATION AND ENVIRONMENT

The test was performed in a virtual setting, using one-on-one remote GoToMeeting sessions. Participants completed the session from their respective home or work locations via a personal computer and browser. To complete the usability tasks, participants were given keyboard and mouse control of the administrators screen. The application was run on Google Chrome using a test environment. System performance was representative to what actual users would experience in a field implementation.

3.7) TEST FORMS AND TOOLS

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

1. Non-Disclosure Agreement (NDA) and Informed Consent Form
2. Moderator’s Guide
3. Post Test Questionnaire

Examples of these documents can be found in Appendices 3-5. The Moderator’s Guide was devised so as to be able to

capture required data and follow a consistent format. The participant’s interaction with the EHRUT was recorded via GoToMeeting.

3.8) PARTICIPANT INSTRUCTIONS

See Appendix 4 for detailed of the instructions in this study.

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

4) DATA SCORING

Measures	Rationale and Scoring
Effectiveness	<p>Task Success: Task success was determined by assigning numeric weights for various levels of task success: Success = 1.0 Partial success = 0.5 Failure = 0.0</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 per task. A task was counted as a ‘Partial success’ if the participant was able to achieve the correct outcome with minimal assistance. . The total number of successes were calculated for each task and provided as a percentage for mean and standard deviation.</p> <p>Task Failure: A task was counted as a “Failure” if the participant was not able to achieve the correct answer or performed it incorrectly, or reached the end of the allotted time before completion. Task time was not taken for errors. Not all deviations were counted as errors. The total incorrect clicks impacted the task success mean and standard deviation.</p>
Efficiency	<p>Task Deviations: The participant’s workflow (i.e. steps) through the application was documented. Deviations occurred if the participant followed an incorrect path. This path was compared to the optimal path. The mean for the observed path was calculated and compared to the optimal path.</p> <p>Task Time: Each task was timed, starting from when the administrator said “Begin” until the task was completed or failed. Only task times for tasks that were successfully completed were included in the average task time analysis. The mean time and standard deviation were calculated for each task. The observed time was subtracted from the optimal task time to get the Task Time Deviation.</p>
Satisfaction	<p>Task Ratings: Participants subjective impression of the ease of use of the application was measured by administering a post-task question via single ease of use question (SEQ). Common convention is that average rating for systems judged easy to use should be 3.3 or above. To measure participants confidence in and likeability of Uprise overall, a post-test questionnaire was administered upon concluding the session. See full Post Test Questionnaire in Appendix 5.</p>

Table 3: Details of how observations were scored

5) RESULTS

5.1) 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 any of the tasks, so no data was excluded from the analysis. No participant received any errors while performing the tasks. There were no testing irregularities or issues that affected data

collection or integration of the results.

The usability testing results for the EHRUT are detailed below (see Table 4). The results should be seen in light of the objectives and goals outlined in Section 3.2 Study Design. The data yielded actionable results that, when corrected, will yield material, positive impact on user performance.

do	Task Name	Task Success (Mean)	Task Success (Std Dev)	Task Time (Mean)	Task Time (Std Dev)	Task Time Deviation (Observed Mean)	Task Time Deviation (Optimal Mean)	Usability Rating	(Std Dev) (Usability)
A1.1	Record medication via CPOE	100	0	11	7	4	8	4.85	0.34
A1.2	Change medication via CPOE	100	0	73	38	47	34	3.8	1.03
A1.3	Display changed CPOE medication order	100	0	8	10	6	4	5	0
A2.1	Record Lab order via CPOE	100	0	32	27	21	18	4.5	0.97
A2.2	Change Lab order via CPOE	100	0	35	11	16	21	4.7	0.68
A2.3	Display changed CPOE Lab order	100	0	6	10	5	4	5	0
A3.1	Record Imaging order via CPOE	100	0	37	15	13	26	4.6	0.52
A3.2	Change Imaging order via CPOE	100	0	24	9	9	16	4.8	0.63
A3.3	Display changed CPOE Imaging order	100	0	4	1	1	3	5	0
A4.1	Using CPOE, trigger a drug-drug interaction by entering a new medication order	95	15.81	106	46	68	47	3.8	1.14
A4.2	Using CPOE, trigger a drug-allergy interaction by entering a new medication order	100	0	39	18	16	25	4.7	0.48
A4.3	Adjust the severity level of a displayed drug-drug interaction	100	0	10	13	10	4	4.9	0.31
A5.1	Record a patient's preferred language, date of birth, birth sex, race, ethnicity, sexual orientation, gender identity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	100	0	70	9	8	62	4.6	0.51
A5.2	Change the patient's preferred language, date of birth, birth sex, race, ethnicity, sexual	100	0	43	10	10	34	4.8	0.42

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	orientation, gender identity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)								
A5.3	Display the patient's changed preferred language, date of birth, birth sex, race, ethnicity, sexual orientation, gender identity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	100	0	18	15	15	8	4.9	0.31
A6.1	Record a problem to the problem list	100	0	25	10	17	17	4.9	0.32
A6.2	Change a problem on the problem list	100	0	11	5	6	6	4.9	0.32
A6.3	Display the active problem list	100	0	9	4	5	5	5	0
A6.4	Display the historical problem list	100	0	10	10	5	5	5	0
A7.1	Record a medication to the medication list	100	0	51	16	19	34	4.2	0.63
A7.2	Change a medication on the medication list	95	15.81	44	18	20	27	4.4	0.70
A7.3	Display the active medication list	100	0	9	3	4	5	5	0
A7.4	Display the historical medication list	100	0	9	5	4	5	5	0
A8.1	Record a medication allergy	100	0	14	4	5	10	5	0
A8.2	Change a medication allergy	100	0	9	4	0	13	5	0
A8.3	Display the active medication allergy list	100	0	4	1	1	3	5	0
A8.4	Display the historical medication allergy list	100	0	5	2	1	5	5	0
A9.1	Add a CDS intervention and/or reference resource for each of the required elements: (problem list)	100	0	60	20	43	20	4.1	0.74
A9.2	Add a CDS intervention and/or reference resource for each of the required elements: (medication list)	100	0	39	9	20	20	4.8	0.42
A9.3	Add a CDS intervention and/or reference resource for each of the required elements:	100	0	31	6	12	20	4.8	0.42

	(medication allergy list)								
A9.4	Add a CDS intervention and/or reference resource for each of the required elements: (at least one demographic)	100	0	30	7	10	20	4.8	0.42
A9.5	Add a CDS intervention and/or reference resource for each of the required elements: (laboratory test)	100	0	29	9	10	20	4.8	0.42
A9.6	Add a CDS intervention and/or reference resource for each of the required elements: (vital signs)	100	0	22	5	2	20	4.8	0.42
A9.7	Add a CDS intervention and/or reference resource for each of the required elements: (a combination of two elements – demographics and vitals)	100	0	23	7	4	20	4.8	0.42
A9.8	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (problem list)	100	0	30	9	12	19	4.9	0.32
A9.9	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (medication list)	100	0	85	40	50	43	3.5	1.18
A9.10	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (medication allergy list)	100	0	82	44	47	43	3.8	0.79
A9.11	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (at least one demographic)	100	0	18	13	9	12	4.9	0.32
A9.12	Trigger the CDS	100	0	60	23	32	31	4.4	0.84

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	interventions/resources added using the applicable data elements from each of the required elements (laboratory test)								
A9.13	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (vital signs)	95	15.81	31	18	17	17	4.7	0.68
A9.14	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements (a combination of two elements – demographics and vitals)	100	0	91	24	31	63	4.6	0.70
A9.15	View the intervention/resource information using the Infobutton standard for data elements in the problem list	100	0	4	2	1	3	5	0
A9.16	View the intervention/resource information using the Infobutton standard for data elements in the medication list	100	0	3	4	1	3	5	0
A9.17	View the intervention/resource information using the Infobutton standard for data elements in demographics	100	0	4	3	1	3	5	0
A9.18	Trigger the CDS interventions/resources based on data elements in the problem list, medication list, and medication allergy list by incorporating patient information from a transition of care/referral summary	95	15.81	133	43	77	64	4.3	0.68
A9.19	Access the following attributes for one of the triggered CDS	100	0	11	12	13	3	4.9	0.32

	interventions/resources: bibliographic citation, developer, funding source, release/revision date								
A14.1	Record UDI	100	0	46	32	31	23	4.1	0.88
A14.2	Change UDI Status	100	0	30	21	23	13	4.5	0.97
A14.3	Access UDI, device description, identifiers, and attributes	100	0	6	3	3	4	4.9	0.32
B2.1	Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record	100	0	90	21	33	60	4.6	0.70
B2.2	Generate a new CCDA with reconciled data	100	0	27	16	19	12	4.5	0.71
B3.1	Create new prescription	95	15.81	83	35	28	60	4.5	0.71
B3.2	Change prescription (dosage or duration)	100	0	45	18	14	34	4.4	0.84
B3.3	Cancel prescription	95	15.81	42	40	23	27	3.9	1.29
B3.4	Refill prescription	95	15.81	55	24	36	24	3.8	0.92
B3.5	Receive fill status notification	90	21.08	79	38	52	34	3.3	1.06
B3.6	Request and receive medication history information	100	0	17	15	15	6	4.6	0.52

Table 4: Data Analysis, n=10

The results from the overall software satisfaction rating (Likert Scale) scored the subjective satisfaction with the system based on performance with these tasks to be a mean of 4.3 out of 5 and standard deviation of 0.67.

5.2) SUMMARY OF VERBALIZED COMMENTS:

Problem List

- Nice to see a summary of patient's problems outside of exam. Nice feature to have

Clinical Decision Support

- Should be able to enter vitals directly in exam modal instead of entering vitals details modal
- The checkbox for making CDS active should be enabled, over requiring the user to type in a date
- Would be nice if CDS shows automatically on Summary screen without refreshing

Electronic Prescribing:

- Not intuitive to cancel a prescribing
- Would be nice to see all medication details on the screen instead of scrolling to see the information

5.3) DISCUSSION OF FINDINGS

1. CPOE Medication Order

- Effectiveness: The success score for each of the tasks under CPOE Medication order was 100%.

- Efficiency: On average participants completed the task within the same number of steps as an expert users for viewing a medication order, but took longer to add and change a medication order. Participants had a slight task time deviation for adding and viewing a medication order, but had difficulty changing a medication order,
 - Satisfaction: The participants gave an average satisfaction rating of 4.6 out of 5 on a Likert scale.
2. CPOE Laboratory Order
- Effectiveness: The success score for each of the task under CPOE Laboratory order was 100%.
 - Efficiency: On average participants completed the task within the same number of steps as an expert user for changing and viewing a laboratory order, but took longer to add an order. Participants had a slight task time deviation for viewing a medication order, with a greater task time deviation for adding and viewing a medication order.
 - Satisfaction: The participants gave an average satisfaction rating of 4.7 out of 5 on a Likert Scale.
3. CPOE Imaging Order
- Effectiveness: The success score for each of the task under CPOE Imaging order was 100%.
 - Efficiency: On average participants completed the task within the same number of steps as an expert user for viewing and adding an imaging order, but took longer to change an imaging order. Participants had a slight task time deviation for adding and viewing an imaging order, but had difficulty with adding an imaging order.
 - Satisfaction: The participants gave an average satisfaction rating of 4.8 out of 5 on a Likert Scale.
4. Drug-Drug and Drug-Allergy Interaction Checks
- Effectiveness: The success score for triggering a drug-allergy interaction by adding a medication order and adjusting severity level of drug-drug interaction notifications was 100%. However, some of the participants faced slight difficulty while triggering a drug-drug interaction by adding a medication order. The success rate for triggering a drug-drug interaction by adding a medication order was 95%.
 - Efficiency: On average participants completed adjusting the severity level of drug-drug interaction notification within the same number of steps as an expert user, but took longer for triggering a drug-drug and drug-allergy interaction by adding a medication order. Participants had a slight task time deviation for drug-allergy interaction by adding a medication order and adjusting severity level of drug-drug interaction notifications, with a greater task time deviation for drug-drug interaction by adding a medication order.
 - Satisfaction: The participants gave an average satisfaction rating 4.4 of out of 5 on a Likert Scale.
5. Demographics
- Effectiveness: The success score for each of the tasks under demographics was 100%.
 - Efficiency: On average participants completed all tasks within the same number of steps as an expert user. Participants had a slight task time deviation for creating and changing demographic information for a patient, with a greater task time deviation for viewing saved demographic details.
 - Satisfaction: The participants gave an average satisfaction rating of 4.8 out of 5 on a Likert Scale.
6. Problem List
- Effectiveness: The success score for each of the tasks under problem list was 100%.
 - Efficiency: On average participants completed changing a problem and viewing active and historical problem list within the same number of steps as an expert user, but took slightly longer for adding a problem. Participants had a slightly higher task time deviation for changing a problem and viewing the patient's active problem list, with a greater task time deviation for adding a problem and viewing the patient's historical problem list.
 - Satisfaction: The participants gave an average satisfaction rating of 5 out of 5 on a Likert Scale.
7. Medication List
- Effectiveness: The success score for adding a medication, viewing active and historical medication list was 100%. However, some of the participants faced slight difficulty while changing a medication. The success rate for changing a medication was 95%.Efficiency
 - Efficiency: On average participants completed viewing the active and historical medication list within the same number of steps as an expert user, but took slightly longer for adding and changing a

medication. Participants had a slightly higher task time deviation for viewing the active and historical medication list, with a greater task time deviation for adding and changing a medication.

- Satisfaction: The participants gave an average satisfaction rating of 4.7 out of 5 on a Likert Scale.

8. Medication Allergy List

- Effectiveness: The success score for each of the tasks under medication allergy list was 100%.
- Efficiency: On average participants completed viewing the active and historical problem list for a patient within the same number of steps as an expert user, but took slightly longer for adding and changing a problem. Participants completed changing the severity for an allergy within the optimal time but had a slightly higher task time deviation for adding an allergy and viewing the patient's active and historical medication allergy list.
- Satisfaction: The participants gave an average satisfaction rating of 5 out of 5 on a Likert Scale.

9. Clinical Decision Support (CDS)

- Effectiveness: The success score for each of the tasks under clinical decision support was 100%, except triggering CDS intervention for vital signs and incorporating a patient's information from a Transition of Care (TOC) to trigger CDS intervention was 95%.
- Efficiency: On average participants completed triggering a CDS intervention for problem list demographics, a combination of 2 elements within the same amount of steps as an expert user. Participants also completed viewing the resource information for a triggered CDS intervention within the same amount of steps as an expert user. Participants took slightly longer to complete the remaining CDS tasks. Participants had a slightly higher task time deviation for setting up a CDS intervention, and triggering a CDS intervention (problems, demographics, lab test, vital signs, 2 elements) and viewing resource information. Participants had difficulty with triggering a CDS intervention for medications, medication allergies, and incorporating a TOC patient to trigger intervention.
- Satisfaction: The participants gave an average satisfaction rating of 4.6 out of 5 on a Likert Scale.

10. Implantable Device List

- Effectiveness: The success score for each of the tasks under implantable device list was 100%.
- Efficiency: On average participants completed changing the UDI status within the same amount of steps as an expert user, but slightly higher for adding and viewing UDI details. Participants had a slightly higher task time deviation for adding an implantable device, changing the status and accessing details for UDI.
- Satisfaction: The participants gave an average satisfaction rating of 4.5 out of 5 on a Likert Scale.

11. Clinical Information Reconciliation and Incorporation

- Effectiveness: The success score for incorporating and reconciling a CCD was 100%. Creating a new CCD with the reconciled data was 95% success rate.
- Efficiency: On average participants completed incorporating and reconciling information from a CCD for a patient and creating new CCD with the reconciled data with a greater amount of steps than an expert user. Participants had a slightly higher task time deviation for both clinical information reconciliation and incorporation tasks when compared to the optimal time.
- Satisfaction: The participants gave an average satisfaction rating of 4.6 out of 5 on a Likert Scale.

12 Electronic Prescribing

- Effectiveness: The success rate for changing a prescription and requesting/receiving Fill History was 100%. Overall faced the most challenges with electronic prescribing. The success rate for adding, discounting and refilling a prescription was 95%, and viewing fill status from a pharmacy was 90%.
- Efficiency: On average participants completed electronic prescribing tasks with a greater amount of steps than an expert user. Participants had a slightly higher task time deviation for all electronic prescribing tasks.
- Satisfaction: The participants gave an average satisfaction rating of 4.1 out of 5 on a Likert Scale.

6) CONCLUSION

6.1) USE, TESTED PERFORMANCE, AND ERROR RATES

No errors were encountered by any participant during the study while performing the tasks. When the user clicked on an incorrect button or followed an incorrect workflow, it did not pose any harm or threat to the integrity of collecting and managing patient health information.

For example, a common incorrect step was in the medication details window. Users often clicked the medication name to edit the medication over the Edit button. This action would not pose any risk to the patient; this action would simply queue the selected medication up for additional actions.

Another common incorrect step was when users were trying to add an implantable device. Most users clicked the add icon within the Procedures/Special Test section over the Implantable Device hyperlink. While there is a likely occurrence for this action because the add icon is typically how values are added, the rate at which implantable devices are added for Optometrist/our targeted users is low. Clicking the plus icon does not pose any risk to the patient; users would just not find the expected value.

Given the tasks tested, there were no identifiable risk-prone errors that have adverse consequences that occurred. To help prevent adverse consequences due to user error, there is built-in validation where possible; such as prompts to confirm deleting of clinical data. There were no testing irregularities or problems observed that would hinder the interpretation of this study's data.

6.2) MAJOR FINDINGS

One of the main goals of this study was to evaluate Uprise application's effectiveness, efficiency, and usability. Based on the findings collected in this study, Uprise performs well in all three categories. All participants were able to complete the desired task outcome within minimal to no assistance, without any failures. This includes half of the participants whose first time it was using the application; further demonstrating the effectiveness of Uprise. Overall, most participants completed the tasks within the same optimal steps as an expert user. Participants had the quickest time and smallest deviation with tasks that align with their everyday workflow. For example, adding an order, problem, and allergy users completed the tasks within an optimal time as an expert user. Uncommon tasks for an Optometry healthcare professional such as adding Implantable Devices, participants had a higher task time deviation.

Based on the data collected, participants faced the most difficulty with electronic prescribing. While all participants were able to successfully achieve the desired task outcome, users had a higher number of steps and task time deviation. Uprise uses an integrated third party for managing medications. The medication details window is a robust module supporting a variety of workflows and functionality. None of the users tested performed the following actions in their clinic: requesting fill status history from Surscripts or viewing the fill status history from a pharmacy. This led to confusing understanding of the tasks and increased the task time deviation. A verbalized comment from a test participant not using Uprise noted that after you have been through the prescription workflow it's easy. This study highlighted a number of actions performed within an exam. Uprise uses the same icons for a variety of actions, such as adding, making it intuitive for users to navigate regardless of where they are in the application. The Orders section within an exam uses the same workflow for laboratory and diagnostic imaging tests, making it easy for a user to place a computerized provider order entry.

Usability ratings for both individual tasks and the overall application indicate a high level of satisfaction and usability. Software is generally considered as easy to use with a usability rating of 3.3, and Uprise performs above that in both tested tasks and overall application. A number of tasks were rated as a 5 out of 5 on a Likert scale and an overall usability of 4.3.

6.3) AREAS FOR IMPROVEMENT

Feedback from participants shows that the application has areas that can be improved. The following list summarizes changes to be considered in future releases:

- Implantable Device:
 - Many had difficulty finding the Implantable Device details module. The action appear to the user as a hyperlink under the Procedures/Special test exam section. In order to prevent confusion we are investigating creating this as its own section.
- Clinical Decision Support
 - Users commented that having the ability to check 'Active' and the current date auto-populate would speed up the workflow. Showing the 'Active' checkbox but disabled was confusing. We have reviewed and prioritized this item to get in for a future release.
- Electronic Prescribing
 - Users commented that in the Medication section of an exam, both the plus and pencil icon had the same effect, but would expect different outcomes. In general users had the most difficulty with the electronic prescribing task due to amount of scrolling, and confusion on the next action. Given Uprise's integration with a third party, we will work with the third party to see what changes can be made on our end as well as make suggestions for changes on their end.

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Appendices

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

- 1) Recruiting Screener
- 2) Participant Demographics
- 3) Non-Disclosure Agreement (NDA) and Informed Consent Form
- 4) Moderator's Guide
- 5) Post Test Questionnaire



Appendix 1: RECRUITING SCREENER

Hello,

I am reaching out to you on behalf of VisionWeb. We are recruiting individuals to participate in a usability study. This study is intended to improve usability and increase patient safety within our electronic health record, Uprise.

Participants will perform a series of tasks and be asked for feedback. We would like to ask you a few questions to see if you qualify. Your opinion is valuable to continue fostering innovation within the healthcare industry. We greatly appreciate your time.

1. Are you Male or Female?
2. Do you, or does anyone in your home, work in marketing research, usability research, web design?
3. Which of the following best describes your age: 20-39, 40-59, 60-74, 75 and older?
4. What is your current position and title? If you are in the healthcare industry please specify which specialty.
5. About how many hours per week do you spend on the computer?

We would be more than happy to answer any questions you may have. After we have received answers to the above questions, we will coordinate with you to schedule a date that best fits your schedule.

Appendix 2: PARTICIPANT DEMOGRAPHICS

ID	Gender	Age	Education	Occupation/Role	Professional Experience	Computer Experience	Product Experience	Assistive Technology Needs
1.	Female	30-39	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Optometrist	60	300	17	No
2.	Male	30-39	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Optometrist	96	240	0	No
3.	Male	40-49	Bachelor's Degree	Manager (Optician)	240	264	22	No
4.	Male	30-39	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Optometrist	108	300	0	No
5.	Female	30-39	Some college credit, no degree	Operation Director (Optometry)	120	300	4	No
6.	Male	30-39	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Optometrist	96	300	0	No
7.	Female	50-59	High school graduate, diploma or the equivalent (for example: GED)	Manager (Optician)	360	216	36	No
8.	Male	50-59	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Optometrist	336	180	36	No
9.	Female	30-39	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Optometrist	84	276	0	No
10.	Female	30-39	Trade/technical/vocational training	Certified Ophthalmic Assistant	48	144	0	No



Appendix 3: CONSENT AGREEMENT – NDA AND INFORMED CONSENT

Purpose

The purpose of this study is to evaluate an electronic health records system. If you decide to participate, you will be asked to perform several tasks and give your feedback. The study will last about 75 minutes.

Agreement

I understand and agree that as a voluntary participant in the present study conducted by VisionWeb I am free to withdraw consent or discontinue participation at any time. I understand and agree to participate in the study conducted by the VisionWeb.

I understand that the information is for research purposes only and that my name will not be used for any purpose other than research.

I understand and agree that the purpose of this study is to make software applications more useful and usable in the future.

I understand and agree that the data collected from this study will be shared with others outside of VisionWeb. I understand and agree that data confidentiality is assured, because only deidentified data – i.e., identification numbers not names – will be used in analysis and reporting of the results.

I agree to immediately raise any concerns or areas of discomfort with the study administrator. I understand that I can leave at any time.

Confidentiality

I acknowledge the confidential nature of this study and agree that I will not (a) disclose any Confidential Information to any Person/person or entity, except to VisionWeb's Representatives/Affiliates, employees, advisors and other representatives who need

to know the Confidential Information to assist in the study, or (b) use the Confidential Information, or permit it to be accessed or used, for any purpose other than to perform my obligations under this Agreement.

Publicity and Announcements

I will not (orally or in writing) publicly disclose or issue any press release, make any other public statement, or otherwise communicate with the media, concerning this Agreement, the existence of this Agreement or the subject matter hereof, without the

prior written approval of VisionWeb, except to the extent that it is required to make any public disclosure or filing regarding the subject matter of this Agreement (i) by applicable Law, or (ii) under any rules or regulations of any securities exchange of which the securities of such party are listed or traded or (iii) in connection with enforcing its rights under this Agreement.

Please check one of the following:

YES, I have read the above statement and agree to be a participant.

NO, I choose not to participate in this study.

Signature: _____

Printed Name: _____

Date: _____

Appendix 4: MODERATORS GUIDE

Prior to test day

- Confirm schedule with participants
- Ensure EHRUT lab environment is running properly
- Send participants NDA and Informed Consent

Day of test day

- Send testing reminder
- Provide copy of tasks and inform participant to print out

Prior to each participant session:

- Reset application

During test:

- Confirm identity and demographics
- Record session
- Reset application to starting point for next task

Orientation:

Thank you for participating in this study. This is a usability study required as part of our ONC 2015 Certification – Safety Enhanced Design. Our session today will last 60 – 75 minutes. During that time you will take a look at our electronic health record system. Uprise version 3.1. Our goal is to increase usability and prevent patient safety errors by creating an intuitive design and workflow. Please be honest with your feedback.

You will be presented with a series of tasks to complete. For each task I will navigate you to the starting point of that task and read the task out loud. After I have finished reading the description of the task, I will say “Begin”, at this point perform the task as described. Please complete these tasks on your own without any help from the interviewer, and as quickly as possible with the fewest errors or deviations. I will ask your impression about the task once you are done.

We are recording our session today. All information that you provide will be kept confidential and your name will not be associated with your comments at any time.

Do you have any questions or concerns before we begin?

Post-test Conclusion:

Thank you for participating in this study. The primary goal of this study was to test the usability of common clinical workflows within Uprise 3.1. If you have any questions please do not hesitate to contact us.



Appendix 5: SYSTEM USABILITY SCALE QUESTIONNAIRE

What was your overall impression of this system?

Please rate the software: Task Ratings: 1 = Very Difficult, 2=Difficult, 3=Neither Easy Nor Difficult, 4=Easy, 5=Very Easy

What aspects of the system did you like most?

What aspects of the system did you like least?

Were there any features that you were surprised to see?

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

Would you recommend this system to your colleagues?