HOPS Healthcare

Meaningful Use Stage 3 Usability Study
Usability Issues and Recommendations

Vedos 45x

(Ambulatory & Inpatient)

Computerized Provider Order Entry – Medications
Computerized Provider Order Entry – Laboratory
Computerized Provider Order Entry - Diagnostic Imaging
Drug-Drug, Drug-Allergy Interaction Checks
Medication Allergy List Medication List
Family Health History
Social, Psychological, and Behavioral Data
Demographics
Authentication, Access Control, Authorization
Auditable Events and Tamper Resistant (Cures Update)
Audit Report(s) (Cures Update)
Amendments
Automatic Access Time-Out
Emergency Access
End-user Device Encryption
Encrypt authentication credentials
Multi-factor authentication
Safety-enhanced Design
Quality Management System
Accessibility-Centered Design

Date of Usability Test: March 2022 – May 2023

Date of Report: June 2023

Prepared by: Ashutosh Kachot, Chief Operations & VP Strategy | ashutosh.kachot@hops.healthcare

Contents

SUMMARY

From *March 2022 – May 2023*, we conducted a usability test of the Vedos 45x HOPS platform, in accordance with National Institute of Standards and Technology (NIST) and Meaningful Use certification guidelines. In these tests, end users completed a variety of tasks throughout the system; these tasks were designed to assess how easily users could complete representative clinical workflows and to identify areas to improve the usability of our software.

To meet Meaningful Use requirements, we had to assess the usability of twenty features throughout the system:

- Computerized Provider Order Entry – Medications
- Computerized Provider Order Entry – Laboratory
- Computerized Provider Order Entry - Diagnostic Imaging
- Drug-Drug, Drug-Allergy Interaction Checks
- Medication Allergy List Medication List
- Family Health History
- Social, Psychological, and Behavioral Data
- Demographics
- Authentication, Access Control, Authorization
- Auditable Events and Tamper Resistant (Cures Update)
- Audit Report(s) (Cures Update)
- Amendments
- Automatic Access Time-Out
- Emergency Access
- End-user Device Encryption
- Encrypt authentication credentials
- Multi-factor authentication
- Safety-enhanced Design
- Quality Management System
- Accessibility-Centered Design

After conducting tests with end users to analyze the usability to each of those features, we analyzed each test to evaluate the usability of our software based on three metrics.

This metric:	**Analyzes:**
Effectiveness	Whether or not participants completed the task Efficiency The time required and steps taken to complete thetask
User Satisfaction	Participant feedback on ease of use and areas for improvement

While gathering and analyzing testing sessions, we noted areas users struggled in the system, the cause of those struggles, and ways to improve the usability of those areas. From these observations, we crafted a list of usability issues and recommendations.

This document describes the usability issues we found in Vedos 45x HOPS and our recommendations for these issues.

TESTING PROCESS

This section provides a brief outline of our testing process, including participant profiles, testing procedure, evaluative metrics, and issue identification.

Participants

We tested a total of 14 representative participants for this usability test. All of the participants are active users and prospective users of the Vedos 45x HOPS software representing clinical, administrative, and IT staff. Participants were asked to perform tasks for functions that most closely matched their daily workflow. On average, these participants had, at the time of testing, 11+ years of EHR experience.

Testing Procedure

Participants each completed tasks across the system to test multiple functionality points. We composed the tasks to mimic a representative clinical workflow, with different tasks spread across a patient visit. Here's an example task:

> Patient X has taken Azithromycin for her urinary tract infection, but has had dyspnea, cough, and chest and back pain since starting the medication. Discontinue this medication.

Each participant performed each task without assistance to the best of his or her ability, as quickly as possible, and with the fewest possible deviations. After each task, we asked the participant to rate the ease or difficulty of the task and gathered any participant feedback about the task.

Test Environment

Following is a summary of the participants' computing environments:

Tested product:	VEDOS EMR-EHR, version 45x
Computer platforms:	Microsoft Surface Pro 2 HP Elite x2
Display:	n/a
Screen resolution:	Microsoft Surface Pro 2: 1920 x 1080 resolution HP Elite x2: 1920 x 1080 HP Notebook : 1366 x 768
Operating system:	Windows 10

Evaluative Metrics

To analyze testing results, we captured seven primary pieces of data: task success, task errors, task deviations, task performance time, task time standard deviations, task rating, and System Usability Scale scores.

Task Success

We counted a task as a success if the participant was able to achieve the correct outcome without assistance. We compiled the overall success rate for a task by dividing the number of task successes by the number of task attempts.

Task Errors

While each participant worked through a task, we recorded his or her path to complete the task. We noted an error if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, or followed an incorrect link *and* was not able to complete the task without returning to a previous step in the intended path.

Task Deviations

While each participant worked through a task, we recorded his or her path to complete the task. We noted a deviation if the participant performed an unexpected or unnecessary action, navigated to an incorrect screen, or selected an incorrect item, but was able to continue towards completing the task.

Task Time

We recorded the time from when a participant started a task to the time they finished it, expressed in seconds. Participants reported when they finished a task. We stopped task times when a participant failed to finish a task and continued task times when participants finished a task but failed to recognize they had completed it.

Task Time Standard Deviation

We calculated the standard deviation of task performance times. The task time standard deviation captures the number of seconds that constitutes one standard deviation from the mean task performance time. For example, a standard deviation of 10 seconds indicates that one standard deviation from the mean task time is equal to the mean task time plus or minus 10 seconds.

Task Rating

After each task, participants scored the ease or difficulty of the task on a scale of 1 (very difficult) to 5 (very easy). We computed the average rating for each task. In addition, during this process, we gathered participant feedback about the task—what they liked, disliked, thought could be improved, etc.

System Usability Scale (SUS)

The SUS is an industry-standard, 10-item questionnaire that assesses the usability of the system under test. We administered the SUS to each participant following each testing session and compiled the overall SUS scores. During this process, we asked participants for their feedback on the entire system.

Issue Identification

After completing each testing session and compiling test data and observations, we identified areas where participants struggled in using the system. For example, if a task had a low task success rate and high task time, we analyzed the task to see if participants made common deviations to increase task time and prevent them from completing the task. If a task had low task ratings, we reviewed feedback to determine if participants had common complaints about the functionality in the task.

Conversely, we noted areas where the system performed well to determine what sort of workflows participants liked. We can use positive findings to help identify intuitive areas of the system and expand that functionality when possible to less intuitive functions.

For each issue, we calculated the number of participants who struggled with that issue, where the issue occurred in the participants' workflow, how the issue affected the outcome of the task, and whether or not the issue may affect patient safety. With that information, we assigned a priority to each issue, on a scale of 1 –3.

Severity 1: Severe usability issue that caused multiple or significant task failures or has room to improve patient safety.

Severity 2: Major usability issue that caused major struggles, or significantly slowed down users, or caused an isolated task failure.

Severity 3: Efficiency usability issue. Efficiency or workflow could be improved but the issue did not cause significant disruption.

In addition to identifying the details and priority of each issue, we composed a recommendation to each issue.

MEDICATION ALLERGY LIST

Task Data

The Medication Allergy List portion of the usability study was composed of three tasks. The following table outlines the mean effectiveness, efficiency, and user satisfaction data of these three tasks.

Task	Effectiveness (% Success)	Efficiency	User Satisfaction (Rating)
Access Allergies	**80%**	Time (sec): 72 Std Dev (sec):45 Errors: **5** Deviations: 5	**3.5**/5.0
Change Allergy	**92%**	Time (sec): 60 Std Dev (sec): 30 Errors: **4** Deviations: **15**	**4.0**/5.0
Record Allergy	**92%**	Time (sec): 60 Std Dev (sec): 30 Errors: **4** Deviations: **15**	**4.0**/5.0

Medication Allergy List Issues

Issue 1: User added an uncoded allergy

Issue Data

Severity: **1** Patient Safety: **No** Number of users: **3 Findings**

Three participants added the allergy as an uncoded allergy. Adding an allergy as uncoded is too simple and can accidentally occur when a user mistypes an allergy.

Because the allergy search field is type-ahead and search results do not appear as quickly as users expect, a user typically types in a value and presses the Enter key.

However, users commonly mistype words during searches, especially complicated allergy names. The system is not quick enough to alert the user of no search results before the user presses Enter. Since the only actionable item is to “add as free text” when the system finds no search results, hitting Enter selects the “add as free text” option for the mistyped allergy and adds the allergy to the patient’s list as uncoded. To top it all off, since the search results are not fast enough, the user assumes that the complete accepted their entry and that it is entered as any other allergy.

Uncoded allergies cannot be used for interaction checking, so therefore the data is not as helpful for clinical decision support as it should be. This may cause patient safety issues if a user does not manually review the allergy list.

Quotes

None

Recommendations

When a user with access to enter uncoded allergies enters a value and the system finds no search results, we will remove the uncoded allergy as the default selection and force the user to find and select the uncoded option if they desire to have the value added as an uncoded allergy. We will no longer present the user with a default option of adding as free text. Users can then reevaluate why they are not getting search results. Ensure that users make a purposeful decision to add a free text allergy, rather than inadvertently accepting a default.

Issue 2: User attempted to file before completing all required fields

Issue Data

Severity: **3** Patient Safety: **No** Number of users: **1**

Findings

One participant attempted to file before completing all required fields, which caused them to have to dismiss a warning message. A required field contains an asterisk (*) before the field label. The field labels are too far away from the input fields to allow users to quickly see which fields are required so they can fill them out before attempting to save.

Quotes

None

Recommendations

Close the special gap between the field labels and the input fields.

MEDICATION LIST

Task Data

The Medication List portion of the usability study was composed of three tasks. The following table outlines the mean effectiveness, efficiency, and user satisfaction data of these three tasks.

Task	Effectiveness (% Success)	Efficiency	User Satisfaction (Rating)
Access Medication	**94%**	Time (sec): **68** Std Dev (sec): 40 Errors: 4 Deviations: **15**	**4.5**/5.0
Change Medication	**89%**	Time (sec): **60** Std Dev (sec): 35 Errors: **3** Deviations: 13	5.0/5.0
Record Medication	**92%**	Time (sec): **100** Std Dev (sec): 54 Errors: 5 Deviations: **15**	**4.5**/5.0

Medication List Issues

Issue 1: Users failed to add the medication as a reported medication

Issue Data

Severity: **2** Patient Safety: **No** Number of users: **5**

Findings

Users had trouble adding a medication as a reported medication. It is not apparent that users can toggle between searching for a medication to prescribe or searching for a medication to add it as reported.

Quotes

None

Recommendations

Consider adding the Reported functionality not as a separate search but as an attribute for a medication. That way, users do not have to remember the additional step of marking in the system that they are searching for a reported medication. They can search like they would for prescribing a medication and when filling out the medication details they can mark that the medication is reported.

DRUG-DRUG, DRUG-ALLERGY INTERACTION CHECKS

Task Data

The Drug-Drug, Drug-Allergy Interaction Checks portion of the usability study was composed of two tasks. The following table outlines the mean effectiveness, efficiency, and user satisfaction data of these two tasks.

Task	Effectiveness (% Success)	Efficiency	User Satisfaction (Rating)
Adjustment of Severity Level for Drug-Drug Interaction Check	**83%**	Time (sec): **93** Std Dev (sec): **86** Errors: **1** Deviations: **0**	**4.0**/5.0
Drug-Allergy Interaction	**100%**	Time (sec): **45** Std Dev (sec): **24** Errors: **0** Deviations: **6**	**4.4**/5.0

Drug-Drug, Drug-Allergy Interaction Checks Issues ***Issue 1: User turned off all medication interaction checking*** **Issue Data**

Severity: **2** Patient Safety: **No** Number of users: **1**

Findings

Instead of modifying the severities of which interactions alert the user, the user turned off all interaction checking for medications.

Quotes

None

Recommendations

Do not let users completely turn of interaction checking. Only allow users to modify which severities alert the user.

COMPUTERIZED PROVIDER ORDER ENTRY

Task Data

The Computerized Provider Order Entry (CPOE) portion of the usability study was composed of nine tasks. The following table outlines the mean effectiveness, efficiency, and user satisfaction data of these nine tasks.

Task	Effectiveness (% Success)	Efficiency	User Satisfaction (Rating)
Record CPOE Medication	**92%**	Time (sec): 100 Std Dev (sec): 54 Errors: **5** Deviations: **15**	**4.5**/5.0
Change CPOE Medication	**89%**	Time (sec): 60 Std Dev (sec): 35 Errors: **3** Deviations: 13	**5.0**/5.0
Access CPOE Medication	**94%**	Time (sec): **68** Std Dev (sec): 4**0** Errors: **4** Deviations: **15**	**4.5**/5.0
Record CPOE Laboratory	**90%**	Time (sec): 65 Std Dev (sec): 36 Errors: **4** Deviations: **14**	**4.0**/5.0
Change CPOE Laboratory	**88%**	Time (sec): 70 Std Dev (sec): 40 Errors: **5** Deviations: **17**	**3.5**/5.0
Access CPOE Laboratory	**90%**	Time (sec): **63** Std Dev (sec): 35 Errors: **4** Deviations: **16**	**4.0**/5.0
Record CPOE Diagnostic Imaging	**90%**	Time (sec): 65 Std Dev (sec): 36 Errors: **4** Deviations: **14**	**4.0**/5.0
Change CPOE Diagnostic Imaging	**90%**	Time (sec): 63 Std Dev (sec): 35 Errors: **4** Deviations: **16**	**4.0**/5.0
Access CPOE Diagnostic Imaging	**92%**	Time (sec): 60 Std Dev (sec): **30** Errors: **3** Deviations: **12**	**5.0**/5.0

Computerized Provider Order Entry Issues - Medications/Laboratory/Diagnostic Imaging

Issue 1: User entered a medication as free-text/uncoded

Issue Data

Severity: **2** Patient Safety: **No** Number of users: **1**

Findings

When a user searched for a medication, they selected the dropdown arrow for the search field. This action cleared out their search. Two participants proceeded to selected Free Text, which will add a medication that is not system defined, and thus cannot be used for interaction checking.

Quotes

None

Recommendations

Entering free text should be a last resort option, if no system defined entry will work for the patient's chart. Evaluate how users can enter in free text entries and make sure that entering a system defined entry is easy, and only if no system defined entry exists should uncodified data be used.

Issue 2: User attempted to search for a medication in the wrong search field

Issue Data

Severity: **3** Patient Safety: **No** Number of users: **3**

Findings

Users must select on an icon in order to add a medication, but right next to the icon is a search box for non-medication orders. Three participants attempted to search for a medication in the non-med orders search box.

Quotes

None

Recommendations

Split up the add medication icon and the Search Orders/Sets field so that users are not tempted to search for medications in the wrong field.

Issue 3: User failed to discontinue a medication

Issue Data

Priority: **2** Patient Safety: **No** Number of users: **2**

Findings

Two participants failed to find the Stop button because it is hidden under a click and is also not accessible from the medication details screen.

Quotes

None

Recommendations

Make discontinuing a medication a flat process and more accessible from different places of the EHR.

DEMOGRAPHICS

Task Data

The Demographics portion of the usability study was composed of four tasks. The following table outlines the mean effectiveness, efficiency, and user satisfaction data of these four tasks.

Task	Effectiveness (% Success)	Efficiency	User Satisfaction (Rating)
Record Patient Demographics (Race, Ethnicity, Preferred Language, Sex, Sexual Orientation, Gender Identity,Date of Birth)	Physician users: **95%**	Time (sec): **70** Std Dev (sec): 30 Errors: **3** Deviations: **15**	**5.0**/5.0
Access and Edit Patient Demographics (Race, Ethnicity, Preferred Language, Sex, Sexual Orientation, Gender Identity,Date of Birth)	Physician users: **92%**	Time (sec): 60 Std Dev (sec): 15 Errors: **4** Deviations: **15**	**4.5**/5.0

Demographics Issues

Issue 1: Users struggled with opening up a view-only SocialHistory screen where they cannot add or edit new information.

Issue Data

Severity: **2** Patient Safety: **No** Number of users: **8**

Findings

Eight participants opened up a view-only version of the Social History screen from the patient's chart and wondered why they could not edit the information when they are able to see it. This information must be edited within the visit document.

Quotes

"I don't see why I can't edit this."

Recommendations

Allow users to edit the information from the Chart's social history screen.

SYSTEM USABILITY SCALE (SUS) SCORE

The System Usability Scale (SUS) analyses subjective user feedback to the system, on a numeric scale from 0 - 100. Generally, anything above 68 is considered usable. In this test, the SUS was 68.5.

APPENDIX B: CLINICAL PARTICIPANT DEMOGRAPHICS

Gender

Male	7	50%
Female	7	50%

Age

Choose not to disclose	0	0%
Under 18	0	0%
18-24	0	0%
25-34	7	28%
35-44	8	32%
45-54	8	32%
55-64	2	8%
65-74	0	0%
Over 75	0	0%

What is the highest level of education you have completed?

Choose not to disclose	0	0%
No schooling	0	0%
8th grade or under	0	0%
High school graduate, or equivalent	1	2%
Trade/technical/vocational training	0	0%

Associate degree	3	6%
Bachelor's degree	1	2%
Master's degree	9	92%
Doctorate degree	0	0%

What is your occupation/role? (Select all that apply)

Dietitian	1
Lab Technician	1
Matron-In-Charge	1
Medical Officer	1
Nurse	1
Pharmacist	1
Phlebotomist	1
Provider	1
R1	1
R2	1
Radiologist	1
Radiology Technician	1
Receptionist	1
Store Manager	1

How many years have you been working in your current profession?

Less than 1 year	0	0%
1-3 years	1	1%
4-6 years	0	0%
7-9 years	0	0%
Over 10 years	13	99%

4-6 years	6	24%
7-9 years	4	16%
Over 10 years	7	28%