

ISO/IEC 25062 Common Industry Format for Usability Test Reports

myAvatar Certified Edition v2017.01

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Netsmart Technologies

Address inquiries to: Carol Reynolds

Phone: 1-913-696-2818

Email: creynolds@ntst.com

Address: 4950 College Blvd. Overland Park, KS 66211

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Executive Summary

For almost a decade, Netsmart has been highly focused on solution usability. As part of this initiative we worked with a leader in user experience research and design to analyze our solutions and create a base set of guidelines. A core part of our Software Development Lifecycle (SDLC) includes integration of a UX (User Experience) team with a focus of usability based upon safety-enhanced design including patient safety, increased individual effectiveness and efficiency through increased user productivity/efficiency, decreased user errors, and increase in safety and improved cognitive support. A user centered design process is integrated into the SDLC to ensure a safety-enhanced design is achieved.

The User Centered Design process that is utilized at Netsmart is the [ISO/IEC 25062:2006](#). This standard is the common industry standard for usability test reports. This format includes the following steps: description of the product, goals of the test, test participants, tasks the users were asked to perform, experimental design of the test, the method or process by which the test was conducted, the usability metrics and data collection methods, and the numerical results. This process is used because it very closely aligns with the requirements set for Safety-Enhanced Design. It also provides the most clarity on what the best practice is for execution of each step.

This standard was applied to the usability test of myAvatar Certified Edition v2017.01 which was conducted February 8, 2017 at Netsmart's facility in Kansas. This test measured the usability of the application by tracking efficiency, effectiveness, and satisfaction. Ten participants of varying experience levels completed tasks which were reflective of frequently used tasks in the application, such as medication/lab/radiology ordering, recording problems and medication allergies, and viewing drug-drug and drug-allergy interactions.

The test sessions were recorded to assist in measuring data. Experienced usability specialists moderated the tests and compiled the metrics. Key metrics that were tracked include task completion rate, task time, error rate, task deviations, satisfaction ratings, and participant verbalizations and recommendations.

The testing showed a 100% task completion rate, a less than 1 minute average task time, and an SUS score of 72. And while these metrics support the usability of the application, there is always room for improvement. Based on recommendations voiced during the tests and the rate of errors/task times associated with certain tasks, there were a few notable improvement ideas. For instance, it was brought up that the action buttons in the application should be more clear and consistent as to increase efficiency and accuracy of the user.

Introduction

Full Product Description

The Order Entry component of myAvatar Certified Edition v2017.01 is designed to maximize the workflows for managing outpatient lab, radiology and medications orders. myAvatar Certified Edition v2017.01 provides our users with an efficient workflow to review, add, and change medication, laboratory, and radiology orders as well as laboratory order results. Information like allergies, diagnoses, and interactions are displayed to the user as they work with the various orders. Users can also review, add, and change problems, demographics, and implantable devices as well.

Test Objectives

This test was to evaluate the usefulness and functionality (does the application work as intended), ease of use (do both physicians and non-physicians understand how to use the application), safety (ability to avoid errors), and satisfaction (what is the desirability of the application) of myAvatar Certified Edition v2017.01. The content of the myAvatar Certified Edition v2017.01 was a similar depiction of what a participant would see in the production application. Aside from test

patients in the application, all other libraries were the same as they would be in production, e.g. drug libraries, drug to drug interactions, drug to allergy interactions, diagnosis codes, medication libraries, etc.

The goals for this usability test for the myAvatar Certified Edition Outpatient Order Entry were to test against 10 different areas being certified:

- 170.315(a)(1) CPOE – Medications
- 170.315(a)(2) CPOE – Laboratory
- 170.315(a)(3) CPOE – Diagnostic Imaging (NEW)
- 170.315(a)(4) Drug-drug, Drug-allergy Interaction Checks
- 170.315(a)(5) Demographics (NEW)
- 170.315(a)(6) Problem List
- 170.315(a)(7) Medication List
- 170.315(a)(8) Medication Allergy List
- 170.315(a)(14) Implantable Device List (NEW)
- 170.315(b)(3) Electronic Prescribing

Methods

Participants

Ten participants were tested in this study. Our intended users are clinicians, so we used participants with a clinical background to give us more accurate and reliable results. We also used participants with varying professional experience and licenses, computer experience levels, and experience with the product. We used these varying experience levels because we understand that in a real-world setting, users would have varying computer and product experience levels. The table below represents the demographics that were collected from each participant. The participants chosen were not compensated fiscally, as to decrease in biased results. These participants were not directly involved in the development of the application.

	Occupation/Role	Professional Experience	Age	Sex	Education	Computer Experience	Product Experience
1	Chief Nursing Officer	RN,BSN	50	F	Bachelor’s of Science in Nursing	15 years	3.5 years
2	Director of Product Management	RN	50	F	Bachelor’s in Nursing	20 years	Minimal
3	Managing Architect	N/A	26	M	Bachelor’s	16 years	4 years
4	Managing Solutions Architect	N/A	28	F	Bachelor’s in Family Studies and Human Services	5 years	5 years
5	Learning Architect	N/A	47	F	BA	16 years	13 years
6	Chief Clinical Officer	Licensed Psychologist	67	M	PHD	30 years	Low

7	Senior Clinical Solutions Consultant	RN	58	F	NEED	18 years	Less than 1 year
8	Product Manager	N/A	26	F	Bachelor's of Science	12 years	3 years, 8 months
9	Senior QA Engineer	N/A	45	F	Bachelor's of Speech Pathology and Audiology	20+ years	4 years
10	Delivery Consultant	N/A	24	M	Bachelor's in Management Information Systems	15 years	1 year

Participant Instructions

All participants were given a short explanation of what the tests entail and were given the ability to ask questions before the test was administered. The test moderator read the tasks/scenarios off to each participant and the participant then attempted the explained task. Participants had to opportunity to ask for clarification of tasks. We measured task completion rate, task time, error rate, and satisfaction ratings. We observed their behavior and documented verbalizations to see patterns of across participants. The information captured with Morae includes audio, screen capture, and mouse and keyboard inputs. GoToMeeting allowed us to record remote users' screens, audio, and mouse movements. This information was reviewed after the session to collect metrics.

Experimental/Study Design

The objective of this test was to measure effectiveness, efficiency, and satisfaction. The participants' vocal feedback and reactions were recorded. This qualitative feedback was analyzed for patterns in their responses. This feedback was used to inform the design. Quantitative observations were made through the dependent variables below. The quantitative metrics measured were task success rate, task failure rate, task deviation rate, error rate, task time, and user satisfaction rating. The participants filled out the SUS questionnaire to assess the satisfaction of the participant after using the application.

Tasks/Scenarios

The participant was given the set of tasks below which reflect tasks that a user of the application would complete. The tasks were chosen because of their importance in regards to functionality, criticality in regards to safety, and frequency of use in the application. The participants were welcome to ask the moderator questions and refer back to the task sheet given. Below are the scenarios that were given to participants.

Scenario 1 – Patient A - Tasks: Record demographics (170.315 (a)(5))

- A new client comes in for an appointment. You want to check if they are in your system. Open the “Admission” form.
- Type in “(name)” in Last Name. Type in “(name)” in First Name. Select “(gender)” as Gender. Click Search
- You see that there are no clients that match your search so click Add new Client to admit this client into the system.
- Click yes to auto assign next ID number
- Enter in a birth date for the client
- Enter a pre-admit/admission date

- Enter a pre-admit/admission time
- Enter in Program (O.P) Adult Psych
- Enter a type of admission
- Click Demographics tab in the left hand column to enter some demographics for this client.
- Fill out Ethnicity
- Fill out Race
- Fill out Preferred Language
- Fill out Sexual Orientation
- Fill out Gender Identity
- Submit your changes.

Scenario 2 – Patient B - Tasks: View demographics (170.315 (a)(5)), Change demographics (170.315 (a)(5))

- The client has told you that they have gotten divorced since the last visit, and that they are now working part time 16 hours instead of full time. Open the “Update Client Data” form for “(name)”.
- Update the client’s marital status and employment status.
- Submit the changes.

Scenario 3 – Patient B - Tasks: View medications/medication list (170.315(a)(1) & 170.315(a)(7)), View medication allergy list (170.315(a)(8)), Change medication/medication list (170.315(a)(1) & 170.315(a)(7)), Record medication/medication list (170.315(a)(1) & 170.315(a)(7)), Electronically prescribe (170.315(b)(3))

- As you talk with your client during the appointment, they state that they continue to have trouble sleeping. You decide to prescribe Lunesta. Open the “Launch OrderConnect” form for “(name)”.
- You review the EMR’s active medication list and medication history list and realize the patient has been prescribed Ambien, 10 mg, as needed at bedtime.
- You also see the patient’s current medication allergy list and see they are allergic to Lunesta.
- In order to prevent prescribing more than one sleep agent (e.g., same-class polypharmacy) and avoid an allergic reaction, you discontinue the Ambien 10mg and you prescribe a new drug, trazodone, 150 mg tablet, as needed at bedtime.
- Upon completing the order send the prescription via eRx to the Surescripts Test Pharmacy.
- Verify the order was made by reading back the new medication list.
- Access the RxHx tab to see the medication history screen. Click on the Trazodone record and click to add a Comment. You want to make note that this was prescribed over Lunesta because of a drug allergy, so type that into the comment box.
- Close the chart

Scenario 4 – Patient B - Tasks: View medication allergies (170.315(a)(8)), Record medication allergy (170.315(a)(8)), Change medication allergy (170.315(a)(8)), View lab tests (170.315(a)(2)), Order lab test (170.315(a)(2)), Record medication (170.315(a)(1)), View drug-allergy interactions (170.315(a)(4)), View drug-drug interactions (170.315(a)(4)), Change medication (170.315(a)(1)), Change the level of severity for drug-drug interactions (170.315(a)(4))

- Your patient comes in for their regular appointment. You discuss the current symptoms they have been experiencing. They mention they are having a mild allergic reaction of swelling when taking their Abilify. Open the “Allergies and Hypersensitivities” form for “(name)”. Add Aripiprazole (medication name for Abilify brand) as an allergy to the chart with a severity of mild. Close the form after adding.
- Open the “Launch OrderConnect” form for “(name)”.

- View all allergies for the patient. Verify that the Aripiprazole allergy added in the EHR appears in the client's known allergies list.
- The client also indicates that their peanut allergy has gone away and they no longer have any reactions to eating peanuts. Click on the allergy tab. Discontinue the peanut allergy. While here, change the severity of the Abilify allergy to Moderate, because the patient indicated that their swelling gets pretty bad after taking their Abilify.
- The patient complains about being overly fatigued, achy and has trouble urinating. You suspect it's a simple urinary tract infection from the symptoms described, but want to be sure.
- Select the plus button next to the form title tab and select the "Launch OrderConnect" form.
- You plan to order a urinalysis. But you notice that a urinalysis has already been ordered for the patient.
- You also prescribe Bactrim for the suspected UTI. You notice that on the order confirmation screen, you see both moderate and major interaction alerts. You would like to only see major interactions. Close the client's chart in the browser. Close the "Launch OrderConnect" form in the myAvatar application.
- Log into the Admin tool.
- Go to the alerts page and select to change the "alerts with severity shown when severity level is:" dropdown to Major or higher. Save the changes and Log off of the admin tool.
- Re-open the "Launch OrderConnect" form for the client "(name)".
- Proceed to prescribe Bactrim again. Now when you get to the interaction alerts on the order confirmation screen, you see that the alerts only appear for major drug-drug interactions. Complete the order.
- After you speak to your client more, you decide to add a Comprehensive Metabolic Panel.
- The patient reports they don't feel like the Flonase has been working, so you decide to discontinue Flonase as well as Abilify, since the client reported the allergic reaction.
- Close the chart

Scenario 5 – Patient B - Tasks: View implantable device list (170.315(a)(14)), Change implantable device list (170.315(a)(14)), Record implantable device list (170.315(a)(14))

- The client tells you that they just had an implantable device removed. You want to see if the history of this implantable device is in their record. Open the "Implantable Device List" form for "(name)".
- Enter the client's name and the unique device identifier. Review the information that has been returned.
- You see that the device has not been added to their record, so file the device to the client and set the status as inactive.

Scenario 6 – Patient B - Tasks: View problem list (170.315(a)(6)), Record problem (170.315(a)(6)), Change problem (170.315(a)(6))

- The patient has been complaining of a migraine. Open the "Problem List" form for "(name)".
- Add the problem "Migraine" to the patient's problem list.
- Put in the remaining required fields (Date of onset and Status).
- The patient also tells you they no longer have the flu. Change the status of flu to "inactive".
- Save the changes.

Scenario 7 – Patient C - Tasks: View lab test results (170.315(a)(2)), Change lab test (170.315(a)(2)), Add radiology order (170.315(a)(3)), Change radiology order (170.315(a)(3)), View radiology order (170.315(a)(3)), Change medication (170.315(a)(1))

- At the last visit you ordered a urinalysis lab test. Open the "Launch OrderConnect" form for "(name)". Review the lab test results for the order, changing the status to clinically reviewed.
- To be thorough, you decide to order a CT scan to determine if the patient's symptoms could be related to a stroke.

- After placing the order, the patient tells you that they will be out of town for the next three days, so you will need to change the order's start date to 3 days later. Discontinue the placed order and re-order the new order with the new start date. Confirm the order change by viewing the radiology list.
- Based on the discussion with the patient you decide to change the current medications to help with the immediate issues. Increase the medication RISPERDAL 2mg, 1 tablet, every night at bedtime to 3mg with the same directions. Confirm the order change.

Test Procedure

The tests were moderated by experienced usability specialists. The moderators gave each participant a brief explanation of what they could expect in the test, read through each task and scenario to the user, and tracked comments and behaviors of the participants. Participants were instructed that they could ask for clarification along the way and were able to refer to a printed copy of the task. Task timing began at the point that the task had begun and ended once the participant had completed that task. Following the test, the participant was given an SUS questionnaire to complete. Metric information was stored into a report following the testing.

Test Location

Testing was conducted on February 8, 2017 at Netsmart Technologies, 4950 College Blvd., Overland Park, Kansas. In-person tests were conducted with participants who were onsite and virtually with remote participants. The tests were completed in a quiet meeting room with, at most, one other user test being conducted at the same time.

Test Environment

The intended facility would be an inpatient or outpatient behavioral health facility where orders are recorded and used in a clinical setting. In this instance, the testing was conducted in the Kansas Netsmart building. Testing was conducted on 1366x768 resolution DELL laptops. The laptops were provided and setup by Netsmart for the duration of the test. The participants used a standard keyboard and mouse for input. When the myAvatar Certified Edition v2017.01 application was used, it was being accessed on Internet Explorer. The myAvatar application being used was a production environment on a WAN network. This environment had content similar to what appears in the field on this application. The system performance during the testing is reflective of what would be experienced in the field.

Test Forms and Tools

The laptops used were equipped with either Morae (a usability testing application which records screens, mouse clicks, sweeps and keystrokes) or GoToMeeting (screen recording/audio recording tool). Morae was used for the participants on location and GoToMeeting for those who were remote.

Usability Metrics

The usability metrics captured during the test were based on the NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records. These metrics include effectiveness, efficiency, and satisfaction. Effectiveness was measured by tracking success and error rates. Efficiency was measured through task time and deviations. Satisfaction was measured with a satisfaction questionnaire (SUS).

Effectiveness

A task was considered a success if the user was able to complete the task. If the participant abandoned the task, it was counted as a failure. If a participant deviated away from the optimal path to complete a task, but ultimately was still able to accomplish the task, then the task was marked as a success. A percentage was measured for success and failure rate. Any errors that occurred during tasks were recorded as well. An error was defined as an action taken that disrupted the completion of the task.

Efficiency

Task time was measured for each task based on when the user first began a task to when the user finished the task. An average task time was measured at a task level and individual level and the standard deviation of these times were also measured. Task deviation was recorded to measure the amount of deviation from the optimal or quickest path through the task.

Satisfaction

In systems engineering, the SUS is a simple, ten-item attitude Likert scale giving a global view of subjective assessments of usability. It was developed by John Brooke at Digital Equipment Corporation in the UK in 1996 as a tool to be used in usability engineering of electronic office systems. An SUS questionnaire was given to each participant after completing the tasks in the application. Common conventions find that systems with a rating of 66 or higher can be seen as easy to use. See [J. Sauro, Measuring Usability With the System Usability Scale \(SUS\)](#)

Results

Data Analysis and Reporting

The findings and details of the usability testing are detailed below. The results were measured based on the explanations in the “Usability Metrics” section above.

Analysis (Task Averages)

Task	Success Rate	Number/Type of Errors	Task Time (seconds)	Standard Deviation (seconds)
Record demographics	100%	1: Marked selections in the wrong field at first	51.3	+33.3
View demographics	100%	0	5.6	-12.3
Change demographics	100%	1: Had trouble finding submit button	23.9	+5.9
View Medication	100%	0	8.7	-9.21
Record Medication	100%	3: Went to wrong location originally, Had trouble initially finding the right button	36.8	+18.8
Change Medication	100%	3: Accidentally unselected a button that needed to be selected before changing medication	14.5	-3.4
View Medication List (active and historical)	100%	0	5.2	-12.72
View lab orders	100%	0	5.4	-12.52
Record lab order	100%	1: Selected wrong button at first	23.3	+5.3
Change lab order	100%	0	21	+3
View lab results	100%	0	7.3	-10.6
View radiology order	100%	0	7.1	-10.8
Record radiology order	100%	1: Accidentally selected lab order instead of radiology order button	22.2	+4.2

Change radiology order	100%	1: Changed order date instead of start date, but realized the issue and fix the error	39.3	+21.3
View medication allergies (current and history)	100%	0	5.6	-12.3
Add medication allergy	100%	1: Could not find results for the brand name of medication, so instead had to search for actual compound name	40.9	+22.9
Change medication allergy	100%	0	8.3	-9.6
Drug-Drug Interaction Checking	100%	0	4.7	-13.2
Drug-Allergy Interaction Checking	100%	0	9	-8.9
Changing Severity Level of Drug-Drug Interactions Shown	100%	0	20.7	+2.7
View Problem List	100%	0	4.7	-13.2
Record Problem	100%	0	30.1	+12.1
Change Problem	100%	0	8.2	-9.6
Send prescription electronically and verify changes	100%	0	9	-8.9
View implantable device list	100%	0	11.5	-6.4
Record implantable device	100%	2: Accidentally clicked submit button without filing to client	38.7	+20.7
Change implantable device	100%	0	20.75	+2.8

Analysis (Participant)

Participant	Success/Failure	Number/Type of Errors	Verbalizations/Recommendations	Standard Deviation (seconds)	Avg Task Time (seconds)	SUS
1-RS	100% Success	1: Had to use an alternative medication name when searching for medication allergy	Having to log out of application and log into the Admin tool and log back into myAvatar is cumbersome	-2.9	15.59	67.5
2-CT	100% Success	1: Selected wrong button at first when attempting to place an order	It's confusing to select a checkbox and then a go button to create a new medication order.	+7.2	25.52	97.5

3-SM	100% Success	0		-7.3	10.92	92.5
4-SC	100% Success	3: Went to wrong locations at first to complete tasks, Unselected a button that needed to be selected to place an order		+2.9	21.21	95
5-JB	100% Success	1: Accidentally submitted a form before she was ready		-1.3	16.92	87.5
6-LW	100% Success	3: Unselected buttons that needed to be selected to make an order, select radiology button instead of lab button when trying to order a lab		-3.5	9.58	87.5
7-DM	100% Success	1: Looked in wrong place initially when trying to order a medication		+5.3	23.58	55
8-MG	100% Success	1: Marked selections in the wrong field once	Implantable device ID is very long	+10.7	29.04	82.5
9-HM	100% Success	1: Selected the wrong client at first when attempting to add an implantable device		-8.4	9.85	87.5
10-JV	100% Success	2: Had trouble finding the right button to place an order, and accidentally changed the order date at first instead of start date when attempting to change start on an order	It's not clear that you have to click the discontinue buttons and then click the go button before the discontinue action takes place.	-2.7	15.51	55

Effectiveness

100% of the tasks were successfully completed by the participants. There were tasks that involved more effort than others, but even so, every task was successfully completed by all of the participants. There were no system errors that presented themselves during the test, only 14 user errors amongst all of the tasks and participants. Most of these user

errors were participants simply clicking on the wrong things accidentally, which were all easily noticed and reconciled without effecting the task completion rate.

Efficiency

The average task time for all tasks and all participants was under one minute. The highest deviation from the average task time, in regards to a less efficient time, was an additional 33 seconds. In addition, the highest deviation, in regards to a more efficient time, was a decrease in 13 seconds.

Satisfaction

We used the System Usability Scale (SUS) to gauge participant satisfaction. This is a 10 question weighted scale that scores the application from 0-100 with 100 being the most usable. See the “Usability Metrics” section above for more details about this scale. Common conventions find that a system with a rating of 66 or higher can be seen as easy to use. Each of our participants were given an SUS questionnaire after testing. The average SUS score amongst the participants was 72.

Major Findings

It can be deduced that with a 100% task completion rate, a less than 1 minute average task time, and an SUS score of 72, the applications are indeed user-friendly based on the three criteria above that were measured. In addition, there were no critical safety concerns that presented themselves during the test.

Based on the rate of errors and task times recorded for each task, it can be determined that the most risk prone errors were during the medication ordering and changing process as well as adding an implantable device. These tasks had the largest amount of user errors and also had larger task times. It can be inferred that based on that, those are the most risk prone tasks in the system. However, it is important to note that the errors that occurred during these tasks were all simple user errors that were easily and quickly reconcilable and didn't interfere with patient safety.

In all instances where specific safety/risk scenarios were presented, the participants were supplied with accurate information and were able to use that information to keep from risking the patient's safety. For example, when the participant was tasked to consider placing an order for Lunesta while the patient had a Lunesta drug allergy, the system effectively presented the user with the critical information and the participant was able to avoid a safety issue.

Areas for Improvement

Although the application measured well in regards to efficiency, effectiveness, and satisfaction, there is always room for improvement. A few of the participants made recommendations throughout their sessions. Some of these recommendations include using more clear and consistent action buttons. Some participants had trouble determining exactly what some of the action buttons would do because of their inconsistency and lack of clarity. It was also recommended that the implantable device identifier be condensed into an easier ID, as not to have to type in such a long ID when searching for the device.

Based on the findings during the study, one can deduce that the adding and changing a medication order process could be improved to eliminate user errors and increase efficiency. It was mentioned above that if the buttons were more consistent and clear, that the ordering process would become more efficient and lead to less errors.

That being said, the application overall performed very well in the three areas being measured: efficiency, effectiveness, and satisfaction. We take pride in these results and the user-centered design and safety-enhanced design that our application includes.

Carol J Reynolds, SVP Client Experience

Carol Reynolds

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