



NovoClinical

EHR Usability Test Report of Novoclinical 1.0

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

Novoclinical 1.0

Date of Usability Test: 11/06/2017
Date of Report: 11/08/2017

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1. EXECUTIVE SUMMARY

A usability test of Novoclinical, 1.0 (Clinical Practice Management EHR) was conducted on 11/06/2017 in Ogden by Novomedici Quality Assurance Team. 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). Novoclinical uses NISTIR 7741 for the user-centered design implementation of the EHR.

During the usability test, 4 healthcare providers and 6 other users (Including Nurse, MA and Support staff) matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks.

This study collected performance data on 12 tasks typically conducted

on an EHR:

- Computerized provider order entry – medications
- Computerized provider order entry – laboratory
- Computerized provider order entry – diagnostic imaging
- Drug-drug, drug-allergy interaction checks
- Demographics
- Problem list
- Medication list
- Medication allergy list
- Clinical decision support
- Implantable device list
- Clinical information reconciliation and incorporation
- Electronic prescribing

During the 40 minute one-on-one usability test, each participant was greeted by the administrator and asked to review and sign an informed consent/release form; they were instructed that they could withdraw at any time. Participants had prior experience with the EHR, participants were given a demo of the system and the required training to participate in usability testing. The administrator introduced the test, and instructed participants to complete a series of tasks (given one at a time) using the EHRUT. During the testing, the administrator timed the test and, along with the data logger(s) recorded user performance data electronically. The administrator did not give the participant assistance in how to complete the task.

Participant screens 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 with \$100 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. Following is a summary of the performance and rating data collected on the EHRUT.

Measure Task	N	Task Success	Path Deviation	Task Time		Errors	Task Ratings 5=Easy
	#	%	Deviations (Observed/ Optimal)	Mean(SD)	Deviations (Observed/ Optimal)	Mean(SD)	Mean(SD)
Computerized provider order entry – medications	10	100	74/70	121 / 23.97 seconds	121/105	0.30 / 0.48	4.0 / 0.00
Computerized provider order entry – laboratory	10	100	62/60	68 / 5.80 seconds	68/64	0.70 / 0.67	4.7 / 0.48
Computerized provider order entry – diagnostic imaging	10	100	52/50	70 / 5.06 seconds	70/63	0.40 / 0.52	4.5 / 0.53
Drug-drug, drug-allergy interaction checks	10	100	63/60	132 / 11.66 seconds	132/117	0.00 / 0.00	4.3 / 0.67
Demographics	10	100	52/50	64 / 2.90 seconds	64/58	0.50 / 0.53	4.4 / 0.52
Problem list	10	100	63/60	68 / 7.04 seconds	68/59	0.50 / 0.53	4.2 / 0.42
Medication list	10	100	41/40	65 / 1.90 seconds	65/61	0.60 / 0.52	4.7 / 0.48
Medication allergy list	10	100	42/40	70 / 7.04 seconds	70/62	0.70 / 0.48	4.4 / 0.52
Clinical decision support	10	100	30/30	191 / 11.12 seconds	191/140	0.30 / 0.48	3.2 / 0.63
Implantable device list	10	100	43/40	190 / 9.47 seconds	190/146	0.00 / 0.00	3.4 / 0.52
Clinical information reconciliation and incorporation	10	100	40/40	71 / 12.90 seconds	71/66	0.30 / 0.48	4.7 / 0.48
Electronic prescribing	10	100	106/100	128 / 10.28 seconds	128/106	1.00 / 1.15	3.6 / 0.52

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 89.75%

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

- Major findings
 1. Computerized provider order entity for laboratory and diagnostic imaging is well tested with multiple orders. The generation is very easy and easy to track. Users are happy with the less steps required after the order is placed by doctor.
 2. Computerized provider order entity for medication is well tested, as we use a third party service to order medication, there are some part of the process out of our control. Users are moderate happy but suggested if the synchronization of the medication to EHR can be done in less steps.
 3. Demographics, Problem list, Medication list, Medication allergy list screens are very easy to use and access from multiple pages.
 4. Implantable device, some user found it hard to use this feature, as it require to know the device number to populate the data, on the other hand they like the idea that user can manually enter the data.
 5. Clinical information reconciliation and incorporation is moderately easy to use. Users liked the feature of directly processing the CDA file without downloading it. Users also liked the comparison view for the reconciliation.
 6. Users given mixed reaction regarding Clinical decision support. Some users suggested it is complex to configure it. Some users suggested providing another way of viewing the decisions other than popping up the decision every time user open the patient.
- Areas for improvement
 1. Decision support user interface can be friendlier.
 2. Decision support view for patients can be in different way, so that user do not have to close the popup every time.
 3. Clinical reconciliation process screen can be improved further, like auto scroll then reconciliation action happens.

2. INTRODUCTION

The EHRUT(s) tested for this study was Novoclinical, 1.0. Designed to present medical information to healthcare providers in clinical settings, the EHRUT consists of doctor and office staff area to provide a complete healthcare solution to clinics and providers. The usability testing attempted to represent realistic exercises and conditions.

The system is used by the providers and clinical staff for recording patient relation information and any other related communications. For usability testing a separate system environment was created and the minimum required data or configurations was created prior to the testing. The usability testing attempted to represent realistic exercises and conditions.

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

I PARTICIPANTS

A total of 10 participants were tested on the EHRUT(s). Participants in the test were Provider, Nurse and Clinical Staff. Participants were recruited by Novomedici, LLC. In addition, participants had no direct connection to the development of or organization producing the EHRUT(s). Participants were not from the testing or supplier organization. Participants were given the opportunity to have the same orientation and level of training as the actual end users would have received.

For the test purposes, end-user characteristics were identified and translated into a recruitment screener used to solicit potential participants.

Participants had a mix of backgrounds and demographic characteristics conforming to the recruitment screener. The following is a table of participants by characteristics, including demographics, professional experience, computing experience and user needs for assistive technology. Participant names were replaced with Participant IDs so that an individual's data cannot be tied back to individual identities.

	Part ID	Gender	Age	Education	Occupation/ role	Professional Experience	Computer Experience	Product Experience	Assistive Technology Needs
1	001	F	37	High school graduate	MA	17 years	17 years	5 years	n/a
2	002	F	37	High school graduate	Receptionist	15 years	15 years	5 years	n/a
3	003	F	52	Bachelor's Degree	Billing	7 years	7 years	3 years	n/a
4	004	F	33	High school graduate	MA	7 years	7 years	3 years	n/a
5	005	F	58	High school graduate	Billing	9 years	9 years	4 years	n/a
6	006	F	24	High school graduate	MA	4 years	4 years	4 years	n/a
7	007	F	41	High school graduate	PA	11 years	11 years	5 years	n/a
8	008	M	57	Doctorate degree	Physician	30 years	30 years	10 years	n/a
9	009	M	55	Doctorate degree	Physician	30 years	30 years	10 years	n/a
10	010	F	42	Doctorate degree	PA	9 years	9 years	6 years	n/a

10 participants (matching the demographics in the section on Participants) were recruited and 10 participated in the usability test. No participants failed to show for the study.

Participants were scheduled for 40 minute sessions with 5 minutes in between each session for debrief by the administrator(s) and data logger(s), and to reset systems to proper test conditions. A spreadsheet was used to keep track of the participant schedule, and included each participant's demographic characteristics.

II 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 1 EHR. Each participant used the system in the same location, and was provided with 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.

III TASKS

A number of tasks were constructed that would be realistic and representative of the kinds of activities a user might do with this EHR, including:

- **Computerized provider order entry – medications** : User can order an medication or change/refill/change status of an existing order from the e-prescribing software(MdToolBox).
- **Computerized provider order entry – laboratory** : User will create a laboratory order and send it using electronic means(HL7 or Efax). User can change the order after the order is created.
- **Computerized provider order entry – diagnostic imaging** : User will create a radiology order and send it using electronic means(HL7 or Efax). User can change the order after the order is created.
- **Drug-drug, drug-allergy interaction checks** : User while ordering the medication through MdToolBox can see the Drug-drug, drug – allergy check. The Medication ordering system should show an alert to user so that user can change the drug accordingly or can override the alert with specific reasons.
- **Demographics** : User can insert/update the demography information from patient in to the EHR system. User will be able to save all the specific information(gender, name, dob, race, ethnicity, address, contact information etc).
- **Problem list** : User can insert/update the medical history problem list. User will be able to track the problems by the date or encounter in the system.
- **Medication list** : User can insert/update the medical history medication list. User will be able to track the medications by the date or encounter in the system.
- **Medication allergy list** : User can insert/update the medical history allergy list. User will be able to track the allergies by the date or encounter in the system.
- **Clinical decision support** : User can configure the decisions in the system, the decisions can be on demography or any medical history component like allergy. The system on a successful match of a

decision will notify user of the decision and the other details like the developer, created date etc of the decision. The alert will be shown to all the users of the system upon accessing that patient.

- **Implantable device list:** User can insert/update the medical history implantable devices list. User will be able to track the implantable devices from the system medical history of the patient.
- **Clinical information reconciliation and incorporation**
- **Electronic prescribing :** User will order an medication for the Novoclinical EHR and then complete the medication order using the MdToolBox medication order system using electronic interface provided by MdToolBox ePrescribing system.

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users. Tasks should always be constructed in light of the study objectives.

IV PROCEDURES

Upon arrival, participants were greeted; their identity was verified and matched with a name on the participant schedule. Participants were then assigned a participant ID. Each participant reviewed and signed an informed consent and release form. A representative from the test team witnessed the participant's signature.

To ensure that the test ran smoothly, two staff members participated in this test, the usability administrator and the data logger. The usability testing staff conducting the test was experienced usability practitioners with 5 years of experience from Software System background, and has experience in Quality Assurance.

The administrator moderated the session including administering instructions and tasks. The administrator also monitored task times, obtained post-task rating data, and took notes on participant comments. A second person served as the data logger and took notes on task success, path deviations, number and type of errors, and comments.

Participants were instructed to perform the tasks (see specific instructions below):

- As quickly as possible making as few errors and deviations as possible.
- Without assistance; administrators were allowed to give immaterial guidance and clarification on tasks, but not instructions on use.
- Without using a think aloud technique.

For each task, the participants were given a written copy of the task. Task timing began once the administrator finished reading the question. The task time was stopped once the participant indicated they had successfully completed the task. Scoring is discussed below in Section 3.9.

Following the session, the administrator gave the participant the post-test questionnaire (e.g., the System Usability Scale, 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.

Participants were thanked for their time and compensated. Participants signed a receipt and acknowledgement indicating that they had received the compensation.

V TEST LOCATION

The test facility included a waiting area and a quiet testing room with a table, computer for the participant, and recording computer for the administrator. Only the participant and administrator were in the test room. All observers and the data logger worked from a separate room where they could see the participant's screen and face shot, and listen to the audio of the session. To ensure that the environment was comfortable for users, noise levels were kept to a minimum with the ambient temperature within a normal range. All of the safety instruction and evacuation procedures were valid, in place, and visible to the participants.

VI TEST ENVIRONMENT

The EHRUT would typically be used in a healthcare office or clinic. In this instance, the testing was conducted in a doctor facility. For testing, the computer used a desktop running windows 10.

The participants used a mouse and keyboard when interacting with the EHRUT.

The Novoclinical used resolution 1920X1080. The application was set up according to the vendor's documentation describing the system set-up and preparation. The application is a cloud based application running using a test database deployed in cloud. Technically, the system performance (i.e., response time) was representative to what actual users would experience in a field implementation. Additionally, participants were instructed not to change any of the default system settings (such as control of font size). The machines used in the testing process contains screensize of 19.5", resolution 1920X1080, color settings "Default Blue" and connected in LAN configuration.

VII TEST FORMS AND TOOLS

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

- Informed Consent
- Moderator's Guide
- Post-test Questionnaire
- Incentive Receipt and Acknowledgment Form

The Moderator's Guide was devised so as to be able to capture required data.

The participant's interaction with the EHRUT was captured and recorded digitally with screen capture software running on the test machine. A web camera recorded each participant's facial expressions synced with the screen capture, and verbal comments were recorded with a microphone. The test session were electronically transmitted to a nearby observation room where the data logger observed the test session.

VIII PARTICIPANT INSTRUCTIONS

The administrator reads the following instructions aloud to each participant :

Thank you for participating in this study. Your input is very important. Our session today will last about 40 minutes. During that time you will use an instance of an electronic health record.

I will ask you to complete a few tasks using this system and answer some questions. You should complete the tasks as quickly as possible making as few errors as possible. Please try to complete the tasks on your own following the instructions very closely. Please note that we are not testing you we are testing the system, therefore if you have difficulty all this means is that something needs to be improved in the system. I will be here in case you need specific help, but I am not able to instruct you or provide help in how to use the application.

Overall, we are interested in how easy (or how difficult) this system is to use, what in it would be useful to you, and how we could improve it. I did not have any involvement in its creation, so please be honest with your opinions. All of the information that you provide will be kept confidential and your name will not be

associated with your comments at any time. Should you feel it necessary you are able to withdraw at any time during the testing.

Following the procedural instructions, participants were shown the EHR and as their first task, were given time (10 minutes) to explore the system and make comments. Once this task was complete, the administrator gave the following instructions:

For each task, I will read the description to you and say "Begin." At that point, please perform the task and say "Done" once you believe you have successfully completed the task. I would like to request that you not talk aloud or verbalize while you are doing the tasks. I will ask you your impressions about the task once you are done.

Participants were then given 12 tasks to complete. Tasks are listed in the moderator's guide.

IX 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:

- Effectiveness of Novoclinical by measuring participant success rates and errors
- Efficiency of Novoclinical by measuring the average task time and path deviations
- Satisfaction with Novoclinical by measuring ease of use ratings

4. DATA SCORING

The following table details how tasks were scored, errors evaluated, and the time data analyzed.

Measures	Rationale and Scoring
<p>Effectiveness: Task Success</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 on a per task basis.</p> <p>The total number of successes were calculated for each task and then divided by the total number of times that task was attempted. The results are provided as a percentage.</p>
<p>Effectiveness: Task Failures</p>	<p>If the participant abandoned the task, did not reach the correct answer or performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as an “Failures.” No task times were taken for errors.</p> <p>The total number of errors was calculated for each task and then divided by the total number of times that task was attempted. Not all deviations would be counted as errors. This should also be expressed as the mean number of failed tasks per participant.</p> <p>On a qualitative level, an enumeration of errors and error types should be collected.</p>
<p>Efficiency: Task Deviations</p>	<p>The participant’s path (i.e., steps) through the application was recorded. Deviations occur if the participant, for example, went to a wrong screen, clicked on an incorrect menu item, followed an incorrect link, or interacted incorrectly with an on-screen control. This path was compared to the optimal path. The number of steps in the observed path is divided by the number of optimal steps to provide a ratio of path deviation.</p> <p>It is strongly recommended that task deviations be reported. Optimal paths (i.e., procedural steps) should be recorded when constructing tasks.</p>
<p>Efficiency: Task Time</p>	<p>Each task was timed from when the administrator said “Begin” until the participant said, “Done.” If he or she failed to say “Done,” the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation and standard error) were also calculated.</p>
<p>Satisfaction: Task Rating</p>	<p>Participant’s subjective impression of the ease of use of the application was measured by administering both a simple post-task question as well as a post-session questionnaire. After each task, the participant was asked to rate “Overall, this task was:” on a scale of 1 (Very Difficult) to 5 (Very Easy). These data are averaged across participants.</p> <p>Common convention is that average ratings for systems judged easy to use should be 3.3 or above.</p> <p>To measure participants’ confidence in and likeability of the Novoclinical overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, “I think I would like to use this system frequently,” “I thought the system was easy to use,” and “I would imagine that most people would learn to use this system very quickly.”</p>

5. RESULTS

I DATA ANALYSIS AND REPORTING

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above.

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

Measure Task	N	Task Success	Path Deviation	Task Time		Errors	Task Ratings 1=Easy
	#	%	Deviations (Observed/ Optimal)	Mean(SD)	Deviations (Observed/ Optimal)	Mean(SD)	Mean(SD)
Computerized provider order entry – medications	10	100	74/70	121 / 23.97 seconds	121/105	0.30 / 0.48	4.0 / 0.00
Computerized provider order entry – laboratory	10	100	62/60	68 / 5.80 seconds	68/64	0.70 / 0.67	4.7 / 0.48
Computerized provider order entry – diagnostic imaging	10	100	52/50	70 / 5.06 seconds	70/63	0.40 / 0.52	4.5 / 0.53
Drug-drug, drug-allergy interaction checks	10	100	63/60	132 / 11.66 seconds	132/117	0.00 / 0.00	4.3 / 0.67
Demographics	10	100	52/50	64 / 2.90 seconds	64/58	0.50 / 0.53	4.4 / 0.52
Problem list	10	100	63/60	68 / 7.04 seconds	68/59	0.50 / 0.53	4.2 / 0.42
Medication list	10	100	41/40	65 / 1.90 seconds	65/61	0.60 / 0.52	4.7 / 0.48
Medication allergy list	10	100	42/40	70 / 7.04 seconds	70/62	0.70 / 0.48	4.4 / 0.52
Clinical decision support	10	100	30/30	191 / 11.12 seconds	191/140	0.30 / 0.48	3.2 / 0.63
Implantable device list	10	100	43/40	190 / 9.47 seconds	190/146	0.00 / 0.00	3.4 / 0.52
Clinical information reconciliation and incorporation	10	100	40/40	71 / 12.90 seconds	71/66	0.30 / 0.48	4.7 / 0.48
Electronic prescribing	10	100	106/100	128 / 10.28 seconds	128/106	1.00 / 1.15	3.6 / 0.52

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be: 89.75%.

II DISCUSSION OF THE FINDINGS

1. Decision support user interface can be friendlier.
2. Decision support view for patients can be in different way, so that user do not have to close the popup every time.
3. Clinical reconciliation process screen can be improved further, like auto scroll then reconciliation action happens.
4. Implantable device can be further upgraded to be more user friendly.

EFFECTIVENESS

Novoclinical system is easy to use as per the user experience, there are some findings that are discussed in finding section. Users were only helped if they deviate the path.

EFFICIENCY

For most of the test items the test user did not deviate much from the expert user. Only the implantable device and Clinical decision support system has some observed deviation in task time.

SATISFACTION

Overall users are satisfied with the way system works. Some points regarding Clinical Decision support and Implantable device are mentioned by the user which are discussed in findings.

MAJOR FINDINGS

1. Computerized provider order entity for laboratory and diagnostic imaging is well tested with multiple orders. The generation is very easy and easy to track. Users are happy will the less steps required after the order is placed by doctor.
2. Computerized provider order entity for medication is well tested, as we use a third party service to order medication, there are some part of the process out of our control. Users are moderate happy but suggested if the synchronization of the medication to EHR can be done in less steps.
3. Demographics, Problem list, Medication list, Medication allergy list and implantable device screens are very easy to use and access from multiple pages.
4. Clinical information reconciliation and incorporation is moderately easy to use. Users liked the feature of directly processing the CDA file without downloading it. Users also liked the comparison view for the reconciliation.
5. Users given mixed reaction regarding Clinical decision support. Some users suggested it is complex to configure it. Some users suggested providing another way of viewing the decisions other than popping up the decision every time user open the patient.

AREAS FOR IMPROVEMENT

1. Decision support user interface can be friendlier.
2. Decision support view for patients can be in different way, so that user do not have to close the popup every time.

3. Clinical reconciliation process screen can be improved further, like auto scroll when reconciliation action happens