

**NISTIR 7742**

# **Customized Common Industry Format Template for Electronic Health Record Usability Testing**

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November 2010



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# Customized Common Industry Format Template for Electronic Health Record Usability Testing

## INTENDED AUDIENCE

This document provides a template for the modified version of *Software engineering — Software product Quality Requirements and Evaluation(SQuaRE) — Common Industry Format (CIF) for usability test reports* (ISO/IEC 25062:2006(E)), the Common Industry Format (CIF) usability test report. This version of the CIF has been customized for use in usability testing of Electronic Health Records (EHRs) by usability administrator(s) and data logger(s). The template enables usability engineers to effectively communicate the results of EHR usability testing.

## INTENDED PURPOSE

The intention of the CIF is to help vendors demonstrate evidence of usability in their final product in a format that allows both independent evaluation of a single product and comparison across multiple products. This document has been prepared as a template to guide EHR usability test administrators meet the usability processes approach put forth by the National Institute of Standards and Technology (NIST). The following customized CIF template is intended to assist EHR vendors, healthcare providers, and researchers in reporting the results of usability testing for each system tested.

## USING THIS DOCUMENT

This document is not intended to be a tutorial on usability or usability testing.<sup>1</sup> To work with this document you should have expertise with common usability industry practices

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<sup>1</sup> Excellent starting points for information are [www.usability.gov](http://www.usability.gov) and [www.upassoc.org](http://www.upassoc.org) as well as Dumas, J., Redish, J. (1994) *A Practical Guide to Usability Testing*. Norwood, NJ: Ablex. Dana Chisnell & Jeffrey Rubin *Handbook of Usability Testing: How to Plan, Design, and Conduct*

and with standard ISO/IEC 25062:2006.<sup>2</sup> The ISO document is intended for the reporting of summative (i.e., quantitative) studies. The modifications here allow for the reporting of qualitative findings (i.e., formative) but strongly recommend and encourage the collection of quantitative measures of user performance.

Reports delivered using this template should conform to the major headings and content areas outlined below. Minor deviations from the outline and format are acceptable, but the reports should follow the template in all material aspects. This template includes the following sections:<sup>3</sup>

- Executive Summary
- Introduction
- Method
- Results
- Appendices

In addition to these sections, the modified CIF must also include a title page; a sample title page is included in the template example.

When completing the modified CIF template, it is highly recommended that EHR usability test administrator(s) and their data logger(s) refer to the instructions and guidance in order to properly complete this template.

The sample data provided in this template is an example or placeholder of the types of content that may be useful in completing the modified CIF template. Gray background text (bounded in square brackets) needs to be replaced by the EHRs' supplied information. It is important to note that this sample content is not to be taken literally or as a starting point.

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*Effective Tests (2nd ed.)* Wiley, 2008.

Schumacher (2009). *Handbook of Global User Research*. Burlington, MA: Morgan Kaufman.

<sup>2</sup> This document can be purchased from:

[http://www.iso.org/iso/iso\\_catalogue/catalogue\\_tc/catalogue\\_detail.htm?csnumber=43046](http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=43046).

<sup>3</sup> Each of these sections has a corresponding section in the ISO/IEC 25062.

# EHR Usability Test Report of nAble v 5.0c

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

nAble Version 5.0 c

Date of Usability Test: 12/4/2017  
Date of Report: 12/14/2017  
Report Prepared By: Nth Technologies, Inc.  
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## EXECUTIVE SUMMARY

A usability test of the nAble 5.0c was conducted on 12/4/2017 at the Nth Technologies, Inc. headquarters by Nth Technologies, Inc. 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, 2 healthcare providers and 8 clinical and medical staff matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks.

This study collected performance data on 36 common EHR tasks that are listed in the Tasks and Measures table below.

During the 45 minute one-on-one usability test, each participant was greeted by the administrator and asked to review and sign an informed consent/release form (included in Appendix 3); they were instructed that they could withdraw at any time. Of the participants, 8 had prior experience with the system, and two were given a standard 3-hour demonstrative and hands-on training process identical to that given to new signups. prior experience with the EHR.<sup>4</sup>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 on paper and electronically. The administrator did not give the participant assistance in how to complete the task.

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<sup>4</sup> If training or help materials were provided, describe the nature of it. The recommendation is that all participants be given the opportunity to complete training similar to what a real end user would receive prior to participating in the usability test.

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 not 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. Following is a summary of the performance and rating data collected on the EHRUT

Task	Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Ratings
			Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Deviations (Observed)	Mean (SD)	Mean (SD)
1. Electronically record and patients Medication order		10	72.5(15.8)	13.8/10	45.5(20.2)	14.7	17.5(24.86)	3.9
2. Electronically edit a patient's Medication order		10	100(0)	3.6/3	22.4(8.03)	1.97	0.3	4.5
3. Display Changed Medication Order		10	100(0)	1/1	3(0)	0	0	5

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4. Electronically record a patient's laboratory order	10	100(0)	3.2/3	15.6(4.30)	5.6	5(10.54)	4.8 (0.6)
5. Electronically change a patient's laboratory order	10	100(0)	4/4	16.5(3.02)	1.5	0(0)	5 (0)
6. Display changed laboratory order	10	100(0)	0/0	0	0	0(0)	4.9 (0.31)
7. Electronically record a patient's diagnostic imaging order	10	100(0)	5.1/5	21.5(6.2)	6.5	0(0)	5(0)
8. Electronically change a patient's diagnostic imaging order	10	100(0)	7.4/7	20.2(4.1)	0.2	0(0)	5(0)
9. Display changed imaging order	10	100(0)	0/0	1(0)	0	0(0)	5(0)
10. Prescribe a medication that is contraindicated based on the patient's medication list and confirm the resulting alert	10	76.5(26.778)	13.2/10	61.9(19.25)	16.9	25(26.35)	3.8(1.13)
11. Prescribe a medication that is contraindicated based on the patient's allergy list and confirm the resulting alert.	10	100(0)	11.6/10	52.5(11.11)	7.5	4.5(8.31)	3.8(1.13)
12. Register a patient using a provided "facesheet" containing demographics	10	98(6.32)	17.5/15	101.5(22.27)	11.5	5(15.81)	4.8(0.63)
13. Add the patient's sexual orientation to the Social History section of the patient chart	10	100(0)	4.2/4	14.2(6.47)	4.2	0(0)	4.9(0.32)
14. Update a patient's demographics using a provided list of corrections	10	100(0)	10.3/10	51.5(9.14)	6.5	0(0)	5(0)
15. Update the patient's sexual orientation in the Social History section of the patient chart	10	100(0)	4/4	11.2(2.09)	1.2	0(0)	5(0)
16. Access a patient's problem list and add a new problem to the list	10	92.5(23.71)	10.6/7	67.8(7.42)	22.8	10(12.91)	4.1(1.53)
17. Access the patient's problem list and resolve an active problem	10	100(0)	3.2/3	19(9.23)	9	0(0)	4.8(0.42)
18. Add a medication to a patient's current medication list.	10	88.5(17.0)	10.9/10	27.2(8.07)	7.2	1(3.16)	4.2(0.79)

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19. Edit a medication on the patient's current medication list	10	95(15.81)	4/4	13.2(3.79)	3.2	0	4.4(0.84)
20. Add an allergy to the patient's allergy list	10	100(0)	5.3/5	30(11.06)	5	2.5(7.90)	4(1.24)
21. Edit an allergy on the patient's allergy list	10	90(31.62)	7/5	38.6(22.94)	13.6	10(31.62)	4.4(0.84)
22. Access a patient's chart and confirm the clinical decision support intervention recommended	10	100(0)	4/4	18.5(4.12)	3.5	0(0)	5(0)
23. Access a patient's chart, complete reconciliation of the Transfer of Care record and confirm the clinical decision support intervention recommended	10	95(15.81)	5.2/4	20(5.72)	5	10(12.91)	4.8(0.42)
24. Record a patient's active implanted device	10	90(31.62)	16.4/9	79.9(38.61)	19.9	0(0)	4.2(1.40)
25. Edit the patient's active implanted device and change the status to inactive	10	100(0)	5/3	11.6(4.7)	1.6	5(15.81)	5(0)
26. Access UDI, device description, identifiers and attributes	10	95(15.81)	3/2	22.5(5.78)	7.5	0(0)	5(0)
27. Import Transition of Care document and assign the correct patient	10	100(0)	9.3/7	41.9(14.10)	11.9	0(0)	4.9(0.31)
28. Reconcile the Problem, Medication, and Allergy lists by selecting items from the document that are not in the patient's current Problem, Medication, and Allergy Lists.	10	87.5(27.00)	62/40	227(39.10)	47	10(17.48)	3.7(0.95)
29. Create and transmit a new prescription to the test pharmacy	10	95(15.81)	9/8	36.1(6.45)	6.1	5(15.81)	3.1(1.20)
30. Create and transmit a new prescription with a diagnosis	10	90(31.62)	16.4/15	64.5(6.43)	4.5	10(31.62)	3.2(1.48)
31. Edit the prescription and transmit the changed prescription to the pharmacy	10	82.5(33.43)	9.3/9	46.5(3.37)	1.5	17.5(33.43)	3.5(0.85)

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32. Cancel a transmitted prescription	10	100(0)	3.1/3	18.5(10.80)	3.5	0(0)	4.8(0.42)
33. Approve a requested prescription refill	10	90(21.08)	5.4/5	34.4(3.86)	4.4	0(0)	4.1(1.10)
34. Deny a requested prescription refill	10	90(21.08)	5.6/5	31(3.16)	1	0(0)	4.43(0.95)
35. Check fill status for a prescription	10	100(0)	0/0	3(0)	0	0(0)	0(0)
36. Request and receive medication history information	10	100(0)	0/0	3(0)	0	0(0)	0(0)

The results from the System Usability Scale scored the subjective satisfaction with the system based on performance with these tasks to be: 79.75. This score reflects both experience with the system as an experienced user and as a completely new user with introductory training.<sup>5</sup>

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

- Major findings
  - o Overall, the nAble EHR system tested comparably to the prior version tested previously, with some notable improvements. Task-to-task workflow timing and step count was reduced with the adjustment of the patient chart to be centered around a main page, rather than spread across many disparate pages. Other chart sections (notably prescription and demographics) remain relatively unchanged.
- Areas for improvement
  - o The most frequent complaints pertained to the third-party Newcrop prescription system, and its relatively weaker usability compared to the rest of the nAble EHR suite. Additionally, small complaints about the sizing of windows, locations of buttons and other UI quality-of-life mentions were documented and quickly resolved.

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<sup>5</sup> See Tullis, T. & Albert, W. (2008). Measuring the User Experience. Burlington, MA: Morgan Kaufman (p. 149). Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.

## **INTRODUCTION**

The EHRUT tested for this study was nAble Version 5.0c, designed to present medical information to healthcare providers in a generalized setting. The EHRUT consists of a system designed for customizable and generalized encounter and medical data recording, clinical use and statistical analysis, along with billing, prescription, diagnosis and other primary ambulatory and clinical uses. 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 task time taken versus optimal task time, task completion rate, path deviation counts and ease of use qualitative metrics were captured during the usability testing.

## **METHOD**

### **PARTICIPANTS**

A total of 10 participants were tested on the EHRUT(s). Participants in the test were physicians, medical assistants and clinical billing and executive staff.

Participants were recruited by Nth Technologies, Inc. primarily from known non-affiliated associates and clinical client connections and were not compensated for their time. In addition, participants had no direct connection to the development or production of the EHRUT(s).

Participants were not from the testing or supplier organization. Participants were given the opportunity to have the same introductory training as the actual end users have received.

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Recruited 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. Experience is measured in months. Participant names were replaced with Participant IDs so that an individual's data cannot be tied back to individual identities.

Participant Identifier	Participant Gender	Participant Age	Participant Education	Participant Occupation/Role	Participant Professional Experience	Participant Computer Experience	Participant Product Experience	Participant Assistive Technology Needs	Participant Identifier
1	Female	30-39	Bachelor's Degree	Office Manager	60	240	60	No	1
2	Male	40-49	Bachelor's Degree	Receptionist	180	360	120	No	2
3	Male	20-29	Bachelor's Degree	Medical Asssistant	48	300	7	No	3
4	Male	30-39	Bachelor's Degree	Executive Assistant	108	240	108	No	4
5	Male	60-69	Doctorate degree (e.g., MD, DNP,	Manager	600	360	120	No	5
6	Female	60-69	Doctorate degree (e.g., MD, DNP,	Physician	360	216	120	No	6
7	Male	30-39	Bachelor's Degree	Executive Director	120	240	1	No	7
8	Female	20-29	Some college credit, no degree	Office Staff	168	228	36	No	8
9	Female	20-29	Some college credit, no degree	Office staff	30	84	7	No	9
10	Male	30-39	Bachelor's Degree	Product Designer	108	280	1	No	10

13 participants were recruited and 10 (matching the demographics in the section on Participants) participated in the usability test. 3 participants failed to show for the study and were not recorded. Participants were scheduled for one 45-minute session with uniquely generated tests that required only a short intermission to process data logs and set up tasks for the next participant, 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 as provided by the participant.

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.

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.

## 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:

- Add and modify medications that meet various criteria (contraindicated medications, medications with diagnoses)
- Prescribe, transmit, document, refill and cancel said medications
- Add and modify patient allergies
- Add and modify patient demographics
- Add and modify patient social history
- Add, modify and inactivate a patient's implantable device
- Reconcile an imported transfer of care document with the existing patient

record and incorporate some, but not all, elements into the patient record

- ☐ And modify a diagnosis
- ☐ Add and modify various elements of a diagnostic plan, including radiology orders, medication orders and laboratory test orders
- ☐ Add and modify a patient's problems
- ☐ Make use of clinical decision networks and engines to incorporate recommended diagnoses and plans into the assessment and plan

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users.<sup>6</sup>

Tasks should always be constructed in light of the study objectives.

## 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.<sup>7</sup>

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 were experienced usability practitioners with 15 combined years of experience in using the EHRUT and multiple years in usability testing and administration and logging experience.

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 form (See Appendix 6) indicating that they had received the compensation.

## 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.

## TEST ENVIRONMENT

The EHRUT would be typically be used in a healthcare office or facility. In this instance, the testing was conducted in a segmented office containing multiple computers and a way to have an administrator and analyst view the testing setup independently.

For testing, the computer used a standard office PC running windows 10 over the Google Chrome browser to access the EHRUT. The participants used a standard mouse and keyboard combination when interacting with the EHRUT.

The EHRUT used a stock Google Chrome browser to display the end-user EHR in a standard high-resolution format, with stock Windows 10 color settings and font sizes.

The application was set up by the vendor according to the vendor's documentation describing the system set-up and preparation. The application itself was running on a Linux server using a test database over a WAN connection through Google Chrome. 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).

## TEST FORMS AND TOOLS

Examples of these documents can be found in Appendices 3-6 respectively. 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 screen capture.<sup>8</sup> The test sessions were electronically transmitted to a nearby observation room where the data logger observed the test session.

## 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 45 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

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and as their first task, were given time (60 minutes) to explore the system and make comments.

Participants who had never used the system previously were offered standard user training provided to new users of the system. 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.*

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*I will ask you your impressions about the task once you are done.*

Participants were then given a comprehensive list containing 36 tasks to complete. Tasks are listed in the task/measurement tables below.

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

**DATA SCORING**

The following table (Table [x]) details how tasks were scored, errors evaluated, and the time data analyzed.<sup>10</sup>

<b>Measures</b>	<b>Rationale and Scoring</b>
<p><b>Effectiveness:</b> 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>Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency.</p> <p>Optimal task performance time, as benchmarked by expert performance under realistic conditions, is recorded when constructing tasks. Target task times used for task times in the Moderator’s Guide must be operationally defined by taking multiple measures of optimal performance and multiplying by some factor [e.g., 1.25] that allows some time buffer because the participants are presumably not trained to expert performance. Thus, if expert, optimal performance on a task was [x] seconds then allotted task time performance was [x * 1.25] seconds. This ratio should be aggregated across tasks and reported with mean and variance scores.</p>
<p><b>Effectiveness:</b> 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.<sup>11</sup> 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><b>Efficiency:</b> 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><b>Efficiency:</b> 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><b>Satisfaction:</b> 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.<sup>12</sup></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 nAble 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." See included full usability score survey documents.</p>
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**Table 2. Details of how observed data were scored.**

## RESULTS

### DATA ANALYSIS AND REPORTING

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. Participants who failed to follow session and task instructions had their data excluded from the analyses.

The usability testing results for the EHRUT are detailed in the table [#3] below.<sup>14</sup> 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.

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

<sup>13</sup> The SUS survey yields a single number that represents a composite measure of the overall perceived usability of the system. SUS scores have a range of 0 to 100 and the score is a relative benchmark that is used against other iterations of the system.

Task	Measure	N	Task Success	Path Deviation	Task Time		Errors	Task Ratings 5=Easy
			Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Deviations (Observed)	Mean (SD)	Mean (SD)
1. Electronically record and patients Medication order		10	72.5(15.8)	13.8/10	45.5(20.2)	14.7	17.5(24.86)	3.9
2. Electronically edit a patient's Medication order		10	100(0)	3.6/3	22.4(8.03)	1.97	0.3	4.5
3. Display Changed Medication Order		10	100(0)	1/1	3(0)	0	0	5
4. Electronically record a patient's laboratory order		10	100(0)	3.2/3	15.6(4.30)	5.6	5(10.54)	4.8 (0.6)
5. Electronically change a patient's laboratory order		10	100(0)	4/4	16.5(3.02)	1.5	0(0)	5 (0)
6. Display changed laboratory order		10	100(0)	0/0	0	0	0(0)	4.9 (0.31)
7. Electronically record a patient's diagnostic imaging order		10	100(0)	5.1/5	21.5(6.2)	6.5	0(0)	5(0)
8. Electronically change a patient's diagnostic imaging order		10	100(0)	7.4/7	20.2(4.1)	0.2	0(0)	5(0)
9. Display changed imaging order		10	100(0)	0/0	1(0)	0	0(0)	5(0)
10. Prescribe a medication that is contraindicated based on the patient's medication list and confirm the resulting alert		10	76.5(26.78)	13.2/10	61.9(19.25)	16.9	25(26.35)	3.8(1.13)
11. Prescribe a medication that is contraindicated based on the patient's allergy list and confirm the resulting alert.		10	100(0)	11.6/10	52.5(11.11)	7.5	4.5(8.31)	3.8(1.13)
12. Register a patient using a provided "facesheet" containing demographics		10	98(6.32)	17.5/15	101.5(22.27)	11.5	5(15.81)	4.8(0.63)

13. Add the patient's sexual orientation to the Social History section of the patient chart	10	100(0)	4.2/4	14.2(6.47)	4.2	0(0)	4.9(0.32)
14. Update a patient's demographics using a provided list of corrections	10	100(0)	10.3/10	51.5(9.14)	6.5	0(0)	5(0)
15. Update the patient's sexual orientation in the Social History section of the patient chart	10	100(0)	4/4	11.2(2.09)	1.2	0(0)	5(0)
16. Access a patient's problem list and add a new problem to the list	10	92.5(23.71)	10.6/7	67.8(7.42)	22.8	10(12.91)	4.1(1.53)
17. Access the patient's problem list and resolve an active problem	10	100(0)	3.2/3	19(9.23)	9	0(0)	4.8(0.42)
18. Add a medication to a patient's current medication list.	10	88.5(17.0)	10.9/10	27.2(8.07)	7.2	1(3.16)	4.2(0.79)
19. Edit a medication on the patient's current medication list	10	95(15.81)	4/4	13.2(3.79)	3.2	0	4.4(0.84)
20. Add an allergy to the patient's allergy list	10	100(0)	5.3/5	30(11.06)	5	2.5(7.90)	4(1.24)
21. Edit an allergy on the patient's allergy list	10	90(31.62)	7/5	38.6(22.94)	13.6	10(31.62)	4.4(0.84)
22. Access a patient's chart and confirm the clinical decision support intervention recommended	10	100(0)	4/4	18.5(4.12)	3.5	0(0)	5(0)
23. Access a patient's chart, complete reconciliation of the Transfer of Care record and confirm the clinical decision support intervention recommended	10	95(15.81)	5.2/4	20(5.72)	5	10(12.91)	4.8(0.42)
24. Record a patient's active implanted device	10	90(31.62)	16.4/9	79.9(38.61)	19.9	0(0)	4.2(1.40)
25. Edit the patient's active implanted device and change the status to inactive	10	100(0)	5/3	11.6(4.7)	1.6	5(15.81)	5(0)
26. Access UDI, device description, identifiers and attributes	10	95(15.81)	3/2	22.5(5.78)	7.5	0(0)	5(0)

27. Import Transition of Care document and assign the correct patient	10	100(0)	9.3/7	41.9(14.10)	11.9	0(0)	4.9(0.31)
28. Reconcile the Problem, Medication, and Allergy lists by selecting items from the document that are not in the patient's current Problem, Medication, and Allergy Lists.	10	87.5(27.00)	62/40	227(39.10)	47	10(17.48)	3.7(0.95)
29. Create and transmit a new prescription to the test pharmacy	10	95(15.81)	9/8	36.1(6.45)	6.1	5(15.81)	3.1(1.20)
30. Create and transmit a new prescription with a diagnosis	10	90(31.62)	16.4/15	64.5(6.43)	4.5	10(31.62)	3.2(1.48)
31. Edit the prescription and transmit the changed prescription to the pharmacy	10	82.5(33.43)	9.3/9	46.5(3.37)	1.5	17.5(33.43)	3.5(0.85)
32. Cancel a transmitted prescription	10	100(0)	3.1/3	18.5(10.80)	3.5	0(0)	4.8(0.42)
33. Approve a requested prescription refill	10	90(21.08)	5.4/5	34.4(3.86)	4.4	0(0)	4.1(1.10)
34. Deny a requested prescription refill	10	90(21.08)	5.6/5	31(3.16)	1	0(0)	4.43(0.95)
35. Check fill status for a prescription	10	100(0)	0/0	3(0)	0	0(0)	0(0)
36. Request and receive medication history information	10	100(0)	0/0	3(0)	0	0(0)	0(0)

**Table 3: Data collected in usability testing**

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be:79.75. Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average. With the additional testing of newer users who have never seen the system prior to training and testing, I believe this score to accurately reflect the usability of the nAble v5.0c EHR system as a whole, for both newer and experienced users.<sup>15</sup>

## **DISCUSSION OF THE FINDINGS**

The system, overall, tested well, with only a few minor glitches and adjustments frequently recommended. The most common recommendation was to expand the size of some popover boxes used in the problem list and diagnosis and plan, and also to recommend to Newcrop, the third-party pharmaceutical order system that they work on their usability as well. At the time of this report, actions have been taken to fulfill all concerns participants had with the system.

### **EFFECTIVENESS**

For every metric besides metrics involving medication, the system tested well above 90% success and well above 4.5 SUS-scale ease of use measurements. The only portions of the nAble system that tested poorly in usability involved the aforementioned Newcrop prescription system.

### **EFFICIENCY**

Overall, the system scored well in efficiency – the optimal to observed ratio rarely exceeded more than 1.5, even for first-time users with an introductory level of training. Participants commented that the system had clearly defined paths for specific paths, and that the system seemed to have clear path lead-ins that allowed users to go from task to task with a minimum of searching or confusion. There were some deviations when it came to the prescription system, as people found it was inordinately easy to accidentally delete an order or record incorrect information on it, especially when it came to date ranges for prescriptions, which required date range entry prior to the input of a historical medication or new prescription, and allowed no date range changes after the input.

### **SATISFACTION**

The participants in the study praised the system of its ease of use and ability to effectively point a user towards the next task they needed to do. There were minor complaints about the sizing of specific boxes and the Newcrop system, all of which Nth Technologies, Inc. is working to address at this time.

### **MAJOR FINDINGS**

Overall, the nAble EHR system tested comparably to the prior version tested previously, with some notable improvements. Task-to-task workflow timing and step count was reduced with the adjustment of the patient chart to be centered around a main page, rather than spread across many disparate pages. Other chart sections (notably prescription and demographics) remain relatively unchanged, and scoring stayed relatively static (and above-average) for those sections. It is important to note the difference between this test and prior usability tests, which is the addition of

### **AREAS FOR IMPROVEMENT**

The most frequent complains pertained to the third-party Newcrop prescription system, and its relatively weaker usability compared to the rest of the nAble EHR suite. Additionally, small complaints about the sizing of windows, locations of buttons and other UI quality-of-life mentions were documented and quickly resolved.