



## **EHR Usability Test Report of Juno EHR (v 17.1)**

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

Date of Usability Testing:

Session 1:

September 5 to September 11, 2019

Session 2:

October 17 to October 22, 2019

Date of Report:

October 30, 2019

Report Prepared By:



DSS, Inc.

12575 U.S. Highway 1, Suite 200

Juno Beach, FL 33408

<https://www.dssinc.com/>

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## Executive Summary

A usability test of *Juno EHR* was conducted by DSS, Inc in 2 sessions on 9/5/19-9/11/19 and 10/16/19-10/22/19. Ten testers performed regular user testing over remote teleconferencing sessions using *GotoMeeting*. The purpose was to test and validate the usability of the current user interface and provide evidence of usability of *Juno EHR* as the EHR Under Test (EHRUT). Ten (10) healthcare providers matching the target demographic criteria participated in each study using the EHRUT in simulated, but representative tasks. Both studies focused on measuring the effectiveness of, efficiency of, and satisfaction with *Juno EHR* among a sample of participants representing potential users of the system.

These studies collected performance data on 40 tasks in the following 11 domains typically conducted on an EHR:

- § 170.315(a)(1) - CPOE Medications
- § 170.315(a)(2) - CPOE Laboratory
- § 170.315(a)(3) - CPOE Radiology
- § 170.315(a)(4) - Drug-drug, Drug-allergy Interaction Checks
- § 170.315(a)(5) - Demographics
- § 170.315(a)(6) - Problem List
- § 170.315(a)(7) - Medication List
- § 170.315(a)(8) - Medication Allergy List
- § 170.315(a)(9) - Clinical Decision Support
- § 170.315(a)(14) - Implantable Device List
- § 170.315(b)(2) - Clinical Information Reconciliation and Incorporation

Results of the studies indicated the *Juno EHR* system were quite satisfactory with regards to effectiveness and efficiency and the participants were very satisfied with the system even though some areas of improvement were identified that will be addressed in future development.

The following types of data were collected for each participant:

- Number of tasks successfully completed within the allotted time
- Time to complete the tasks
- Number and types of errors
- Path deviations as measured by mouse movement
- Participant's satisfaction ratings of the system

User metrics were compared to optimal metrics as determined by measurement of a user fully familiar with the EHRUT functionality.

## Tasks

**Table 1: Summary of Usability Testing for *Juno EHR***

		Task Success-Mean (%)	Task Time - Mean (sec)	Optimal Time (sec)	Task Errors (mean) (%)	Task Likert Rating
A1.1	Record CPOE Medication Order	30%	106.60	73	0	4.5
A1.2	Change CPOE Medication Order	20%	121.90	87	0	4.1
A1.3	Access CPOE Medication Order	100%	35.00	73	10%	4.89
A2.1	Record Lab order via CPOE	40%	62.90	55	0	4.7
A2.2	Change Lab order via CPOE	20%	92.30	66	0	4.6
A2.3	Display changed CPOE Lab order	60%	19.80	33	0	5
A3.1	Record Imaging order via CPOE	70%	107.79	120	0	4.2
A3.2	Change Imaging order via CPOE	20%	92.30	82	0	4.5
A3.3	Display changed CPOE Imaging order	60%	19.80	22	0	5
A4.1	Using CPOE, trigger a drug-drug interaction by entering a new medication order	100%	183.50	254	0	3.8
A4.2	Using CPOE, trigger a drug-allergy interaction by entering a new medication order	70%	73.00	78	0	4
A4.3	Adjust the severity level of a displayed drug-drug interaction	60%	188.40	206	0	3
A5.1	Record a patient's preferred language, date of birth, birth sex, sexual orientation, gender identity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	80%	216.25	297	0.2	3.9
A5.2	Record a patient's race and ethnicity.	60%	67.50	68	0	4.1
A5.3	Record a patient's preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	40%	73.20	70	0	4
A5.4	Change the patient's preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	50%	48.20	48	0	4.2
A5.5	Change the patient's preferred language, date of birth, birth sex, race, ethnicity, sexual orientation and gender identity.	40%	152.50	150	0	4.3

A5.6	Display the patient's changed preferred language, date of birth, birth sex, race, ethnicity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	90%	30.40	60	0	4.7
A5.7	Display the patient's changed sexual orientation and gender identity.	60%	37.70	34	0	4.9
A6.1	Record a problem to the problem list	10%	147.90	116	0	3.9
A6.2	Change a problem on the problem list	10%	104.70	53	0	4.4
A6.3	Display the active problem list	10%	34.10	21	0	4.9
A6.4	Display the historical problem list	10%	22.00	15	0	4.9
A7.1	Record a medication to the medication list	70%	173.30	195	0	4
A7.2	Change a medication on the medication list	30%	40.80	31	0	4.6
A7.3	Display the active medication list	60%	27.50	31	0	5
A7.4	Display the historical medication list	70%	16.80	20	0	5
A8.1	Record a medication allergy	30%	124.30	110	0	4.1
A8.2	Change a medication allergy	40%	127.30	128	0	4.5
A8.3	Display the active medication allergy list	90%	12.60	30	0	5
A8.4	Display the historical medication allergy list	80%	64.20	78	0	4.4
A9.1	Trigger the CDS interventions/resources based on data elements in the problem list, medication list, and medication allergy list by incorporating patient information from a transition of care/referral summary	80%	24.30	30	0	3.55
A9.2	Add a CDS intervention and/or reference resource for each of the required elements: Problem List, Medication List, Medication Allergy List, at least one Demographic, Laboratory Test, Vital Signs, and a Combination of at least 2 of the elements above	60%	152.00	180	0	3.55
A9.3	Access the following attributes for one of the triggered CDS interventions/resources: bibliographic citation, developer, funding source, release/revision date. View the	80%	70.70	90	0	3.55

	intervention/resource information using the Info button standard for data elements in the problem list, medication list, and demographics					
A9.4	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements	100%	905.30	1185	0	3.55
A14.1	Record UDI	20%	212.50	99	0	3.55
A14.2	Change UDI Status	70%	53.10	59	0	3.55
A14.3	Access UDI, Device Description, Identifiers and Attributes	30%	94.90	42	0	3.55
B2.1	Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record	30%	506.00	347	0	3.55
B2.2	Generate a new CCDA with reconciled data	44%	149.22	135	0	3.55
	Mean Session 1	57.16%	240.89	240.78	0.01	3.55
	Mean Session 2	50.97%	84.66	87.23	0.01	4.42
	Overall Mean	52.36%	119.81	121.78	0.01	4.23
	Overall Median	60%	82.75	73	0	4.2
	Overall Std Dev	27.37%	154.62	188.62	0.03	0.56

**Major Findings:**

This evaluation demonstrated that the DSS Inc. *Juno EHR* system is a highly usable system with a relatively short learning curve. Participants with minimal amounts of experience using the *Juno EHR* system before the study, experienced very little initial difficulty understanding the navigation and information architecture. Participants with more experience were able to solve most tasks without difficulty or error. The individual Task Satisfaction scores were well above the 3.2 cutoff that indicates the usability is good with scores that ranged from 1-5 with a mean of 4.23, a median of 4.2 and a standard deviation of 0.56. The System Usability Scale Scores were significantly different for Session 1 and Session 2, i.e., 64.5 for Session 1 and 74.25 for Session 2. In a study evaluating 500 studies, the average was 68 and in looking at the percentile rankings that normalize the data, the 74.25 would be in a percentile rank of 70% and interpreted as a grade of B-. The goal is to score above 80.3 to be in the top 10% of scores and being in the category where users are more likely to be recommending the product.

System Effectiveness based on both Task Success-Mean (%) and the Task Errors – Mean (%) was good, though showed some room for improvement. The methodology utilized to calculate the optimal task time was based on a formula like the one detailed in NISTR 7741, i.e., calculated time X 1.5 based on the expert time; however, given the lack of training provided to the testers in advance, the Task Success-Mean for tasks that were completed within that time was only 52.36% overall, 57.16% for Session 1 and 50.97% for Session 2. Given that the task performance was within control limits for 99% of the tasks,

this will be addressed as part of user training so that users gain a level of comfort needed to improve the task efficiency. In the case of some specific tasks that represent new functionality, such as B2.1 Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record, feedback was provided to the design team as an area for improvement.

System Efficiency based on Task Time-Mean (sec) showed significant variation across the 11 criteria; however, 392 of the 396 tasks that were completed were within control. Only 4 tasks had data points outside the +/- 2 SD. These were not generally the same tasks that had multiple path deviations and there was no specific common cause identified for those 4 tasks. Analysis of the Path Deviations shows some room for improvements as detailed in the Areas for Improvement.

### *Areas for Improvement:*

No particular area of the application was cited as in need of improvement by a majority of the users. Although two of the testers provided a SUS score of less than 50 out of 100, they did not provide any specific comments. The following specific items were identified in EHRUT as areas for improvement:

- Inconsistent layout, i.e., table of contents on the right instead of the left, use of double clicks versus single clicks, location of the Done button on various pages
- Need to re-size the CDA tool used for reconciliation
- Consider moving or re-sizing the tabs at the bottom in the CDA tool used for reconciliation
- Entry of vitals in the Ambulatory Care-Provider note is not intuitive as the user wants to enter data directly into the grid
- Layout of the Major Procedures tab versus Major Procedures with Device tab is confusing

In addition, based on the data analysis, making these and other minor enhancements will improve the overall user experience of the system and increase the effectiveness, efficiency, and satisfaction for both experienced and novice users.

- **Indication of Required Fields**
  - For the 3 tasks associated with the new functionality for the a14 Implantable Devices criteria, users were introduced to the Clinical Note Template (CNT) design. The template is utilized for documented major historical procedures in addition to those involving an implantable device. The general functionality for identifying required fields is very user friendly; however, the users doing the testing lacked experience with this type of clinical documentation in addition to the lack of experience with the design of CNTs; therefore, both the efficiency and the effectiveness were impacted as reflected in the task time and the path deviations.
- **Lack of user instructions**
  - For b2 Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record, the task time had a wide range, i.e. 335 – 677 seconds with a mean of 506 seconds and a median of 57 seconds. Though there were no errors, there were 2 path deviations and the Risk Rating for this task is “Very High” based on a “Possible” likelihood and a “Severe” potential consequence for an error. This is functionality new to most EHR systems so the testers were not familiar with this process. Feedback has been provided to the

design/development team for improvements and the addition of user instructions to be included in the next version.

- **Inconsistent styles**
  - Participants occasionally attempted to use the “right-click” functionality on features and functions that did not support it. Adding this functionality when it makes sense to do so would likely eliminate many of these errors/deviations. This feedback has been provided to the design/development teams for consideration when doing new designs and modifications.

## INTRODUCTION

## METHOD

### Participants

Ten (10) individuals (5 men and 5 women) participated in both sessions of the Usability Study using *Juno EHR*, the EHRUT. Participants were physicians, nurses, pharmacists, and/or other healthcare/Health IT practitioners. Volunteers were solicited from Document Storage Systems, Inc. (DSS, Inc.) from both current and previous DSS staff from areas within the company that were not involved in the development of the application. An e-mail was sent companywide asking for participants. Those who responded to take part in the study were asked to fill out a questionnaire (see Appendix A) that served as the participant screener. Participants meeting the criteria for participation in the study were contacted and scheduled via telephone and email.

Participants’ performance was compared to optimal performance for each task. Optimal performance was set based on the performance of each task by a manager fully familiar with the functionality of the EHRUT.

Participants had experience with the occupation and expertise that aligns with the capability under testing. The demographic characteristics of the test participant characteristics reflected the audience of current and future users. Table 2 presents participant characteristics, including demographics, professional experience, computing experience, and previous EHR experience. Participant characteristics reflect the audience of current and future users and meet the criteria designated in the 2015 Edition Certification Companion Guide for Safety-Enhanced Design - 45 CFR 170.315(g)(3).

**Table 2. Participant Characteristics**

Part ID	Gender	Age	Education	Role/Title	Professional Experience (yrs.)	EHR Experience (yrs.)	Computer Experience (yrs.)	Experience with Juno EHR (yrs.)	Assistive Tech Needs
P11	Female	60 to 69	College Graduate-BSN	RN	25	26	27	0	None



P12	Male	60 to 74	College Graduate -RN	RN	35	25	30	0	None
P13	Male	50 to 59	Post Graduate- MD	MD	30	12	12	0	None
P14	Male	50 to 59	College Graduate- RN/ BA	RN	25	32	20	0	None
P15	Female	40 to 49	College Graduate-MSN	RN	25	10	20	0	None
P16	Female	20 to 29	College Graduate- MSN	RN	12	12	29	0	None
P17	Male	70 to 79	Post Graduate- PhD	Clinical Psychologist	40	30	50	0	None
P18	Female	60 to 69	College Graduate- MBA	RN	40	5	20	0	None
P19	Male	30 to 39	Postgraduate- PharmD	Pharmacist	7	6	20	0	None
P20	Female	60 to 69	College Graduate- BSN	RN	41	30	40	0	None

## Study Design

The overall objective of this usability test was to uncover areas where the *Juno EHR* system performed well – that is, effectively, efficiently, and with satisfaction – and areas where the system failed to serve the clinical documentation and workflow needs of users. Data from this test may be used as a baseline for future tests of updated versions of *Juno EHR* and/or for comparing *Juno EHR* with other EHRs presenting the same tasks. In short, this testing serves as both a means to record or benchmark current usability and to identify areas where improvements must be made.

Participants had a range of experience with EHRs in general, but all had no direct experience and/or training with the *Juno EHR* system. Participants completed the DSS Inc. *Juno EHR* usability during individual 60 - 90 minute *GotoMeeting* sessions. During the test, each participant interacted with various components of *Juno EHR* system. Each participant was provided with the same instructions.

*Juno EHR* was evaluated for effectiveness, efficiency and satisfaction as defined by the following measures collected and analyzed for each participant:

- Effectiveness as measured by the number of tasks successfully completed without assistance
- Efficiency as measured by the time to complete the tasks
- Number and types of errors
- Path deviations
- Participant’s verbalizations (comments)
- Satisfaction as measured by the participant’s satisfaction ratings of both the individual tasks and the system

## Tasks

A total of forty (40) tasks were analyzed in scenarios that would be realistic and representative of the kinds of activities a user might engage in while using *Juno EHR* in actual medical settings, including patient tasks in the following 11 domains as defined in 45 CFR Part 170 Subpart C of the Health Information Technology: Standards, Implementation Specifications, and Certification Criteria for Electronic Health Record Technology. The tasks focused on the following sub-set of 2015 Edition Certification Criteria specified by ONC:

#### Session 1 (9/5/19 – 9/11/19)

- § 170.315(a)(9) - Clinical Decision Support
- § 170.315(a)(14) - Implantable Device List
- § 170.315(b)(2) - Clinical Information Reconciliation and Incorporation

#### Session 2 (10/17/19/ - 10/22/19)

- § 170.315(a)(1) - CPOE Medications
- § 170.315(a)(2) - CPOE Laboratory
- § 170.315(a)(3) - CPOE Radiology
- § 170.315(a)(4) - Drug-drug, Drug-allergy Interaction Checks
- § 170.315(a)(5) - Demographics
- § 170.315(a)(6) - Problem List
- § 170.315(a)(7) - Medication List
- § 170.315(a)(8) - Medication Allergy List

## Procedures

All participants received the information for the testing via email. Participants were assigned a participant ID. Each participant reviewed and signed an informed consent and release form. See Appendix B.

Upon connection to the online meeting tool (*GotoMeeting*), each participant was greeted with gratitude exchanged for his or her participation in the study. Participant identities and demographic questionnaire submission was verified. Participant names were replaced with participant IDs so that a given individual's data cannot be linked to his/her identity. Prior to beginning testing, each participant reviewed and signed an informed consent form. Once the consent was signed, the administrator assisted the participant in logging into the testing system.

The ONC Usability Team test administrator administered the test. The administrator moderated the session by providing both verbal and written instructions for the overall usability test and for each of the tasks comprising the test. The administrator and other ONC team members also monitored task success, path deviations, number and description of errors, and audio-recorded

participant verbal comments. A data logger logged task times, obtained post-task rating data, and took notes on participant comments and administrator feedback.

For each of the nine (9) tasks in Session 1 and the thirty-one (31) tasks in Session 2, participants were provided written instructions. Following the administrator's instructions, each participant performed each task by first reading the task then completing the task as they interpreted it. Task time was stopped and recorded when the test administrator observed on their workstation that the participant had successfully completed the task. This same procedure was conducted for each of the tasks. For Session 1, the participants provided an overall rating for the tasks; however, after each task in Session 2, the individual task was rated on a Likert Scale "On a scale from 1 to 5, where 1 is 'Very Difficult and 5 is 'Very Easy,' how satisfied were you with the ease of use for this task?"

Following completion of the tasks, the administrator electronically presented to the participant one post-test questionnaire (see Appendix E). After the participant completed the questionnaires, the administrator thanked each participant for his or her time and allowed the participant to make any comments on or ask any questions about the system and/or the tasks presented. For each session, the participant's schedule, demographic information, task success rate, time on task, errors, deviations, verbal responses, and post-test questionnaire were digitally recorded. The system was then reset to proper test conditions for the next participant.

All testing sessions were recorded using the *GotoMeeting* recording functionality and saved for reference.

## Test Location

All participants were tested on the *Juno EHR* system during remote conferencing sessions using *GotoMeeting*. Each participant was requested in advance to secure a quiet room with minimal distractions and a desktop or laptop computer that could connect to the Internet with a *GotoMeeting* session. Majority of the participants used a Lenovo Thinkpad laptop with Windows 10 as the operating system and a display resolution of 1920 x 1080 with permission granted to launch a remote desktop connection with server access approval from our IT department. During a given *GotoMeeting* session, the test administrator, available ONC team report writer members and participants communicated with one another.

The *GotoMeeting* usability test session was conducted by a test administrator from DSS, Inc. working from a small conference room at DSS, Inc., Juno location.

## Test Environment

While the EHRUT typically would be used in a healthcare office, inpatient or ambulatory center facility, testing of the *Juno EHR* system was conducted via remote connection during individual

*GotoMeeting* sessions. The server machine specs include: Windows Server 2012 R2 with 7GB Ram. Each participant called into a *GotoMeeting* session requested in advance server access and logged into the sever with administrator assistance.

The *Juno EHR* application itself ran on a Windows Client platform on a LAN connection using a sample database that was set up specifically for the test. Settings ??? The system performance (i.e. response time) was representative to what actual users would experience in a field implementation. Participants used a mouse and keyboard when interacting with the EHRUT to perform the tasks. Participants did not change any of the default settings (such as control of font size) during the test session.

## Test Forms and Tools

As part of the usability test, several documents and instruments were used, including:

1. Informed Consent
2. Tester Script (list of tasks and task ratings)
3. Moderator Guide
4. Post-test Questionnaire

Examples of these documents can be found in can be found in Appendices B, C, D and E respectively. The Moderator's Guide was devised to be able to capture required data. The participant's interaction with the EHRUT was captured and recorded digitally using *GotoMeeting*. These recordings also included the verbal responses via the audio recording function.

## Participant Instructions

### *Session 1*

Thank you for participating in this Usability Study. The session today will last approximately 60-90 minutes. During this session, you will look at the *Juno EHR* software. I will ask you to complete some tasks using this system and answer some questions.

The purpose of this study is to gauge the *usability* of the software. We are interested in how easy (or how difficult) this version is to use, and the features and benefits that would be useful to you. We also want to know how we can improve it. Please note, we are not testing you; we are testing the system. Therefore, if you have any difficulty this may mean something needs to be improved in the system.

In this Usability Study will be testing three ONC criteria: Implantable Devices, Reconciliation, and Clinical Decision Support. We have tried to create scenarios with real clinical data surrounding the functionality the meets the three ONC criteria, however, the scenarios may skip some of the real clinical workflow.

As the moderator, I will help guide you in the test process. If you feel lost or have difficulty completing the scenario, please let me know. As you complete a section the script will say,

“Stop”. Please stop at this time so I can provide some context for the next section of criteria you will be testing.

Participants were then explained the patient scenarios before starting their tasks.

## *Session 2*

Thank you for participating in this Usability Study. The session today will last approximately 60 minutes. During this session, you will look at the Juno EHR software. I will ask you to complete some tasks using this system.

The purpose of this study is to gauge the *usability* of the software. We are interested in how easy (or how difficult) this version is to use, and the features and benefits that would be useful to you. We also want to know how we can improve it. Please note, we are not testing you; we are testing the system. Therefore, if you have any difficulty this may mean something needs to be improved in the system.

In this Usability Study will be testing eight ONC criteria: CPOE Medication, Laboratory, Radiology, Drug Allergy Interaction Checks, Problem List, Medication List, Medication Allergy List and Demographics. We have tried to create scenarios with real clinical data surrounding the functionality that meets these ONC criteria, however, the scenarios may skip some of the real clinical workflow.

As the moderator, I will help guide you in the test process. If you feel lost or have difficulty completing the scenario, please let me know. As you complete a section the script will say, “Stop”. Please stop at this time so you can complete the Task Rating and I can provide some context for the next section of criteria you will be testing.

## Usability Metrics

According to the *NIST GUIDE to the Processes Approach for Improving the Usability of Electronic Health Records* (NISTR 7741), 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 as measured by the number of tasks successfully completed, errors and path deviations
2. Efficiency as measured by the time to complete the tasks
3. Satisfaction as measured by the participant’s satisfaction ratings on ease of use for both the individual tasks and the system

## *Risk Rating*

Each of the tasks were evaluated to determine the Risk Rating of each task based on a prioritization matrix that utilized the likelihood of occurrence and the severity of the

consequences to categorize the risk into one of five categories based on Patient Safety Improvement Handbook, i.e. VHA Handbook 1050.01, VA National Center for Patient Safety. The process is essentially equivalent to that utilized in the Joint Commission SAFER Matrix that looks at overall risks within the healthcare facility.

**Table 3: Risk Rating Prioritization Matrix**

			Potential Consequences					
			No injury/ treatment	Minor injury/ no medical treatment or measurable effect	Injury or illness requiring medical treatment; temporary impairment	Injuries or illness requiring hospital admission	Injuries of illness resulting in permanent impairment	Fatality
			None	Not Significant	Minor	Moderate	Major	Severe
Likelihood	Expected to occur regularly under normal circumstances	<b>Almost Certain</b>	None	Medium	High	Very High	Very High	Very High
	Expected to occur at some time	<b>Likely</b>	None	Medium	High	High	Very High	Very High
	May occur at some time	<b>Possible</b>	None	Low	Medium	High	High	Very High
	Not likely to occur in normal circumstances	<b>Unlikely</b>	None	Low	Low	Medium	Medium	High
	Could happen, but probably never will	<b>Rare</b>	None	Low	Low	Low	Low	Medium
	Could not happen based on design/usage	<b>None</b>	None	None	None	None	None	None

**Table 4: Task Risk Rating**

		<b>Likelihood of Error</b>	<b>Potential Consequences</b>	<b>Risk Rating</b>
A1.1	Record CPOE Medication Order	Possible	Not Significant	Low
A1.2	Change CPOE Medication Order	Unlikely	Not Significant	Low
A1.3	Access CPOE Medication Order	None	None	None
A2.1	Record Lab order via CPOE	Possible	Not Significant	Low
A2.2	Change Lab order via CPOE	Unlikely	Not Significant	Low
A2.3	Display changed CPOE Lab order	None	None	None
A3.1	Record Imaging order via CPOE	Possible	Not Significant	Low
A3.2	Change Imaging order via CPOE	Unlikely	Not Significant	Low
A3.3	Display changed CPOE Imaging order	None	None	None
A4.1	Using CPOE, trigger a drug-drug interaction by entering a new medication order	Unlikely	Severe	High
A4.2	Using CPOE, trigger a drug-allergy interaction by entering a new medication order	Unlikely	Severe	High
A4.3	Adjust the severity level of a displayed drug-drug interaction	Rare	Severe	Medium
A5.1	Record a patient's preferred language, date of birth, birth sex, sexual orientation, gender identity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	Rare	Not Significant	Low
A5.2	Record a patient's race and ethnicity.	Rare	None	None
A5.3	Record a patient's preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	Rare	None	None
A5.4	Change the patient's preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	Rare	None	None
A5.5	Change the patient's preferred language, date of birth, birth sex, race, ethnicity, sexual orientation and gender identity.	Rare	Not Significant	Low
A5.6	Display the patient's changed preferred language, date of birth, birth sex, race, ethnicity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	Rare	None	None
A5.7	Display the patient's changed sexual orientation and gender identity.	None	None	None
A6.1	Record a problem to the problem list	Unlikely	Not Significant	Low
A6.2	Change a problem on the problem list	Unlikely	Not Significant	Low
A6.3	Display the active problem list	None	None	None
A6.4	Display the historical problem list	None	None	None
A7.1	Record a medication to the medication list	Possible	Not Significant	Low
A7.2	Change a medication on the medication list	Unlikely	Not Significant	Low
A7.3	Display the active medication list	None	None	None
A7.4	Display the historical medication list	None	None	None
A8.1	Record a medication allergy	Unlikely	Severe	High
A8.2	Change a medication allergy	Rare	Severe	Medium
A8.3	Display the active medication allergy list	None	None	None
A8.4	Display the historical medication allergy list	None	None	None
A9.1	Trigger the CDS interventions/resources based on data elements in the problem list, medication list, and medication allergy list by incorporating patient information from a transition of care/referral summary	Rare	Not Significant	Low
A9.2	Add a CDS intervention and/or reference resource for each of the required elements: Problem List, Medication List, Medication Allergy List, at least one Demographic, Laboratory Test, Vital Signs, and a Combination of at least 2 of the elements above	None	None	None
A9.3	Access the following attributes for one of the triggered CDS interventions/resources: bibliographic citation, developer, funding source, release/revision date. View the intervention/resource information using the	None	None	None

	Infobutton standard for data elements in the problem list, medication list, and demographics			
A9.4	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements	Rare	Not Significant	Low
A14.1	Record UDI	Possible	Minor	Medium
A14.2	Change UDI Status	Rare	Not Significant	Low
A14.3	Access UDI, Device Description, Identifiers and Attributes	None	None	None
B2.1	Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record	Possible	Severe	Very High
B2.2	Generate a new CCDA with reconciled data	Rare	Not Significant	Low

### Data Scoring

**Table 5: Scoring Protocols for Effectiveness, Efficiency and Satisfaction**

Measures	Rationale and Scoring
<p><b>Effectiveness:</b></p> <ul style="list-style-type: none"> <li>Task Success</li> </ul>	<p>A task was counted as “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 was calculated for each task and then divided by the total number of participants. Results are provided as a percentage under <b>Task Success-Mean (%)</b>. The standard deviation for task success is reported as <b>Task Success-Std Dev (%)</b>.</p>
<p><b>Effectiveness:</b></p> <ul style="list-style-type: none"> <li>Task Failures</li> </ul>	<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 “Fail.” No task times were taken for failed attempts/errors. The total number of errors was calculated for each task and divided by the total number of times that task was attempted. Results are presented as the average error rate under <b>Task Errors-Mean (%)</b>. Variance was reported as <b>Task Errors-Std Dev (%)</b>.</p> <p>Note: Not all deviations are counted as errors</p>
<p><b>Efficiency:</b></p> <ul style="list-style-type: none"> <li>Task Deviations</li> </ul>	<p>The participant’s path (i.e., steps) through the application was recorded. Deviations occur if for example, the participant navigated to an incorrect tab/screen, clicked on an incorrect menu item, made an incorrect selection, interacted incorrectly with an on-screen control or made an incorrect entry.</p> <p>Results are presented under <b>Task Path Deviation-Observed</b> and compared to the expert’s performance which is presented under <b>Task Path Deviation-Optimal</b>. The type of deviations detailed for further analysis/use in improvements.</p>
<p><b>Efficiency:</b></p> <ul style="list-style-type: none"> <li>Task Time</li> </ul>	<p>Each task was timed from the time the participant began the step associated with the specific task until the participant completed the step associated with the end of the specific task. Task time was stopped and recorded when the test administrator observed on their workstation that the participant had successfully completed the task.</p>



	<p>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. Average task time and task time variance were reported as <b>Task Time – Mean (sec)</b>, <b>Task Time Deviation-Mean Observed (sec)</b> and <b>Task Time-Standard Deviation (sec)</b>. These were compared to the expert’s performance which was reported under <b>Task Time Deviation-Mean Optimal (Sec)</b>.</p> <p>Optimal task performance time, as benchmarked by performance under test conditions, was established as part of this EHRUT. Target task time were calculated by taking measures of optimal performance and multiplying it by 1.5 to allow some time buffer because participants are not trained. The times will then be compared to results for future versions of the software.</p>
<p><b>Satisfaction:</b></p> <ul style="list-style-type: none"> <li>• Ease of Use ratings</li> <li>• System Satisfaction</li> </ul>	<p>Participant’s subjective impression of the ease of use of the application was measured by administering both a single post-task question as well as two post-session questionnaires.</p> <p>After each task, the participant was asked to rate “Overall, this task was:” on a Likert Scale where 1 is ‘Very Difficult’ and 5 is ‘Very Easy’. These data are averaged across participants. Common convention should be that average ratings for systems judged easy to use should be 2.7 or higher.</p> <p>To measure participants’ confidence in and likeability of the EHR overall, the testing team administered electronic versions of the System Usability Scale (SUS) post-test questionnaire. (Appendix E). The SUS utilizes a 5 point Likert scale and was scored by normalizing each value from 0 to 4 with 4 being the most positive response, then multiplying the converted responses by 2.5 for a possible range of 0 to 100. In a study evaluating 500 studies, the average was 68 and in looking at the percentile rankings that normalize the data, a raw score of 74 converts to a percentile ranking of 70 and as a grade of B-. The goal is to score above 80.3 to be in the top 10% of scores and being in the category where users are more likely to be recommending the product.</p>

## RESULTS

### DATA ANALYSIS AND REPORTING

#### End User Testing

The results of the usability test were calculated according to the methods specified in the Usability Metrics and Data Scoring sections above. Errors/Task failures were excluded from the Efficiency metrics. All the testers returned post-survey questionnaires. Results are reported below in Table 6.

**Table 6: End User Testing**

		Task Success-Mean (%)	Task Success-Std Dev (%)	Task Path Deviation-Observed (#)	Task Path Deviation-Optimal (#)	Task Time-Mean (sec)	Task Time-Std Dev (sec)	Task Time Deviation-Mean Obs (sec)	Task Time Deviation-Mean Opt (sec)	Task Errors Mean (%)	Task Errors-Std Dev (%)	Task Rating	Task Rating-Std Dev
A1.1	Record CPOE Medication Order	30%	48.30%	4	10	106.60	28.89	41.30	25.36	0%	0%	4.5	0.71
A1.2	Change CPOE Medication Order	20%	42.16%	1	10	121.90	18.73	24.20	37.07	0%	0%	4.1	1.45
A1.3	Access CPOE Medication Order	100%	0.00%	0	0	35.00	16.34	38.00	16.34	10%	31.62%	4.89	0.33
A2.1	Record Lab order via CPOE	40%	51.64%	2	10	62.90	16.17	12.50	12.54	0%	0%	4.7	0.67
A2.2	Change Lab order via CPOE	20%	42.16%	2	10	92.30	16.50	15.50	11.10	0%	0%	4.6	0.71
A2.3	Display changed CPOE Lab order	60%	51.64%	3	0	19.80	6.34	5.40	3.63	0%	0%	5	0
A3.1	Record Imaging order via CPOE	70%	48.30%	1	10	107.79	28.53	26.50	14.20	0%	0%	4.2	1.14
A3.2	Change Imaging order via CPOE	20%	42.16%	2	10	92.30	16.50	15.50	11.10	0%	0%	4.5	0.71
A3.3	Display changed CPOE Imaging order	60%	51.64%	0	0	19.80	6.34	5.40	3.63	0%	0%	5	0
A4.1	Using CPOE, trigger a drug-drug interaction by entering a new medication order	100%	0.00%	6	10	183.50	38.15	70.50	38.15	0%	0%	3.8	1.4
A4.2	Using CPOE, trigger a drug-allergy interaction by entering a new medication order	70%	48.30%	5	10	73.00	16.10	13.80	8.68	0%	0%	4	1.15
A4.3	Adjust the severity level of a displayed drug-drug interaction	60%	51.64%	6	10	188.40	62.65	56.00	28.02	0%	0%	3	1.33
A5.1	Record a patient's preferred language, date of birth, birth sex, sexual orientation, gender identity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	80%	42.16%	1	5	216.25	44.49	80.75	44.49	20%	42%	3.9	1.37
A5.2	Record a patient's race and ethnicity.	60%	51.64%	0	0	67.50	9.40	7.30	5.42	0%	0%	4.1	0.99

A5.3	Record a patient's preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	40%	51.64%	2	5	73.20	17.22	13.40	10.42	0%	0%	4	0.94
A5.4	Change the patient's preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	50%	52.70%	0	5	48.20	11.74	9.20	6.61	0%	0%	4.2	0.63
A5.5	Change the patient's preferred language, date of birth, birth sex, race, ethnicity, sexual orientation and gender identity.	40%	51.64%	3	5	152.50	26.14	20.30	15.25	0%	0%	4.3	0.82
A5.6	Display the patient's changed preferred language, date of birth, birth sex, race, ethnicity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	90%	31.62%	0	0	30.40	16.57	31.80	11.15	0%	0%	4.7	0.48
A5.7	Display the patient's changed sexual orientation and gender identity.	60%	51.64%	1	0	37.70	21.04	15.50	13.82	0%	0%	4.9	0.32
A6.1	Record a problem to the problem list	10%	31.62%	4	5	147.90	30.03	34.50	26.65	0%	0%	3.9	1.1
A6.2	Change a problem on the problem list	10%	31.62%	3	5	104.70	50.35	52.30	49.66	0%	0%	4.4	0.97
A6.3	Display the active problem list	10%	31.62%	1	0	34.10	16.95	14.10	16.04	0%	0%	4.9	0.32
A6.4	Display the historical problem list	10%	31.62%	0	0	22.00	8.31	8.00	7.24	0%	0%	4.9	0.32
A7.1	Record a medication to the medication list	70%	48.30%	1	10	173.30	38.37	36.30	24.10	0%	0%	4	1.15
A7.2	Change a medication on the medication list	30%	48.30%	1	10	40.80	13.94	12.20	11.65	0%	0%	4.6	0.7
A7.3	Display the active medication list	60%	51.64%	1	0	27.50	7.29	6.50	4.45	0%	0%	5	0
A7.4	Display the historical medication list	70%	48.30%	0	0	16.80	6.84	6.6	3.13	0%	0%	5	0
A8.1	Record a medication allergy	30%	48.30%	3	5	124.30	25.40	23.10	16.72	0%	0%	4.1	0.99
A8.2	Change a medication allergy	40%	51.64%	1	5	127.30	25.88	19.70	15.47	0%	0%	4.5	0.97

A8.3	Display the active medication allergy list	90%	31.62%	0	0	12.60	9.05	18.40	6.48	0%	0%	5	0
A8.4	Display the historical medication allergy list	80%	42.16%	1	0	64.20	36.44	33.40	17.32	0%	0%	4.4	1.07
A9.1	Trigger the CDS interventions/resources based on data elements in the problem list, medication list, and medication allergy list by incorporating patient information from a transition of care/referral summary	80%	42.16%	0	0	24.30	5.81	6.90	4.12	0%	0%	3.55	0.93
A9.2	Add a CDS intervention and/or reference resource for each of the required elements: Problem List, Medication List, Medication Allergy List, at least one Demographic, Laboratory Test, Vital Signs, and a Combination of at least 2 of the elements above	60%	51.64%	0	0	152.00	40.81	36.80	32.12	0%	0%	3.55	0.93
A9.3	Access the following attributes for one of the triggered CDS interventions/resources: bibliographic citation, developer, funding source, release/revision date. View the intervention/resource information using the Info button standard for data elements in the problem list, medication list, and demographics	80%	42.16%	0	0	70.70	29.16	30.50	15.19	0%	0%	3.55	0.93
A9.4	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements	100%	0.00%	8	3	905.30	194.81	279.70	194.81	0%	0%	3.55	0.93
A14.1	Record UDI	20%	42.16%	12	10	212.50	160.07	115.10	158.80	0%	0%	3.55	0.93
A14.2	Change UDI Status	70%	48.30%	0	0	53.10	16.48	12.90	11.20	0%	0%	3.55	0.93

A14.3	Access UDI, Device Description, Identifiers and Attributes	30%	48.30%	0	0	94.90	60.31	62.10	49.62	0%	0%	3.55	0.93
B2.1	Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record	30%	48.30%	1	2	506.00	170.97	181.40	144.08	0%	0%	3.55	0.93
B2.2	Generate a new CCDA with reconciled data	44%	52.79%	5	0	149.22	59.92	49.78	32.11	10%	32.00%	3.55	0.93

### Task Failures per Participant

No significant task failures were identified. The overall error rate was 0.1, or 1%.

**Table 7. Task Failures by Participant**

Tester	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20
Tasks (#)	40	40	40	40	40	40	40	40	40	40
Errors (#)	0	1	1	0	0	1	1	0	0	0
Error Rate	0	0.025	0.025	0	0	0.025	0.025	0	0	0

### SUS

The results from the SUS (System Usability Scale) scored the subjective satisfaction with the system based on performance with these tasks to be 74.25 out of 100. Details of the SUS results are described below and SUS scores by participant for Session 1 and Session 2 are shown in Figure 3.

### Errors and Error Types

Of the 400 tasks performed by the 10 participants, there were only 4 errors, an overall rate of 1%. Errors/Task failures were excluded from the Efficiency metrics. Errors were evaluated based on both the risk rating and the error type and cause as detailed below.

No significant patient safety issues were identified. In addition to the impact of not including any training for those involved in the testing, two of the four errors were on tasks that would generally be done by administrative staff rather than clinical staff.

**Table 8. Characterization of Errors**

Task ID	Task	Risk Rating	Type	Cause
A1.3	Access CPOE Medication order	None	Incorrect selection	User chose wrong type of med, i.e. IP vs OP
A5.1	Record a patient's preferred language, date of birth, birth sex, sexual orientation, gender identity (inpatient only)	Low	Incorrect selection	User not familiar with task
A5.1	Record a patient's preferred language, date of birth, birth sex, sexual orientation, gender identity (inpatient only)	Low	Incorrect selection	User not familiar with task
B2.2	Generate a new CCDA with reconciled data	Low	Server went down	System performance related error

## DISCUSSION OF THE FINDINGS

### EFFECTIVENESS

Of the forty (40) tasks presented, the tasks were successfully completed by all the participants with one exception. Overall, the participant's mean successful task completion rate for both Session 1 and Session 2 was very high with an overall rate of ninety-seven point five (97.5) percent, indicating that in general the participants had little or no difficulty completing the tasks.

The amount of prior experience with EHR systems and with *Juno EHR* was related to successful task performance and error rates; participants with more prior experience were more likely to successfully complete tasks with less errors and task deviations than those with less prior experience.

### EFFICIENCY

Participants who successfully completed tasks generally completed those tasks within an acceptable time. Some tasks were completed more quickly than the calculated optimal time, while several tasks took slightly longer than expected. For Study 1 the participants were able to complete the tasks, though the overall completion rate within the task set time was only 37.78%. The complexity of the process for a14 implantable devices and b2 clinical reconciliation and incorporation significantly impacted the overall completion rate. The tasks that took the longest required the participants to navigate to an unfamiliar portion of a page, interact with a workflow, locate and select specific actions. Those tasks may be performed more quickly with a minor update to the information architecture or the user experience.

Some participants made errors when attempting to navigate toward solving their assigned tasks. These errors may be associated with those participants not being familiar and not understanding the presented information architecture of the *Juno EHR* system. The tasks surrounding a14 implantable device caused users some errors, but these could be caused by the unfamiliarity of inputting UDI numbers into an EHR. As noted above, prior experience with EHR systems was related to successful task completion.

Path Deviations-Observed (#) were greater than the Path Deviations – Optimal (#) for Session 1; however, this was reversed in Session 2 where Path Deviations-Observed (#) were below the Path Deviations-Optimal (#) for Session 2. Path Deviations were categorized by the type of deviation and analyzed further by type for a determination as to whether the design should be changed or if the task needed to be addressed through more in-depth attention during training. Those that needed to be referred to the design/development team were included in the Areas for Improvement. In addition, for the a4 Drug-drug, Drug-allergy Interaction Checks criteria, the possibility of increasing the number of physician testers is being evaluated.

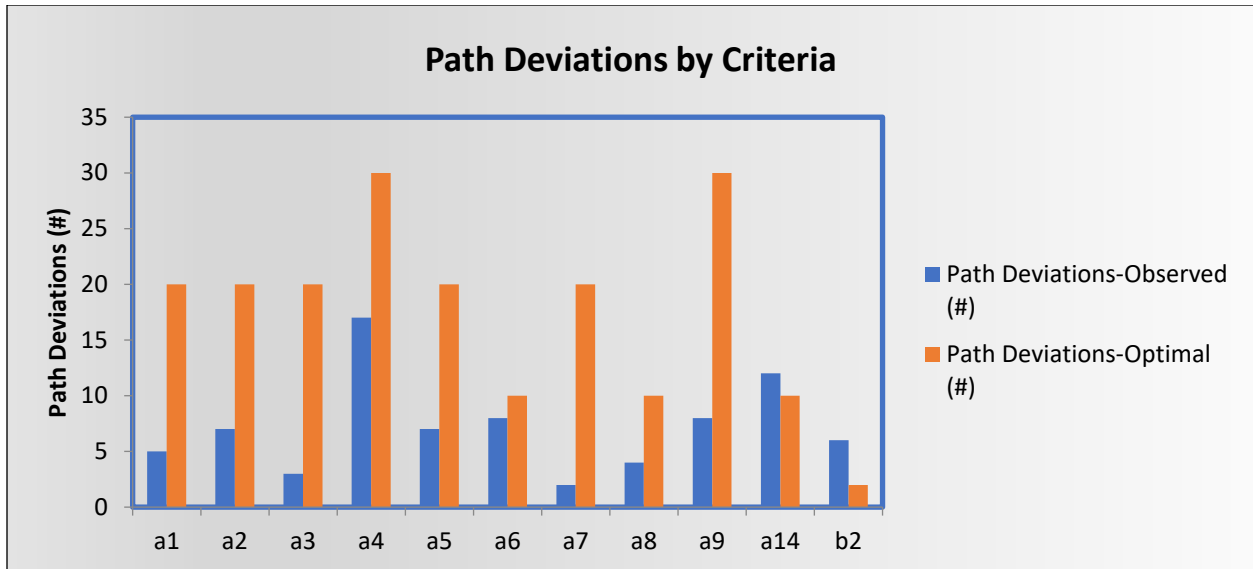


Figure 1. Path Deviations by Criteria

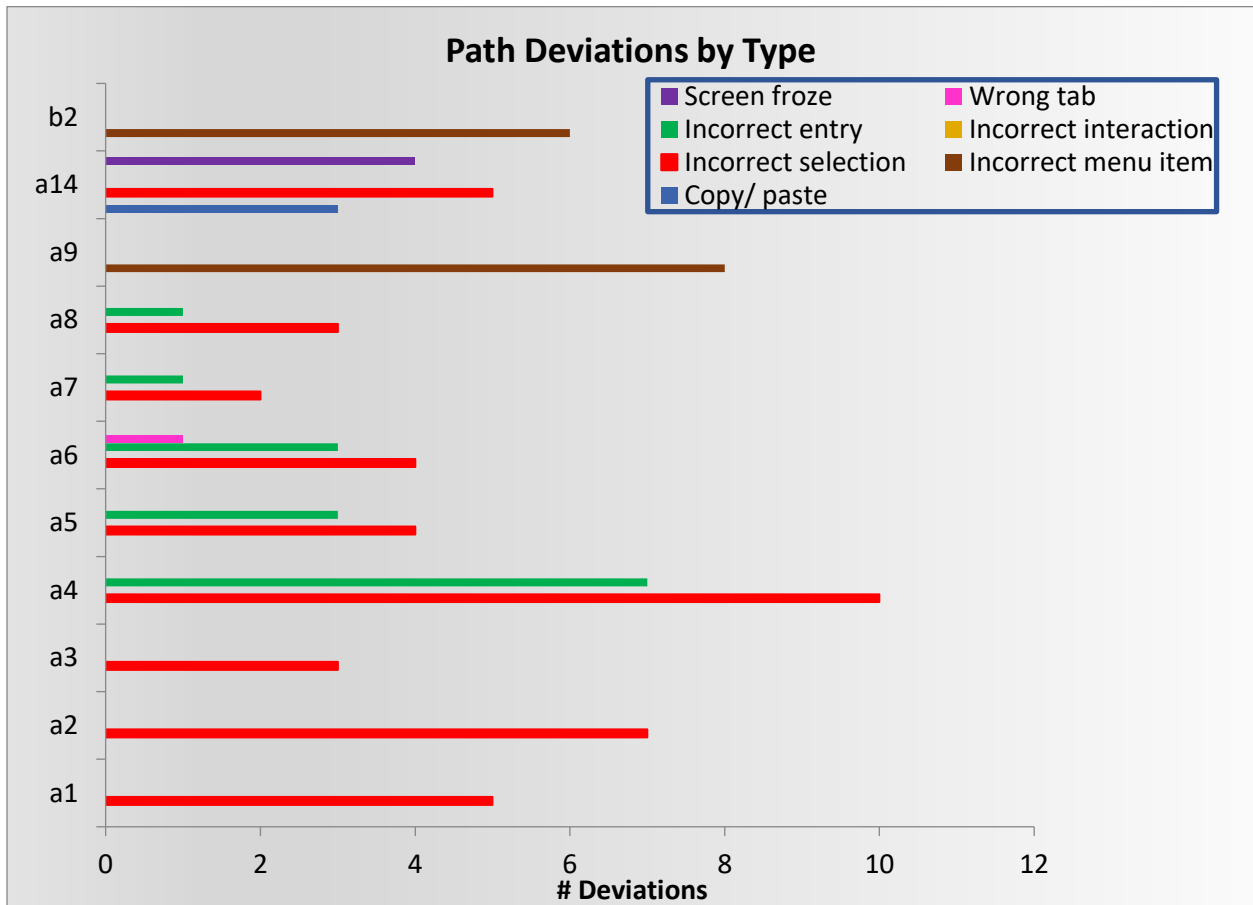


Figure 2. Path Deviations by Type

The Task Time Deviation -Mean Observed was higher than anticipated, i.e. the Median of 23.1 was significantly below the Mean of 39.40 and there was a SD of 51.98. This was attributed to the fact that



no user training was provided as part of the usability testing. Methods to further decrease the number of mouse clicks and to make the design of the order menus more user friendly will be taken into consideration as part of planning for implementation. While this impacts the Efficiency metrics, the Satisfaction metrics for the a1 – a8 criteria were quite high.

## SATISFACTION

In general, the participants for both Session 1 and Session 2 performed well and felt satisfied with *Juno EHR*; however, the satisfaction for Session 2 was significantly higher.

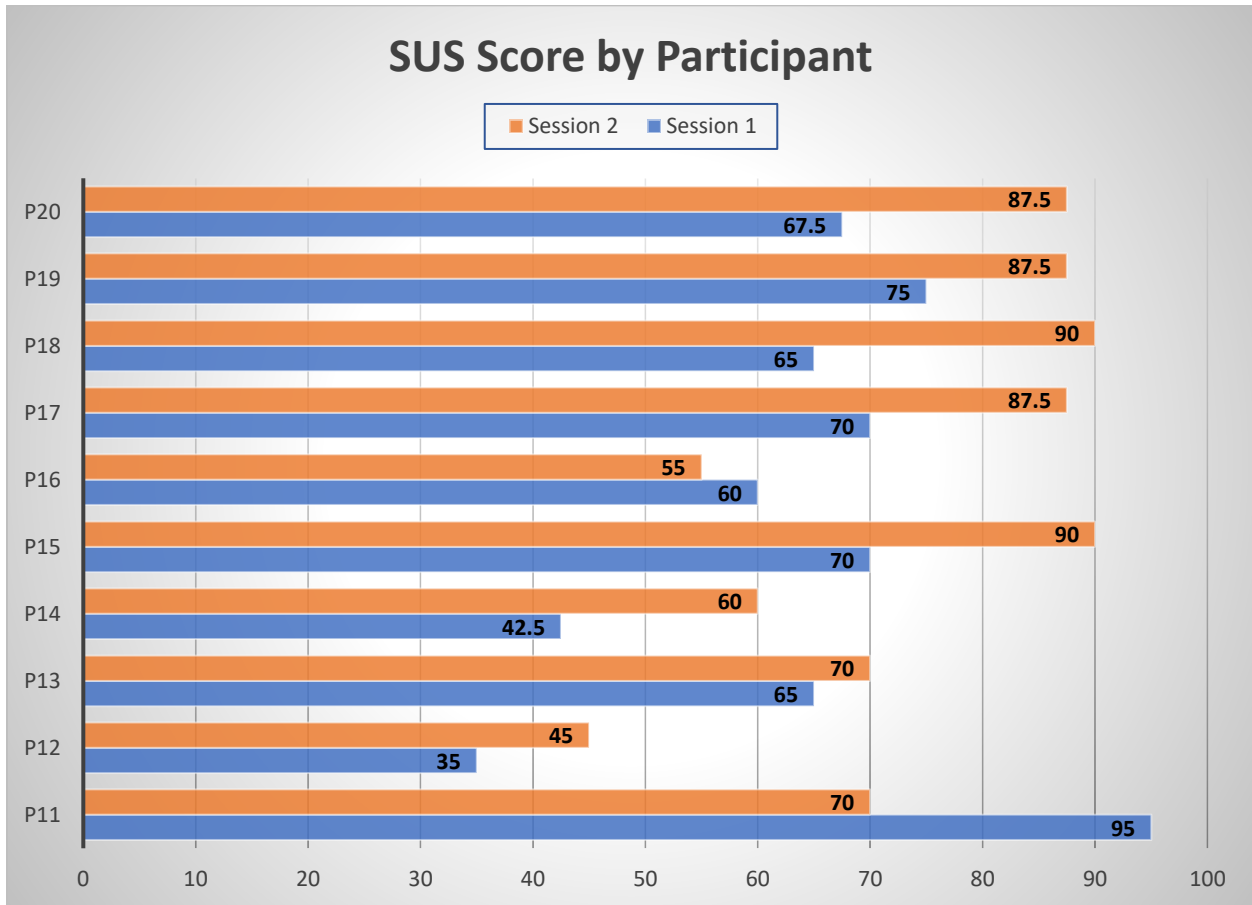


Figure 3. SUS Score by Participant

The rating on the SUS (System Usability Scale) for Session 1 scored the subjective satisfaction with the system performance with these tasks to be only 64.5 out of 100. This is below the industry average of 68 that is generally interpreted as OK, but could use improvement. This was attributed to the general lack of familiarity with the functionality for these 3 criteria as previously detailed. The functionality tested in Session 1 focused on criteria related to a9 Clinical Decision Support, a14 Implantable Devices and b2 Incorporation/ Reconciliation of data was new for the *Juno EHR* application and participants struggled with some of the tasks.

The rating on the SUS for Session 2 was 74.25 out of 100. The functionality tested in Session 2 focused on criteria a1 – a8 which has been available in previous versions of the CPRS software based on the FOIA product as well as being generally available in EHR software so users are more familiar with the tasks. Previous testing conducted for these criteria by The Usability People, LLC in November 2017 had a rating of 84 out of a possible 100, an indication that people will recommend it. The decrease needs further evaluation to determine whether it is significant and what further testing might be indicated before consideration is given to design changes.

## MAJOR FINDINGS

This evaluation demonstrated that the DSS Inc. *Juno EHR* system is a highly usable system with a relatively short learning curve. Participants with minimal amounts of experience using the *Juno EHR* system before the study experienced very little difficulty understanding the navigation and information architecture. Participants with more experience were able to solve most tasks without difficulty or error. The individual Task Satisfaction scores were well above the 3.2 cutoff that indicates the usability is good with scores that ranged from 1-5 with a mean of 4.23, a median of 4.2 and a standard deviation of 0.56. The System Usability Scale Scores were significantly different for Session 1 and Session 2, i.e., 64.5 for Session 1 and 74.25 for Session 2. In a study evaluating 500 studies, the average was 68 and in looking at the percentile rankings that normalize the data, the 74.25 would be in a percentile rank of 70% and interpreted as a grade of B-. The goal is to score above 80.3 to be in the top 10% of scores and being in the category where users are more likely to be recommending the product.

System Effectiveness based on both Task Success-Mean (%) and the Task Errors – Mean (%) was good, though showed some room for improvement. The methodology utilized to calculate the optimal task time was based on a formula like the one detailed in NISTR 7741, i.e., calculated time X 1.5 based on the expert time; however, given the lack of training provided to the testers in advance, the Task Success-Mean for tasks that were completed within that time was only 52.36% overall, 57.16% for Session 1 and 50.97% for Session 2. Given that the task performance was within control limits for 99% of the tasks, this will be addressed as part of user training so that users gain a level of comfort needed to improve the task efficiency. In the case of some specific tasks that represent new functionality, such as B2.1 Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record, feedback was provided to the design team as an area for improvement.

System Efficiency based on Task Time-Mean (sec) showed significant variation across the 11 criteria; however, 392 of the 396 tasks that were completed were within control. Only 4 tasks had data points outside the +/- 2 SD. These were not generally the same tasks that had multiple path deviations and there was no specific common cause identified for those 4 tasks. Analysis of the Path Deviations shows some room for improvements as detailed in the Areas for Improvement.

**Table 9: Risk Analysis**

		<b>Task Complete (%)</b>	<b>Risk Rating</b>
A1.1	Record CPOE Medication Order	100%	Low

A1.2	Change CPOE Medication Order	100%	Low
A1.3	Access CPOE Medication Order	100%	None
A2.1	Record Lab order via CPOE	100%	Low
A2.2	Change Lab order via CPOE	100%	Low
A2.3	Display changed CPOE Lab order	100%	None
A3.1	Record Imaging order via CPOE	100%	Low
A3.2	Change Imaging order via CPOE	100%	Low
A3.3	Display changed CPOE Imaging order	100%	None
A4.1	Using CPOE, trigger a drug-drug interaction by entering a new medication order	100%	High
A4.2	Using CPOE, trigger a drug-allergy interaction by entering a new medication order	100%	High
A4.3	Adjust the severity level of a displayed drug-drug interaction	100%	Medium
A5.1	Record a patient's preferred language, date of birth, birth sex, sexual orientation, gender identity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	90%	Low
A5.2	Record a patient's race and ethnicity.	100%	None
A5.3	Record a patient's preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	100%	None
A5.4	Change the patient's preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	100%	None
A5.5	Change the patient's preferred language, date of birth, birth sex, race, ethnicity, sexual orientation and gender identity.	100%	Low
A5.6	Display the patient's changed preferred language, date of birth, birth sex, race, ethnicity, preliminary cause of death (inpatient only), and preliminary date of death (inpatient only)	100%	None
A5.7	Display the patient's changed sexual orientation and gender identity.	100%	None
A6.1	Record a problem to the problem list	100%	Low
A6.2	Change a problem on the problem list	100%	Low
A6.3	Display the active problem list	100%	None
A6.4	Display the historical problem list	100%	None
A7.1	Record a medication to the medication list	100%	Low
A7.2	Change a medication on the medication list	100%	Low
A7.3	Display the active medication list	100%	None
A7.4	Display the historical medication list	100%	None
A8.1	Record a medication allergy	100%	High
A8.2	Change a medication allergy	100%	Medium
A8.3	Display the active medication allergy list	100%	None
A8.4	Display the historical medication allergy list	100%	None
A9.1	Trigger the CDS interventions/resources based on data elements in the problem list, medication list, and medication allergy list by incorporating patient information from a transition of care/referral summary	100%	Low
A9.2	Add a CDS intervention and/or reference resource for each of the required elements: Problem List, Medication List, Medication Allergy List, at least one Demographic, Laboratory	100%	None

	Test, Vital Signs, and a Combination of at least 2 of the elements above		
A9.3	Access the following attributes for one of the triggered CDS interventions/resources: bibliographic citation, developer, funding source, release/revision date. View the intervention/resource information using the Infobutton standard for data elements in the problem list, medication list, and demographics	100%	None
A9.4	Trigger the CDS interventions/resources added using the applicable data elements from each of the required elements	100%	Low
A14.1	Record UDI	100%	Medium
A14.2	Change UDI Status	100%	Low
A14.3	Access UDI, Device Description, Identifiers and Attributes	100%	None
B2.1	Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record	100%	Very High
B2.2	Generate a new CCDA with reconciled data	90%	Low

**AREAS FOR IMPROVEMENT**

*Areas for Improvement:*

No particular area of the application was cited as in need of improvement by a majority of the users. Although two of the testers provided a SUS score of less than 50 out of 100, they did not provide any specific comments. The following specific items were identified in EHRUT as areas for improvement:

- Inconsistent layout, i.e., table of contents on the right instead of the left, use of double clicks versus single clicks, location of the Done button on various pages
- Need to re-size the CDA tool used for reconciliation
- Consider moving or re-sizing the tabs at the bottom in the CDA tool used for reconciliation
- Entry of vitals in the Ambulatory Care-Provider note is not intuitive as the user wants to enter data directly into the grid
- Layout of the Major Procedures tab versus Major Procedures with Device tab is confusing

In addition, based on the data analysis, making these and other minor enhancements will improve the overall user experience of the system and increase the effectiveness, efficiency, and satisfaction for both experienced and novice users.

- **Indication of Required Fields**
  - For the 3 tasks associated with the new functionality for the a14 Implantable Devices criteria, users were introduced to the Clinical Note Template (CNT) design. The template is utilized for documented major historical procedures in addition to those involving an implantable device. The general functionality for identifying required fields is very user friendly; however, the users doing the testing lacked experience with this type of clinical documentation in addition to the lack of experience with the design of CNTs; therefore, both the efficiency and the effectiveness were impacted as reflected in the task time and the path deviations.

- **Lack of user instructions**
  - For b2 Incorporate a CCDA and conduct reconciliation of the medications, medication allergies, and problems in the CCDA with the information currently in the patient's record, the task time had a wide range, i.e. 335 – 677 seconds with a mean of 506 seconds and a median of 57 seconds. Though there were no errors, there were 2 path deviations and the Risk Rating for this task is “Very High” based on a “Possible” likelihood and a “Severe” potential consequence for an error. This is functionality new to most EHR systems so the testers were not familiar with this process. Feedback has been provided to the design/development team for improvements and the addition of user instructions to be included in the next version.
- **Inconsistent styles**
  - Participants occasionally attempted to use the “right-click” functionality on features and functions that did not support it. Adding this functionality when it makes sense to do so would likely eliminate many of these errors/deviations. This feedback has been provided to the design/development teams for consideration when doing new designs and modifications.

# Appendices

## Appendix A

### Participant Questionnaire

1. Are you male or female?
2. Have you participated in a focus group or usability test in the past 6 months?
3. Do you, or does anyone in your home work in marketing research, usability research, and/or web design?
4. Do you, or does anyone in your home, have a commercial or research interest in an electronic health record software or consulting company?
5. Which of the following best describes your age?  
20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99, 100 and older.
6. Which of the following best describes your education level?
  - No high school diploma
  - High school graduate, diploma or the equivalent
  - Some college credit, no degree
  - Trade technical vocational training
  - Associate degree
  - Bachelor's degree
  - Master's degree
  - Doctorate degree (e.g., MD, DNP, DMD, PhD)
7. Do you require any assistive technologies to use a computer?
8. Please describe your medical or nursing credentials
9. What is your current job title?
10. How long have you held this position? (number of years):
11. What type of facility do you work in and what is your role there?
12. How are medical records handled at your (main) workplace?  
 All Paper     Some Paper/Some Electronic     All Electronic
13. How many EHRs do you use or have you worked with?

14. How many years have you used an electronic health record?

15. How many years have you used the Juno EHR system?

16. About how many hours per week do you spend using a computer?

17. What computer platform(s) do you usually use?

18. In the last month, about how often have you used an electronic health record?

\_\_\_\_\_ Did not use last month

\_\_\_\_ Every day

\_\_\_\_\_ A few times a week.

## Appendix B

### Informed Consent Form

DSS would like to thank you for participating in this study. The purpose of this study is to evaluate an electronic health record's system. If you decide to participate, you will be asked to perform several tasks using the prototype and give your feedback. The study will last about 60-90 minutes.

#### **Agreement**

I understand and agree that as a voluntary participant in the Usability Study conducted by DSS, I am free to withdraw consent or discontinue participation at any time. I understand and agree to participate in the study conducted and recorded by DSS.

I understand and consent to the use and release of the video recording by DSS. I understand that the information and video is for research purposes only and that my name will not be used for any purpose other than research. I relinquish any rights to the video and understand the video recording may be copied and used by DSS without further permission.

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

I understand and agree that the data collected from this study may be shared outside of DSS. I understand and agree that data confidentiality is assured, because only de-identified data – i.e., identification numbers not names – will be used in analysis and reporting of the results.

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

Please check one of the following:

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

NO, I choose not to participate in this study.

Signature: \_\_\_\_\_ Date \_\_\_\_\_



## Appendix C

### Participant/Tester Script- Session 1 and Session 2



DSS Usability Testing  
Session 1- Tester Scri



DSS Usability Testing  
Session 2-Tester Scri

## Appendix D

### Moderator Script – Session 1 and Session 2



DSS Usability  
Testing-Session 1-Mo



Moderator Guide  
Session 2 a1-a8.pdf

## Appendix E

### System Usability Scale Questionnaire

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
2. I found the system unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
3. I thought the system was easy to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
5. I found the various functions in this system were well integrated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
6. I thought there was too much inconsistency in this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
8. I found the system very cumbersome to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
9. I felt very confident using the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5

## Appendix F

### References

**NISTIR 7741** - NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records, Robert M. Schumacher, User Centric, Inc., Svetlana Z. Lowry, Information Access division, Information Technology Laboratory, National Institute of Standards and Technology, U.S. Department of Commerce, National Institute of Standards and Technology, Version 0.2, 15-Nov.2010.

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**ONC** - 2015 Edition Certification Companion Guide Safety- enhanced design - 45 CFR 170.315(g)(3) 3/30/2016

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**SUS** Brooke, J. (1996) SUS: a "quick and dirty" usability scale. In P. W. Jordan, B. Thomas, B. A. Weerdmeester & A. L. McClelland (eds.) Usability Evaluation in Industry. London: Taylor and Francis.