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Safety Enhanced Design

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Version 9.3.1.1

Braintree Health
Braintree Ambulatory EHR, version 9.3.1.1

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For public release:

Braintree Health attests that the usability standard/process and usability report submitted for the certification of Braintree Health Ambulatory EHR, version 9.3.1.1 is accurate and complete per the requirements of the ONC criterion 170.315(g)(3).

A handwritten signature in black ink, appearing to read 'Saad Mohsin', written in a cursive style.

Saad Mohsin
Director of Engineering

11/01/2018

Braintree Health
Braintree Ambulatory EHR version 9.3.1.1



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For public release:

Braintree Health used the following usability design industry standard in developing and designing their health IT module, Braintree Ambulatory EHR, version 5.9: NISTIR 7741.

National Institute of Standards and Technology. (2010). NIST Guide to the Processes Approach for Improving the Usability of Electronic Health Records (NISTIR 7741). Gaithersburg, MD. http://ws680.nist.gov/publication/get_pdf.cfm?pub_id=907313

Per the National Institute of Standards and Technology (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 goals are for users to interact with the system safely, effectively, efficiently, and with an acceptable level of satisfaction. To this end, design to optimize for safety, effectiveness, efficiency and user satisfaction was utilized throughout the design and development cycle.



Saad Mohsin
Director of Engineering

11/01/2018

EHR Usability Test Report of Braintree Health Ambulatory EHR 9.3.1.1

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

Braintree health Ambulatory EHR 9.3.1.1

Date of Usability Test: June 26th – June 28th, 2018

Date of Report: July 6th, 2018

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Executive Summary

A usability test of Braintree Health Ambulatory EHR 9.3.1.1 was conducted between June 26th and June 28th by Braintree Health Software Tester Younas Rehman. 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. During the usability test, a total of 25 active clinicians matching the target demographic criteria served as participants and used Braintree Health EHR 9.3.1.1 in simulated, but representative tasks.

This study collected performance data on 13 scenarios typically conducted on an EHR:

- Enter and update demographics
- Reconciling medication and allergies
- Add and update the medication list
- Add and update allergies
- Drug-drug and drug-allergy interactions
- Configure, review, and order for Clinical Decision Support (CDS)
- Add and update the problem list
- Order and update labs
- Order and update a medication
- Send a medication via eRx
- Submit an eRx change request
- Order and update a diagnostic test
- Add and review implantable device information

During the 60-minute one-on-one remote usability test, each participant was greeted virtually 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. Participants had prior experience with the EHR. The administrator introduced the test, and instructed participants to complete a series of tasks (given one at a time) using the EHR. During the test, 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 on how to complete the task. Participant screens and audio were recorded for subsequent analysis.

The following types of data were collected for each participant:

- Number of tasks successfully completed within the allotted time without assistance
- Time to complete the tasks
- Number and types of errors
- Path deviations
- Participant's verbalizations
- Participant's satisfaction ratings of the system

All participant data was de-identified – no correspondence could be made from the identity of the participant to the data collected. Following the conclusion of the testing, participants were asked to complete a post-test questionnaire and were compensated with no money 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 EHR. Following is a summary of the performance and rating data collected on the EHR.

Summary of Performance

Nurse Tasks

Task	N #	Task Success Mean (SD)	Path Deviation (Observed /optimal)	Task Time Mean (SD)	Task Time Deviations (Observed / Optimal)	Errors Mean (SD)	Task Ratings 5=easy Mean (SD)
DEMOGRAPHICS							
1. Enter preferred language	13	100 % (0.00)	10.5 / 8 CLICKS	102 SECONDS (10)	102 / 48 SECONDS	0 % (0.00)	3.9 (0.41)

CLINICAL RECONCILIATION							
2. Review sig Information	13	100% (0.00)	12.5 / 4 CLICKS	118 SECONDS (15)	118 / 58 (0.00)	0% (0.00)	2.7 (0.30)
3. Add an allergy for reconciliation	13	100% (0.00)	8.4 / 3 CLICKS	67 SECONDS (5)	67 / 35 SECONDS	0% (0.00)	3.2 (0.63)
MEDICATION LIST							
4. Search for a medication	13	100% (0.00)	6.8 / 5 CLICKS	49 SECONDS (8)	49 / 22 SECONDS	0% (0.00)	4.8 (0.29)
5. Stop a medication	13	100% (0.00)	2.5 / 2 CLICKS	15 SECONDS (3)	15 / 8 SECONDS	0% (0.00)	4.7 (0.31)
ALLERGY LIST							
6. Add an allergy	13	100% (0.00)	6.5 / 4 CLICKS	33 SECONDS (6)	33 / 15 SECONDS	0% (0.00)	4.6 (0.23)
7. Add a reaction to an allergy	13	92% (0.96)	14.3 / 4 CLICKS	70 SECONDS (8)	70 / 23 SECONDS	8% (3.00)	3.8 (0.43)
CLINICAL DECISION SUPPORT							
8. Check for interactions to an allergy	13	83% (1.29)	4.5 / 4 CLICKS	41 SECONDS (5)	41 / 27 SECONDS	17% (2)	4.3 (0.38)
DEMOGRAPHICS FOR NEW PATIENT							
9. Enter last name	13	100% (0.00)	15.2 / 10 CLICKS	107 SECONDS (11)	107 / 49 SECONDS	0% (0.00)	4.2 (0.37)

Provider Tasks

Task	N #	Task Success Mean (SD)	Path Deviation (Observed /optimal)	Task Time Mean (SD)	Task Time Deviations (Observed/ Optimal)	Errors Mean (SD)	Task Ratings 5=easy Mean (SD)
CLINICAL DECISION SUPPORT							
1. Change CDS reference link	12	83% (1.29)	6 / 5 CLICKS	58 SECONDS (5)	58 / 44 SECONDS	17% (2)	4.0 (0.40)
2. Order CDS intervention	12	100% (0.00)	11.2 / 2 CLICKS	65 SECONDS (4)	65 / 10 SECONDS	0% (0.00)	3.4 (0.30)
3. Access CDS reference link	12	75% (1.5)	5.0 / 3 CLICKS	56 SECONDS (4)	56 / 22 SECONDS	25% (5)	3.5 (0.28)
PROBLEM LIST							
4. Review active problems	12	83% (1.29)	0 / 0 CLICKS	8 SECONDS (3)	8 / 10 SECONDS	17% (2)	4.8 (0.29)
5. Search for a problem	12	100% (0.00)	4.6 / 5 CLICKS	45 SECONDS (5)	45 / 23 SECONDS	0.00 (0.00)	4.3 (0.38)
6. Update clinical status of a problem	12	92% (0.96)	5.1 / 4 CLICKS	37 SECONDS (6)	37 / 14 SECONDS	8% (3)	4.2 (0.37)
LAB ORDER							
7. Select a lab order	12	100% (0.00)	5.8 / 4 CLICKS	43 SECONDS (5)	43 / 20 SECONDS	0% (0.00)	4.3 (0.38)
8. Change the lab order status	12	92% (0.96)	6.6 / 4 CLICKS	53 SECONDS (9)	53 / 16 SECONDS	8% (3)	3.8 (0.43)

MEDICATION E-PRESCRIBING							
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9. Search for a medication	12	100% (0.00)	13.3 / 12 CLICKS	96 SECONDS (9)	96 / 45 SECONDS	0% (0.00)	4.1 (0.36)
10. Modify the dosage	12	92% (0.96)	6.3 / 4 CLICKS	37 SECONDS (6)	37 / 16 SECONDS	8% (3)	4.4 (0.39)
11. Send the medication via eRx	12	100% (0.00)	3.4 / 2 CLICKS	27 SECONDS (5)	27 / 11 SECONDS	0% (0.00)	4.5 (0.27)
12. Approve an Rx change request	12	100% (0.00)	3.7 / 3 CLICKS	33 SECONDS (5)	33 / 13 SECONDS	0% (0.00)	4.3 (0.38)
13. Cancel a medication due to a drug-drug interaction	12	100% (0.00)	5.9 / 6 CLICKS	37 SECONDS (6)	37 / 25 SECONDS	0% (0.00)	4.5 (0.27)
DIAGNOSTIC IMAGING							
14. Select a diagnostic test	12	100% (0.00)	5.6 / 3 CLICKS	48 SECONDS (4)	48 / 18 SECONDS	0% (0.00)	4.1 (0.36)
15. Modify the diagnostic order	12	100% (0.00)	5.9 / 5 CLICKS	38 SECONDS (4)	38 / 20 SECONDS	0% (0.00)	4.3 (0.38)
IMPLANTABLE DEVICE							
16. Search and select an implantable device	12	100% (0.00)	8.6 / 9 CLICKS	69 SECONDS (8)	69 / 39 SECONDS	0% (0.00)	3.9 (0.41)
17. Review device identifier	12	92% (0.96)	0.2 / 0 CLICKS	18 SECONDS (3)	18 / 11 SECONDS	8% (3)	4.4 (0.39)

Table 2

System Usability Scores

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

- For Nurse tasks: 78
- For Provider tasks: 75

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

Introduction

This study represents usability testing performed on the Braintree Health Ambulatory EHR 9.3.1.1 product designed to provide healthcare professionals with a computerized method of recording and tracking patient healthcare records. Braintree Health Ambulatory EHR 9.3.1.1 (i.e., “the system”) supports a variety of healthcare professional roles (e.g., Nurses, Medical Assistants, Physicians, etc.) across a variety of healthcare practices (e.g., Family Practice, Vascular, Interventional Radiology, etc.).

The purpose of this study was to test and validate the usability of the user interface and provide evidence of user centered design methodologies to support certification according to criteria outlined in Safety Enhanced Design §170.315(g)(3), specifically:

- § 170.315 (a)(1) Computerized provider order entry – medications
- § 170.315 (a)(2) Computerized provider order entry – laboratory
- § 170.315 (a)(3) Computerized provider order entry – diagnostic imaging
- § 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
- § 170.315 (b)(3) Electronic prescribing

The usability testing attempted to represent realistic exercises and conditions. Also, to provide evidence of usability in the EHR, measures of effectiveness, efficiency and user satisfaction, such as task completion rate, time on task, path deviation rate, errors, post-task rating scores, and SUS score were captured during the usability testing.

Method

Participants

A total of 25 participants were tested on the EHR. Participants in the test were doctors (MD/DO), nurses (RN/LNP), and medical assistants. Participants were recruited by the UX research team through Braintree Health's Success Community board and were compensated with no money for their time. In addition, participants had no direct connection to the development of or organization producing the EHR. Participants were not from Braintree Health. Participants did not need any orientation or training as they all were experienced Braintree Health users.

For test purposes, end-user characteristics were identified and translated into a recruitment screener used to solicit potential participants (see Appendix 1).

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. Participant names were replaced with Participant IDs so that an individual's data cannot be tied back to individual identities.

Participant Demographics

N	Part ID	Gender	Age	Education	Occupation /Role	Professional Experience	Computer Experience	Product Experience	Assistive Technology Needs
1	ID02	Female	40	Master's degree	Physician's Assistant	1 year	20 years	1 year	None
2	ID03	Female	55	Master's degree	Nurse Practitioner	7 years	30 years	3 years	None
3	ID04	Female	44	Associate's degree	Medical assistant	16 years	20 years	4 years	None
4	ID06	Female	20	Trade/technical school	Medical assistant	1 year	8 years	1 year	None
5	ID07	Male	60	Master's degree	Provider	5 years	30 years	6 years	None
6	ID08	Female	40	Bachelor's degree	RN	15 years	15 years	1 year	None
7	ID09	Male	42	Doctorate degree	Provider	8 years	20 years	1.5 years	None
8	ID10	Female	40	Bachelor's degree	RN	6 years	18 years	6 years	None

9	ID11	Female	41	Doctorate degree	Provider	17 years	25 years	5 years	None
10	ID12	Male	55	Doctorate degree	Physician Assistant	17 years	30 years	14 years	None
11	ID13	Female	27	Associate's degree	Medical Assistant	4 years	10 years	9 years	None
12	ID14	Female	35	Master's degree	Provider	3 years	20 years	1 year	None
13	ID15	Female	50	Bachelor's degree	RN	3 years	30 years	3 years	None
14	ID16	Female	47	Doctorate degree	Provider	20 years	30 years	8 years	None
15	ID17	Male	39	Trade/technical school	LPN	1 year	23 years	1 year	None
16	ID18	Male	37	Doctorate degree	Provider	4 years	20 years	3 years	None
17	ID19	Male	35	Doctorate degree	Provider	8 years	25 years	6 years	None
18	ID20	Female	25	Some college	Medical assistant	6 years	14 years	4 years	None
19	ID21	Female	36	Associate's degree	Medical assistant	5 years	15 years	3 years	None
20	ID22	Female	35	Bachelor's degree	Medical assistant	2 years	15 years	9 years	None

21	ID24	Female	52	Associate's degree	RN	29 years	20 years	3 years	None
22	ID25	Female	28	Master's degree	Nurse practitioner	3 years	15 years	3 years	None
23	ID26	Male	48	Bachelor's degree	RN	4 years	30 years	7 years	None
24	ID27	Female	35	Doctorate degree	Provider	3 years	20 years	6 years	None
25	ID29	Female	55	Master's degree	RN	5 years	30 years	5 years	None

Table 3

25 participants matching the demographics in the section on Participants participated in the usability test.

Participants were scheduled for 60-minute sessions. A spreadsheet was used to keep track of the participant schedule, and included each participant's demographic characteristics.

Study Design

Overall, the objective of this test was to uncover areas where the application performed well – that is, effectively, efficiently, and with satisfaction – and areas where the application failed to meet the needs of the participants. The data from this test may serve as a baseline for future tests with an updated version of the same EHR and/or comparison with other EHRs provided the same tasks are used. In short, this testing serves as both a means to record or benchmark current usability, but also to identify areas where improvements must be made.

During the usability test, participants interacted with one EHR. Each participant used the system in the same development environment, 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:

Nurse Tasks

Task	Goal	Safety Enhanced Design Criteria	Task Criticality / Patient Safety Risk
DEMOGRAPHICS			
1. Enter preferred language	Enter a preferred language for an existing patient	§ 170.315 (a)(5) Demographics	Medium / Low
CLINICAL RECONCILIATION			
2. Review sig information	Review sig information for a medication being reconciled	§ 170.315 (b)(2) Clinical information reconciliation and incorporation	High / High
3. Add an allergy for reconciliation	Reconcile an allergy that needs to be added to the chart.	§ 170.315 (b)(2) Clinical information reconciliation and incorporation	High / High

MEDICATION LIST			
4. Search for a medication	Find a medication in the search feature.	§ 170.315 (a)(7) Medication list	High / High
5. Stop a medication	Stop a medication that the patient is no longer taking.	§ 170.315 (a)(7) Medication list	High / High
ALLERGY LIST			
6. Add an allergy	Add an allergy to the allergy list.	§ 170.315 (a)(8) Medication Allergy List	High / Medium
7. Add a reaction to an allergy	Add a reaction to an existing allergy.	§ 170.315 (a)(8) Medication Allergy List	High / Medium
CLINICAL DECISION SUPPORT			
8. Check for interactions to an allergy	Review an allergy to see if it has any interactions with any current medications.	§ 170.315 (a)(8) Medication Allergy List § 170.315 (a)(9) Clinical decision support	High / High
DEMOGRAPHICS FOR NEW PATIENT			
9. Enter last name	Enter a last name for a new patient	§ 170.315 (a)(5) Demographics	Medium / Low

Provider Tasks

Task	Goal	Safety Enhanced Design Criteria	Task Criticality / Patient Safety Risk
CLINICAL DECISION SUPPORT			
1. Change CDS reference link	Modify the CDS reference link for an order	§ 170.315 (a)(9) Clinical decision support	Medium / Medium
2. Order CDS intervention	Order a lab test based on a CDS intervention	§ 170.315 (a)(9) Clinical decision support	High / Medium
3. Access CDS reference link	Access the CDS reference link for a medication.	§ 170.315 (a)(9) Clinical decision support	Low / Low
PROBLEM LIST			
4. Review active problems	Review the active problems in the problem list.	§ 170.315 (a)(6) Problem list	High / High
5. Search for a problem	Search and select a problem to be added to the problem list.	§ 170.315 (a)(6) Problem list	High / High
6. Update clinical	Update the status of a	§ 170.315 (a)(6) Problem list	Medium /

status of a problem	problem.		Medium
LAB ORDER			
7. Select a lab order	Search and select a lab test to be ordered.	§ 170.315 (a)(2) Computerized provider order entry – laboratory	High / High
8. Update lab order status	Change the urgency level of the lab order.	§ 170.315 (a)(2) Computerized provider order entry – laboratory	High / High
MEDICATION E-PRESCRIBING			
9. Search for a medication	Search and select a medication to be ordered.	§ 170.315 (a)(1) Computerized provider order entry – medications § 170.315 (b)(3) Electronic prescribing	High / High

10. Modify the dosage	Update the dosage for the medication.	§ 170.315 (a)(1) Computerized provider order entry – medications § 170.315 (b)(3) Electronic prescribing	High / High
11. Send the medication via eRx	Send the medication to the pharmacy via eRx.	§ 170.315 (a)(1) Computerized provider order entry – medications § 170.315 (b)(3) Electronic prescribing	High / High
12. Approve an Rx change request	Approve an incoming eRx change request.	§ 170.315 (a)(1) Computerized provider order entry – medications § 170.315 (b)(3) Electronic prescribing	Medium / Medium
13. Cancel a medication due to a drug-drug interaction	When a drug-drug alert appears while selecting a medication, cancel the order to protect the patient's safety.	§ 170.315 (a)(1) Computerized provider order entry – medications § 170.315 (a)(4) Drug-drug, drug-allergy interaction checks	High / High
DIAGNOSTIC IMAGING			
14. Select a diagnostic test	Search for and find a diagnostic test to be ordered.	§ 170.315 (a)(3) Computerized provider order entry – diagnostic imaging	High / High
15. Modify the diagnostic order	Update the diagnostic order to change the test type.	§ 170.315 (a)(3) Computerized provider order entry – diagnostic imaging	High / High
IMPLANTABLE DEVICE			

16. Search and select an implantable device	Search and find an implantable device to be added.	§ 170.315 (a)(14) Implantable device list	High / High
----------------------------------------------------	----------------------------------------------------	-------------------------------------------	-------------

implantable device	device information to the chart.	device list	
17. Review device identifier	Review the device identifier information for the implantable device	§ 170.315 (a)(14) Implantable device list	High / Medium

Table 4

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

Procedures

All test sessions were administered by Braintree Health UX Researchers having a combined 8 years of experience administering usability tests. Remote testing was held in a WebEx meeting environment that allows screen-sharing, audio-conferencing and the ability to take mouse control of another's person's computer.

Participants were advised to choose a quiet location to participate in the study using their own computers. Regardless of location, all participants received the test scenario, a demographics form (see Appendix 2), and an Informed Consent form (see Appendix 3). After completing the demographics form, the UX Researcher gave an introduction to the usability session. Participants were instructed to:

- Complete the tasks as quickly as possible, using their normal workflow (Participants were not advised to think aloud)
- Complete the tasks without assistance except to clarify task details.

Participants were then given instructions on how to interact with the virtual task instructions, to click the start button when they were prepared to begin a task, and to click the done button whenever they felt they had finished the task. The start and done buttons were incorporated into an Axure HTML prototype being utilized for the usability sessions. Task time began once the user clicked the start button. The task time stopped once the participant clicked the done button. All test sessions were recorded and analyzed using WebEx meeting application. While participants completed the tasks, an observer monitored task times, obtained post-task rating data, and took notes on participant comments. Two additional

observers served as the data logger and took notes on task success, path deviations, number and type of errors, and comments.

Following completion of all tasks, participants were asked to complete a SUS survey and were debriefed about the study. In addition, if time allotted, participants were able to ask questions about the EHR tested and could also describe any aspects of the EHR product they currently use. At the conclusion of the session, participants were thanked for their time and feedback and were instructed that they would receive a gift card by email.

Test Location

Test sessions were held remotely via WebEx. The test administrator, three observers, and participant logged into the session from their various locations. The testing product was located on a remote desktop server that was accessed via Microsoft Remote Desktop application. All observers and the data logger worked from separate rooms where they could see the participant's screen, and listen to the audio of the session.

Test Environment

The EHR would typically be used in a healthcare office or facility. In this instance, the testing was conducted remotely via WebEx. For testing, the moderator used a 15-inch Dell Inspiron, on a 1.7 GHz Intel Core i3 processor. The participants used their own computer, keyboard and mouse when interacting with the EHR.

The application was set up by the Braintree Health Research team according to the documentation describing the system set-up and preparation. The application itself was running on Windows Server 2012 R2 using a test database on a wireless connection. Technically, the system performance (i.e., response time) was somewhat slower than what actual users would experience in a field implementation.

Test Form and Tools

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

Document / Instrument	Details
Recruiting Screener	Maritzcx Survey
Informed Consent	Paper print out
Moderator's Guide	Paper print out

Post-test Questionnaire	Axure HTML prototype
Task List	Axure HTML prototype
Virtual Meeting	WebEx
Remote Connection to EHR Application	Screen Connect Connection

Table 5

Examples of these documents can be found in Appendices 1-4.

The participant's interaction with the EHR was captured and recorded digitally with screen capture software running on the test machine. Screen capture recorded user activities, and verbal comments were recorded with a microphone.

Participant Instructions

The administrator reads the following instructions aloud to each participant:

Thank you for taking the time out of your busy schedule to participate in this study. Your input is very valuable to us. Our total session today will last about 60 minutes. You will be using the Braintree Ambulatory EHR 9.3.1.1.

During this time, I will ask you to complete a few tasks using the system. You should complete these tasks on your own, following the instructions closely, and do them normally as if you are working with the system on a regular day at the practice. On completion of each task, you will be given a short survey of how easy or difficult the task was for you, and whether you have any feedback.

Please note that we are not testing you, we are testing the system, and so, if you have difficulty, there may be something in the system that we need to improve. We are interested in how easy, or how difficult, this system is to use.

I did not design anything you see here, so don't hesitate to be honest with your opinions. I will be here in case you are stuck, but I won't be able to instruct you or provide specific steps on how to use the application. (See the full moderator's guide in Appendix 4)

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 Braintree Health EHR 9.3.1.1 by measuring participant success rates and errors
2. Efficiency of Braintree Health EHR 9.3.1.1 by measuring the average task time and path deviations
3. Satisfaction with Braintree Health EHR 9.3.1.1 by measuring ease of use ratings

Data Scoring

The following table (Table 5) details how tasks were scored, errors evaluated, and the time data analyzed.

Measures	Rationale and Scoring
<p>Effectiveness</p> <p>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.</p> <p>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.</p>
<p>Effectiveness</p> <p>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.¹¹ This should also be expressed as the mean number of failed tasks</p>

per participant.
On a qualitative level, an enumeration of errors and error types should be collected.

<p>Efficiency</p> <p>Task Deviation</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. It is strongly recommended that task deviations be reported. Optimal paths (i.e., procedural steps) should be recorded when constructing tasks.</p>
<p>Efficiency</p> <p>Task Time</p>	<p>Each task was timed from when the administrator said “Begin” until the participant said, “Done.” If he or she failed to say “Done,” the time was stopped when the participant stopped performing the task. Only task times for tasks that were successfully completed were included in the average task time analysis. Average time per task was calculated for each task. Variance measures (standard deviation and standard error) were also calculated.</p>
<p>Satisfaction</p> <p>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. 12</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 Braintree Health EHR 9.3.1.1 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</p>

use,” and “I would imagine that most people would learn to use this system very quickly.” See full System Usability Score questionnaire in Appendix 5.13

Table 5. 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. The usability testing results for Braintree Health EHR 9.3.1.1 are detailed below (see Table 6). The results should be seen in light of the objectives and goals outlined in the Study Design. The data should yield actionable results that, if corrected, yield a positive impact on user performance.

Nurse Tasks

Task	N #	Task Success Mean (SD)	Path Deviation (Observed /optimal)	Task Time Mean (SD)	Task Time Deviations (Observed / Optimal)	Errors Mean (SD)	Task Ratings 5=easy Mean (SD)
DEMOGRAPHICS							
1. Enter preferred language	13	100 % (0.00)	10.5 / 8 CLICKS	102 SECONDS (10)	102 / 48 SECONDS	0 % (0.00)	3.9 (0.41)

CLINICAL RECONCILIATION							
2. Review sig Information	13	100% (0.00)	12.5 / 4 CLICKS	118 SECONDS (15)	118 / 58	0% (0.00)	2.7 (0.30)
3. Add an allergy for reconciliation	13	100% (0.00)	8.4 / 3 CLICKS	67 SECONDS (5)	67 / 35 SECONDS	0% (0.00)	3.2 (0.63)
MEDICATION LIST							
4. Search for a medication	13	100% (0.00)	6.8 / 5 CLICKS	49 SECONDS (8)	49 / 22 SECONDS	0% (0.00)	4.8 (0.29)
5. Stop a medication	13	100% (0.00)	2.5 / 2 CLICKS	15 SECONDS (3)	15 / 8 SECONDS	0% (0.00)	4.7 (0.31)
ALLERGY LIST							

6. Add an allergy	13	100% (0.00)	6.5 / 4 CLICKS	33 SECONDS (6)	33 / 15 SECONDS	0% (0.00)	4.6 (0.23)
7. Add a reaction to an allergy	13	92% (0.96)	14.3 / 4 CLICKS	70 SECONDS (8)	70 / 23 SECONDS	8% (3.00)	3.8 (0.43)
CLINICAL DECISION SUPPORT							
8. Check for interactions to an allergy	13	83% (1.29)	4.5 / 4 CLICKS	41 SECONDS (5)	41 / 27 SECONDS	17% (2)	4.3 (0.38)
DEMOGRAPHICS FOR NEW PATIENT							
9. Enter last name	13	100% (0.00)	15.2 / 10 CLICKS	107 SECONDS (11)	107 / 49 SECONDS	0% (0.00)	4.2 (0.37)

Provider Tasks

Task	N #	Task Success Mean (SD)	Path Deviation (Observed /optimal)	Task Time Mean (SD)	Task Time Deviations (Observed/ Optimal)	Errors Mean (SD)	Task Ratings 5=easy Mean (SD)
CLINICAL DECISION SUPPORT							
1. Change CDS reference link	12	83% (1.29)	6 / 5 CLICKS	58 SECONDS (5)	58 / 44 SECONDS	17% (2)	4.0 (0.40)
2. Order CDS intervention	12	100% (0.00)	11.2 / 2 CLICKS	65 SECONDS (4)	65 / 10 SECONDS	0% (0.00)	3.4 (0.30)
3. Access CDS reference link	12	75% (1.5)	5.0 / 3 CLICKS	56 SECONDS (4)	56 / 22 SECONDS	25% (5)	3.5 (0.28)
PROBLEM LIST							
4. Review active problems	12	83% (1.29)	0 / 0 CLICKS	8 SECONDS (3)	8 / 10 SECONDS	17% (2)	4.8 (0.29)
5. Search for a problem	12	100% (0.00)	4.6 / 5 CLICKS	45 SECONDS (5)	45 / 23 SECONDS	0.00 (0.00)	4.3 (0.38)
6. Update clinical	12	92%	5.1 / 4	37	37 / 14	8%	4.2

status of a problem		(0.96)	CLICKS	SECONDS (6)	SECONDS	(3)	(0.37)
LAB ORDER							
7. Select a lab order	12	100% (0.00)	5.8 / 4 CLICKS	43 SECONDS (5)	43 / 20 SECONDS	0% (0.00)	4.3 (0.38)
8. Change the lab order status	12	92% (0.96)	6.6 / 4 CLICKS	53 SECONDS (9)	53 / 16 SECONDS	8% (3)	3.8 (0.43)
MEDICATION E-PRESCRIBING							

9. Search for a medication	12	100% (0.00)	13.3 / 12 CLICKS	96 SECONDS (9)	96 / 45 SECONDS	0% (0.00)	4.1 (0.36)
10. Modify the dosage	12	92% (0.96)	6.3 / 4 CLICKS	37 SECONDS (6)	37 / 16 SECONDS	8% (3)	4.4 (0.39)
11. Send the medication via eRx	12	100% (0.00)	3.4 / 2 CLICKS	27 SECONDS (5)	27 / 11 SECONDS	0% (0.00)	4.5 (0.27)
12. Approve an Rx change request	12	100% (0.00)	3.7 / 3 CLICKS	33 SECONDS (5)	33 / 13 SECONDS	0% (0.00)	4.3 (0.38)
13. Cancel a medication due to a drug-drug interaction	12	100% (0.00)	5.9 / 6 CLICKS	37 SECONDS (6)	37 / 25 SECONDS	0% (0.00)	4.5 (0.27)
DIAGNOSTIC IMAGING							
14. Select a diagnostic test	12	100% (0.00)	5.6 / 3 CLICKS	48 SECONDS (4)	48 / 18 SECONDS	0% (0.00)	4.1 (0.36)
15. Modify the diagnostic order	12	100% (0.00)	5.9 / 5 CLICKS	38 SECONDS (4)	38 / 20 SECONDS	0% (0.00)	4.3 (0.38)
IMPLANTABLE DEVICE							
16. Search and select an implantable device	12	100% (0.00)	8.6 / 9 CLICKS	69 SECONDS (8)	69 / 39 SECONDS	0% (0.00)	3.9 (0.41)
17. Review device identifier	12	92% (0.96)	0.2 / 0 CLICKS	18 SECONDS (3)	18 / 11 SECONDS	8% (3)	4.4 (0.39)

SUS Scores

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

- Nurse Tasks: 78
- Provider Tasks: 75

Broadly interpreted, scores under 60 represent systems with poor usability; scores over 80 would be considered above average.

Discussion of Findings

Overall

Many tasks experienced high completion rates (90% or higher), including most tasks related to the following: demographics, medication list, allergy list, labs, radiology, e-prescribing, and the implantable device list. It was observed that users were at ease completing the tasks. In the second category of completion rates, those scoring moderately well (75-89%), included the following tasks: CDS, gender identity/sexual orientation, reviewing the active problems, and saving changes to the problem list and implantable device list. The lowest task completion rate was for ignoring a medication for reconciliation. An elaboration on this can be found in the Clinical Reconciliation section below.

For many tasks, the click count deviation rates were relatively low (less than 2 times the clicks when compared to the optimal click path). This would include tasks for demographics, medication list, clinical decision support, problems, labs, diagnostics, and implantable device. For these tasks, few participants drastically deviating from the optimal path. There were a small number of tasks that had considerable click path deviations, specifically for clinical reconciliation, adding a reaction to an allergy, and ordering a CDS intervention. Those tasks averaged over 3 times the number clicks when compared to the optimal path. Time on task deviation rates were high across all tasks. The highest deviation rates (3 times the optimal or longer) were for adding a reaction to an allergy, ordering a CDS intervention, and changing a lab order. Moderate task deviation rates (2 times the optimal or longer) were seen on a variety of tasks including demographics, clinical reconciliation, medication list, allergy list, e-prescribing, approving a change request, and order a diagnostic. There were some tasks that scored low on task time deviation (less than 2

times the optimal), and those were for allergy reconciliation, stopping a medication, CDS allergy reaction, changing a CDS reference link, reviewing problems, adding a problem, canceling a drug-drug interaction, updating a diagnostic test, and the implantable device list tasks.

The error rate was overall low, ranging from 0-17% for most tasks, with one exception with the ignoring a medication for clinical reconciliation at 67%. The task rating scores were moderately high with 18/26 tasks averaging over 4 points on the 1-5 Likert scale. Finally, the overall SUS scores were 78 for nurse tasks and 75 for provider tasks, which is near above average.

Clinical Decision Support

1. Change CDS reference link	12	83% (1.29)	6 / 5 CLICKS	58 SECONDS (5)	58 / 44 SECONDS	17% (2)	4.0 (0.40)
2. Order CDS intervention	12	100% (0.00)	11.2 / 2 CLICKS	65 SECONDS (4)	65 / 10 SECONDS	0% (0.00)	3.4 (0.30)
3. Access CDS reference link	12	75% (1.5)	5.0 / 3 CLICKS	56 SECONDS (4)	56 / 22 SECONDS	25% (5)	3.5 (0.28)
8. Check for interactions to an allergy	13	83% (1.29)	4.5 / 4 CLICKS	41 SECONDS (5)	41 / 27 SECONDS	17% (2)	4.3 (0.38)

For “Change CDS reference link” the task completion rate was relatively high at 83%, and the click rate and time on task rates were acceptable. However, there were some usability issues observed. Some users had difficulty knowing where to go to change the link, and their first instinct was to click inside of the Hemoglobin field instead of clicking on the link icon or manage references button. Only some users noticed the link icon next to the Hemoglobin field, and not all users recognized what the icon represented.

The “Order CDS Intervention” (Care Guidelines) task scored very well with a 100% task completion rate. However, the click count deviation and time on task deviation were both very high with (11.2/2 click deviation) and (65/10 seconds deviation). Some users were initially uncertain how to complete the order, clicking on the save orders button before figuring out they could simply row select and click order. Some users expressed concern that the order was performed correctly since they did not see a diagnosis attached to the order.

The Access CDS reference link task scored moderately well in terms of task completion, with a 75% completion rate. The click path deviation scored well (5/3), however the time on task deviation (56/22 seconds) was moderately high. The task rating also scored moderately with a 3.5. Some users had difficulty finding the CDS reference link that was hidden inside of the resource drop-list button and many users expressed that they had never used the feature

before and didn't know it existed. Some users were immediately drawn to the PDR brief instead of looking in the resources button.

The CDS interaction check to an allergy task scored well in terms of completion rate at 83%. However, there were some users that had trouble finding the interactions button. Also, some users instinctually wanted to leave the Allergy screen and go to the medication module to look for drug-drug interactions.

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Clinical Reconciliation

2. Review sig information	13	100% (0.00)	12.5 / 4 CLICKS	118 SECONDS (15)	118 / 58 SECONDS	0% (0.00)	2.7 (0.30)
3. Add an allergy for reconciliation	13	100% (0.00)	8.4 / 3 CLICKS	67 SECONDS (5)	67 / 35 SECONDS	0% (0.00)	3.2 (0.63)

Clinical reconciliation tasks experienced many issues in terms of several areas of usability. The task completion rate for ignoring a medication for reconciliation was very low at 33%. The click deviation and time deviation were significant, and the overall task-rating was low at 2.7 and 3.2. The issues were very obvious to observe. Users struggled with the layout of this screen. They did not understand where to add or ignore a medication, as the action combo-box options are hidden until a user clicks on the drop down option, and then drop down option appears. The majority of users instead tried clicking the main medications grid for reconciling, which counter-intuitively does nothing. When a user did discover the action combo-box, it seemed by accident, and users will still not confident that they were performing the task correctly. The users did not know which button on the bottom of the screen would save the action. Some users would guess correctly to click "Action" drop down, but some users would instead try clicking the "Reconciliation filter" drop down. During the post-task survey and comments, some users expressed that they don't normally perform reconciliation from this screen. Instead, some users say their clinic manually performs reconciliation from within the medication module or from the medication reconciliation short form (which is an alternative screen).

Allergy List

6. Add an allergy	13	100% (0.00)	6.5 / 4 CLICKS	33 SECONDS (6)	33 / 15 SECONDS	0% (0.00)	4.6 (0.23)
7. Add a reaction to an allergy	13	92% (0.00)	14.3 / 4 CLICKS	70 SECONDS (8)	70 / 23 SECONDS	8% (3)	3.8 (0.43)

Allergy tasks performed very well in terms of completion rates, with 100% for adding an allergy, and 92% for adding a reaction to an allergy. The deviation rate for click count was good for adding an allergy however a bit higher for adding a reaction to an allergy. Also, the deviation rate for time on task was moderately high for adding an allergy and very high for adding a reaction for an allergy. The task ratings were 4.6 for adding an allergy, and 3.8 for adding a reaction. The following usability issues were noted. Users struggled to find how to add a reaction to an allergy. The new reaction feature requires a user to click “drop down” option of allergy reaction. When users found the drop down, they went to search for the reaction and it took some time to find the reaction, with lots of up and down scrolling through the list of reactions. Also, some users did not select the proper reaction in the reaction drop down. Finally, it was an observed usability issues that the allergy screen sequence was not properly handled, with the grid being overly large and requiring the user to scroll up and down to access action buttons.

Demographics

1. Enter preferred language	13	100% (0.00)	10.5 / 8 CLICKS	102 SECONDS (10)	102 / 48 SECONDS	0% (0.00)	3.9 (0.41)
9. Enter last name	13	100% (0.00)	15.2 / 10 CLICKS	107 SECONDS (11)	107 / 49 SECONDS	0% (0.00)	4.2 (0.37)

The tasks related to demographics scored well in terms of task completion rate, with a range of 83% to 100% for various sub-tasks. Click path deviation was (10.5/8) for updating demographic information (task 1) and (15.2/10) for adding new information (task 9). The time on task deviations averaged about two times longer than optimal for both tasks. Task ratings were solid at 3.9 and 4.2. There were some usability issues noted. When creating a new patient, if a user typed in zip information within the lookup, the zip codes would not load properly. Some users had difficulty finding the preferred language drop-list, and it took about 5 seconds before they could find it. Some users also used the “sex” field instead of filling out the gender identity field. There were post-task comments that they didn’t understand the difference between the fields.

Problem List

5. Search for a problem	12	100% (0.00)	4.6 / 5 CLICKS	45 SECONDS (5)	45 / 23 SECONDS	0.00 (0.00)	4.3 (0.38)
6. Update clinical status of a problem	12	92% (0.96)	5.1 / 4 CLICKS	37 SECONDS (6)	37 / 14 SECONDS	8% (3)	4.2 (0.37)

Task completion rates for problem list tasks performed well with a range of 92% to 100%. The click path deviations were very comparable to optimal path (4.6/5) and (5.1/4). The time on task deviation was better than optimal for reviewing active problems. The time on task deviation for search and adding to the problem list was just shy of two times the optimal. The update problem task was over two times the optimal time on task. All of the problem tasks scored over 4 points on the Likert scale with a range of 4.2 - 4.3. In terms of usability, some users either did not remember or notice that they needed to click “save” after modifying a problem. Some users had difficulty finding the icd type drop-list. They took a long time to find it, and initially looked under the “Status” drop-list. Some users also tried several times clicking the “CCM Tracking” checkbox that appears inside the grid next to each problem.

Medication e-Prescribing

9. Search for a medication	12	100% (0.00)	13.3 / 12 CLICKS	96 SECONDS (9)	96 / 45 SECONDS	0% (0.00)	4.1 (0.36)
10. Modify the dosage	12	92% (0.96)	6.3 / 4 CLICKS	37 SECONDS (6)	37 / 16 SECONDS	8% (3)	4.4 (0.39)
11. Send the medication via eRx	12	100% (0.00)	3.4 / 2 CLICKS	27 SECONDS (5)	27 / 11 SECONDS	0% (0.00)	4.5 (0.27)
12. Approve an Rx change request	12	100% (0.00)	3.7 / 3 CLICKS	33 SECONDS (5)	33 / 13 SECONDS	0% (0.00)	4.3 (0.38)
13. Cancel a medication due to a drug-drug interaction	12	100% (0.00)	5.9 / 6 CLICKS	37 SECONDS (6)	37 / 25 SECONDS	0% (0.00)	4.5 (0.27)

The task completion rates for all the medication e-prescribing tasks were very high, with almost all tasks receiving a 100%, with the exception of the modify dosage task at 92%. The click path deviation rate was very close to optimal for all tasks. The time on task deviation rates were almost two times the optimal time for all tasks. The task rating range was 4.1-4.5. Many usability issues were still noted. Some users had difficulty modifying the prescriptions. Users complained that they have to search for the prescription modify link, as they were too confusing. While the task completion rate for sending an eRx was 100%, some users noted they do have problems sometimes while selecting a pharmacy.

Users also expressed the desire to have all medication information visible while making an eRx change approval.

Labs

7. Select a lab order	12	100% (0.00)	5.8 / 4 CLICKS	43 SECONDS (5)	43 / 20 SECONDS	0% (0.00)	4.3 (0.38)
8. Change the lab order status	12	92% (0.96)	6.6 / 4 CLICKS	53 SECONDS (9)	53 / 16 SECONDS	8% (3)	3.8 (0.43)

Lab tasks scored very well for task completion rate, with a range of 92% to 100%. The click deviation rate was close to optimal. The deviation time on task for placing a lab order was about two times that of optimal time. For updating a lab order, it was three times the optimal time. The task rating was 4.3 and 3.8. As for usability issues, some users struggled to find the STAT option.

Diagnostics

14a. Select a diagnostic test	12	100% (0.00)	5.6 / 3 CLICKS	48 SECONDS (4)	48 / 18 SECONDS	0% (0.00)	4.1 (0.36)
15. Modify the diagnostic order	12	100% (0.00)	5.9 / 5 CLICKS	38 SECONDS (4)	38 / 20 SECONDS	0% (0.00)	4.3 (0.38)

Diagnostic tasks scored very well for task completion rate, with all tasks at 100%. The click deviation rate was close to optimal. The deviation time on task for placing a diagnostic order was about two times that of optimal time. For updating a diagnostic order, it was also almost two times the optimal time. The task rating was 4.1 and 4.3. No usability issues were observed for the diagnostic tasks.

Implantable Device List

16. Search and select an implantable device	12	100% (0.00)	8.6 / 9 CLICKS	69 SECONDS (8)	69 / 39 SECONDS	0% (0.00)	3.9 (0.41)
17. Review device identifier	12	92% (0.96)	0.2 / 0 CLICKS	18 SECONDS (3)	18 / 11 SECONDS	8% (3)	4.4 (0.39)

The implantable device tasks scored well on completion rates, with a range of 92% to 100%. Click path deviation was close to optimal, and time on task deviation was somewhat close to optimal. The task ratings were 3.9 and 4.4. For adding an implantable device, some users had difficulty finding the right implantable device.

EFFECTIVENESS

Braintree Health EHR 9.3.1.1 scored well on many measures of effectiveness. The task completion rates performed moderately well, with 24/26 tasks averaging 83% or higher. Task failures were infrequent, and when occurred, they were due to usability issues that can be addressed by design changes. The error rate was low for most tasks, ranging from 0.00 to 0.17 for most tasks, with one exception being the “ignore a medication for reconciliation” task which had a 0.67 error (failure) rate.

EFFICIENCY

Braintree Health EHR 9.3.1.1 scored variably on a task basis on measures of efficiency. The deviation rate ranged from 0.92 – 5.6 (the closer to 1 the better), with some participants deviating significantly from the optimal path on

tasks such as clinical reconciliation and ordering a CDS lab. It was noted that many extra clicks involved scrolling up and down the screen while looking for action buttons. Time on task varied significantly based on task complexity, from 8 seconds to review the problem list to 118 seconds for medication reconciliation.

When comparing observed time on task to optimal time on task, the deviation rate was often somewhat high, with the highest deviation rate at 6.5 for ordering a CDS lab order. There were many reasons for the time on task deviations. First, users were somewhat slowed due to the remote connection that experienced some lag time. Second, some users would stop and try to ask questions or make comments (despite the fact that we asked them to hold off on comments until the end). Third, some users were not familiar with some screens and clicked around before figuring out how to complete the task. Finally, many users would take time after completing the task to review the input carefully before clicking the “done” button. All these factors contributed to the overall high deviation rates for time on task.

SATISFACTION

Braintree Health EHR 9.3.1.1 scored well on measures of satisfaction. Overall post-task rating scales scored over 4 points (on a scale of 1 to 5, 5 being “very easy”) for 18/26 tasks. The overall SUS score was 78 for nurse tasks and 75 for provider tasks which is close to “above average”.

Major Findings

- For Clinical Reconciliation, users are confused by the layout of the screen. The main actions (add, remove, etc.) are very difficult to find, and only visible upon hovering.
- For the Allergy List, users are not selecting the reaction properly, which results in the reaction not being added.
- For accessing the CDS reference link, some users have difficulty finding the CDS reference link
- For CDS ordering a new lab, users are uncertain if the lab order was correctly ordered due to the fact that no diagnosis appears next to the order.
- For problem list, some users are not noticing that they need to click "save" button after modifying a problem.
- For the problem list, some users want to click inside of the "CCM tracking" checkbox that is within the grid.

- For the medication module, some users have trouble modifying the sig due to its complexity and horizontal scrolling.
- For the medication module, there is an observed usability issue. When selecting a different dosage, the modified sig does not carry over.
- For the medication module, some users express difficulty searching for a pharmacy.
- For an eRx change approval, some users express their desire to send a message to the patient directly through the clinical tasking tab.
- For an eRx change approval, some users express the desire to see a list of medications visible.
- For the order module, while updating the status of a lab, some users have difficulty finding the STAT option.
- For the implantable device, some users were having difficulty in searching the devices.

AREAS FOR IMPROVEMENT

- Redesign the clinical reconciliation screen to simplify it and make the main action buttons prominent.
- Redesign the allergy reaction drop down.
- In the allergy module, adjust the spacing and layout so that the main action buttons all fit within the screen and no vertical scrolling is required.
- Redesign the resources button so that the user has more of a clear indication of its purpose and that CDS link could be inside of it.
- Make sure the zip code information carries over into the new patient information from the lookup.
- In the med module, increase the size of overall screen so there is less scrolling.
- Conduct more research on searching and selecting a pharmacy in the med module.
- In the order module, make the STAT option more prominent so that users can find it more quickly.
- In the implantable device list, make device list search more user friendly.

Appendices

Appendix 1: Recruiting Screener

EHR Usability Screener

Hello,

My name is Saad Mohsin. We are recruiting individuals to participate in a usability study for Braintree Health. We would like to ask you a few questions to see if you qualify and if would like to participate. This should only take a few minutes of your time. This is strictly for research purposes. If you are interested in the study, please share your details for participating in a 60-minute remote study preferably within CST working hours (see below) during the weeks of June 26th – June 30th.

8:00am – 6:00pm EST

7:00am – 5:00pm CST

6:00am – 4:00pm MST

5:00am – 3:00pm PST

If you are interested in participating in this study, and to see if you would qualify, please complete the questions below.

Question	Response
First name:	
Last name:	
Address (Street, City and State):	
Home phone:	
Work phone:	
Cell phone:	
Age:	
Gender:	<input type="radio"/> Female <input type="radio"/> Male <input checked="" type="radio"/> Other
Email address:	
When was the last time you participated in a focus group or usability test?	<input type="radio"/> Under 3 months ago <input type="radio"/> More than 3 months ago <input checked="" type="radio"/> Never
Do you, or does anyone in your home, work in marketing research, usability research, web design?	<input type="radio"/> Yes <input checked="" type="radio"/> No
Do you, or does anyone in your home, have a commercial or research interest in an electronic health record software or consulting company?	<input type="radio"/> Yes <input checked="" type="radio"/> No
Which of the following best describes your race or ethnic group?	<input type="radio"/> Caucasian <input checked="" type="radio"/> Asian

	Black/African-American Latino or Hispanic Native American Other
Do you require any assistive technologies to use a computer?	Yes No
Which of the following describes your highest level of education?	High school graduate/GED Some college College graduate Master's degree Doctoral degree Other
What is your practice/organization's specialty?	
What is your current position?	Physician Resident RN Medical Assistant Physician Assistant Nurse Practitioner Other
How long have you held this position? (years)	
Describe your work location (or affiliation) and environment?	Private Practice Health System Government Clinic Other
Besides reading email, what professional activities do you do on the computer?	Access EHR, research Reading news Shopping/banking Digital pictures Programming/word processing No computer use at all
How many hours per week do you spend on the computer?	0-10 11-25 26+ hours
What computer platform do you use most frequently?	Mac PC
What internet browsers do you typically use?	Firefox Internet Explorer Chrome AOL
In the last month, how often have you used an electronic health record?	Nearly every day 3-5 days per week 1-3 days per week
How many years have you used computers in general? (years)	
How many years have you used an electronic health record?	<input type="radio"/> 0-2 years <input type="radio"/> 2-4 years <input type="radio"/> 4-6 years

	6+ years
How many years have you used Braintree Health EHR? (years)	
How many EHRs do you use or are you familiar with?	<input type="checkbox"/> Braintree Health <input type="checkbox"/> Practice Fusion <input type="checkbox"/> EPIC <input type="checkbox"/> Allscripts
How does your work environment handle patient records?	Entirely on paper Some paper some electronic All electronic
Which of the following tasks do you typically perform on a regular basis?	<input type="checkbox"/> Demographics <input type="checkbox"/> Allergy List <input type="checkbox"/> Medication List <input type="checkbox"/> Clinical Reconciliation <input type="checkbox"/> Clinical Decision Support <input type="checkbox"/> CDS configuration <input type="checkbox"/> Lab orders <input type="checkbox"/> Radiology orders <input type="checkbox"/> Medication e-Prescribing <input type="checkbox"/> Implantable Device List

Thank you very much for answering our questions. We look forward to hearing your feedback!

Appendix 2: Participant Demographics

Following is a high-level overview of the participants in this study.

Gender	
Men	7
Women	18
Total Participants	25

Occupation/Role	
Medical Assistant	6
LPN	1
Nurse (RN)	6
Nurse Practitioner	2
Provider (MD/DO)	8

Years of Experience		
Using Computers	0-9 years	1 participants
	10-19 years	7 participants
	20-29 years	10 participants
	30-39 years	7 participants
Using Braintree	0-2 years	6 participants
	2-4 years	6 participants
	4-6 years	4 participants
	6+ years	9 participants
Using an EHR	0-2 years	2 participants
	2-4 years	5 participants

	4-6 years	18 participant
41		
	6+ years	9 participants
Using Electronic in practice	All paper	0 participants
	Some	6 participants
	All electronic	19 participants

Appendix 3: Non-Disclosure Agreement (NDA) and Informed Consent Form

Consent & Agreement Form

Thank you for allowing us to spend time learning from you. The data we gather will be an important tool for enabling physicians and clinical staff to efficiently and effectively complete their work.

If you have questions at any time, you may contact the researcher, Saad Mohsin at saad.mohsin@braintreemd.com or Liaqat Ali, at liaqat.ali@braintreemd.com

Procedures:

- This study is being recorded on screen-sharing, and digital audio. We require your written permission to use these recordings in our work.
- This study is expected to be 55-60 minutes long. Your participation is voluntary and you may withdraw from the session at any time.
- There are no risks associated with participation in this study.

Anonymity:

We may share some quotes, stories, and/or photos (such as screenshots) from this session with our colleagues and management. These quotes and stories will always be anonymized.

Confidentiality Agreement:

Your participation in this study shall be governed by your existing confidentiality agreement with Braintree Health and all aspects of the study, including any oral conversations between your company and Braintree Health regarding the prototype, including but not limited to, the design, performance and/or the results of the prototype, shall be deemed confidential and proprietary and may not be disclosed to any third party, including without limitation through any social media.

* Required **Do you agree to grant the Braintree Health team permission to use screen recording and audio recordings of this session for internal purposes related to the improvement of the product? ***

Yes, I consent and grant the Braintree Health team permission to use screen-recording and audio recordings of this interview for internal purposes related to the improvement of the product. I understand this may include the use of anonymized quotes, stories, and photos in reports and presentations.

No, I do not consent the Braintree Health team to use screen-recording and audio recordings of this session

Your name _____

Email _____

Appendix 4: Moderator's Guide & Tasks

Administrator:

Data Logger:

Date:

Time:

Participant ID:

Location:

Prior to testing:

- Confirm schedule with participants
- Ensure lab environment is working properly
- Ensure equipment is working properly

Pre-test checklist:

- Start remote desktop and access the Braintree Server
- Run Braintree Health Ambulatory EHR 9.3.1.1
- Open EHR
- Login with the appropriate provider and patient, open relevant screens
- Make sure dummy data is correct
- For each participant, open a separate (but duplicate) dummy account in the EHR (i.e. P1, P2, P3, etc.)
- Open Axure HTML prototype (task instructions)
- Start Webex meeting.
- Welcome participant when he/she arrives
- Make sure participant fills out the informed consent and the Demographics form
- Record the WebEx meeting as a backup to the Morae Recorder

Method:

- Remote with

WebEx Equipment:

1. A Dell Inspiron 15" laptop with the Braintree Health EMR link and EHR loaded with webcam and microphone (Alternatively we can also use Screen Connect to access the development server to load the templates)
2. Axure prototype for the task list.
3. Dummy patient accounts for each specialty mentioned below
4. Dummy provider accounts for each specialty mentioned below

User assessment schedule:

Notes on logistics: Individual Sessions last 60 minutes per session, and all sessions are recorded.

Research goals:

The primary goal is to have the user go through each task of 6 criteria listed for SED certification, and gather feedback on the following:

- Ease and effectiveness of
 - o Path Deviations
 - o Task Time
 - o Task Ratings
 - o Error Score
- Task success rate
- Satisfaction scores
- Verbal feedback on general usability

Before passing the control over to you, I want to explain how the task instructions works.

When you're ready, please click on the 'Start' button. When you're done with the task, please click on the 'Done' button to continue to the next task.

I will read the instruction for you first, and then you can feel free to re-read the scenario out loud or quietly in your head. When you are ready, click 'start'.

I'm going to pass control over to you. You will see an alert window that asks for you to take remote control. Click on the "Take Control" button.

Nurse Tasks

Scenario:

Sara Hellen is a 40-year-old female who is an existing patient at Care medical center. She has been with the clinic for over a year. However, last Saturday she went to an Urgent Care due to a sore throat and high fever that lasted more than 3 days.

At the Urgent Care, they also observed high BP and recommend a follow up visit at her PCP for HTN screening.

Demographics Update

Task 1. Some of **Sara's** demographic information has changed. Please update the following:

- Gender identity: female
- Sexual orientation: straight or heterosexual
- Preferred language: English
- Email: sarah.hellen@gmail.com
- Cell phone: 512-333-2490

Clinical Reconciliation

Task 2. Because Sarah has visited another clinic, you need to incorporate information from Care medical center. Reconcile the medications:

- Remove aspirin.
- Read aloud the sig for Ibuprofen
- Add Nifedipine 30 mg.

Task 3. Next you will reconcile the medication allergies.

- Add codeine.

Medication List

Task 4. You need to add to Sarah's medication list.

- Add Lisinopril 10mg tablet.
- Take 1 tablet by oral route every day.

Task 5. Sarah is no longer taking Vitamin-C.

- Stop Vitamin-C.

Allergy List

Task 6. You need to add to the allergy list.

- Add eggs

Task 7. You need to update the allergy list.

- Update Codeine to include nausea as a reaction.

Task 8. You need to check for drug-allergy interactions.

- Check to see if there are any interactions for Codeine.

Add Demographics

Task 9. You need to enter a new patient's demographic information. Add the following:

- Name: Sarah Helen
- DOB: 03/15/1987
- Birth sex: female
- Address: 123 Main St
- Zip: 80016
- Race: White
- Ethnicity: Not Hispanic or Latino

Provider Tasks

CDS Configuration

Task 1. For the diagnosis Diabetes, the Hemoglobin A1C reference link needs to be changed.

- Change the link to be the following URL: <https://medlineplus.gov/a1c.html>

Scenario:

Sarah Helen is a 40-year-old female who is an existing patient at Care medical center in Chicago, Texas. She has been with the clinic for over a year. However, last Saturday she went to an Urgent Care due to a sore throat and high fever that lasted more than 3 days.

At the Urgent Care, they also observed high BP and recommend a follow up visit at her PCP for HTN screening.

CDS Order Lab

Task 2. You notice Sarah is due for a lipid panel.

- Order a lipid panel.

Problem List

Task 3. Read aloud Sarah's active problems.

Task 4. Add Hypertension to the problem list.

Task 5. Update the clinical status of Type II Diabetes to "under control"

Labs

Task 6. You need to order a lab for Sarah's Diabetes.

- Order a glucose tolerance test.

Task 7. You want to make sure the lab order is completed quickly.

- Mark the glucose order as "STAT"

Medications

Task 8. Sarah's glucose level is still high. You need to prescribe Glyburide.

- Prescribe 2.5mg Glyburide
- Sig: 1 tablet by oral route 2 times every day with food
- Quantity: 30
- Refills: 1

Task 9. You need to update the dosage for the order.

- Change the dosage for Glyburide to be 5 mg.

Task 10. You need to send the Glyburide to Sarah's pharmacy.

- Send to VA pharmacy 10.6

Task 11. Sarah is asking questions about Glyburide.

- Access Resources
- Launch the Clinical Decision Support for Glyburide.

Task 12. In your inbox, you notice an Rx change message.

- Approve the change request for Zestril to the generic medication.

Scenario:

A new patient, Monica David is your next patient of the day. She has come into the clinic for frequent and foul smelling urine, as well as coughing and labored breathing. You have already ordered a urine culture.

Radiology

Task 13. You need to order a diagnostic imaging test for Monica's coughing and difficulty breathing.

- Order an abdominal CT with contrast.

Task 14. You need to change the order.

- Change the order to Chest CT without contrast.

Drug-Drug Alert

Task 15. You need to order a medication for Monica.

- Order Bactrim DS 800-160 mg tablet.
- When a drug-drug alert appears, cancel the order.

Implantable Device List

Task 16. Monica has an implantable device that is not listed in her chart.

- Add Viva Quad XT CRT-D (model DTBA1QQ)
- Device placed on 5/01/2018

Task 17. You need to access information about the implantable device:

- Find the Device Identifier and the Manufacturer

Appendix 5: Error Analysis

Scenario	Error Analysis
CDS Configuration	<ul style="list-style-type: none"> • Some users first instinct was to click inside of the hemoglobin field instead of the link icon or manage references button. • The link icon doesn't look clickable.
Clinical Reconciliation	<ul style="list-style-type: none"> • Users are confused by the layout of the screen. • The main actions are difficult to find, and only available
Clinical Decision Support	<p>CDS Reference Link:</p> <ul style="list-style-type: none"> • Some users had difficulty finding the CDS reference link <p>CDS Allergies:</p> <ul style="list-style-type: none"> • Some users had trouble finding the interactions button <p>CDS Order New:</p> <ul style="list-style-type: none"> • Users were uncertain if the lipid panel

	was correctly ordered.
Allergy List	<ul style="list-style-type: none"> • Users were not selecting reaction until they realized that it didn't get added to the reaction field. .

Medication List	<ul style="list-style-type: none"> • No patient safety issues observed.
Demographics	<ul style="list-style-type: none"> • When adding a new patient, if a user types zip information in the lookup, some of the zip codes were missing • Some users had difficulty finding the preferred language drop-list • Some users clicked on "Sex" when asked to fill in "Gender Identity".
Problem List	<ul style="list-style-type: none"> • Some users did not notice that they needed to click "Save" after modifying a problem. • Some users had difficulty finding the problem status drop-list.
Medication e-Prescribing	<p>Prescribe New</p> <ul style="list-style-type: none"> • Some users had trouble modifying the sig. • Observed horizontal scrolling issues on eRx screen. · <p>Rx Change Request</p> <ul style="list-style-type: none"> • Some users expressed their desire to send a message to the patient. • Some users expressed their desire to see a list of medications visible
Labs	<ul style="list-style-type: none"> • Some users had difficulty finding the STAT option.

	<ul style="list-style-type: none"> Some users expressed confusion after they selected STAT, but then did not see the stat indicator in the order summary
<p>Radiology</p>	<ul style="list-style-type: none"> No patient safety issues observed.
<p>Implantable Device List</p>	<ul style="list-style-type: none"> Some users had difficulty finding the implantable device