EHR Usability Test Report of FDB MedsTracker® eRx, v8

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

EHRUT:	**FDB MedsTracker®, v8**
Date of Usability Test:	**Dec 10-21, 2018**
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Table of Contents

1. EXECUTIVE SUMMARY

A usability test of FDB MedsTracker® v8, an e-prescribing and medication management EHR (electronic health record) was conducted remotely December 10 through December 21, 2018 by First Databank. The purpose of this test was to test and validate the usability of the current user interface and provide evidence of usability in the EHR Under Test (EHRUT). The features tested in this study are all required elements for the Office of the National Coordinator for Health Information Technology (ONC) Certification Program, 2015 Edition, and for the Safety-Enhanced Design Attestation. The specific Program criteria assessed as part of this study are:

- 170.314(b)(3) Electronic prescribing

During the usability test, ten healthcare providers matching the target demographic criteria served as participants and used the EHRUT in simulated, but representative tasks.

This study collected performance data on following six task types typically conducted on an EHR:

- E-prescribe New Prescription
- Change Prescription (dosage)
- Cancel Prescription
- Refill Prescription
- Receive Fill Status Notification
- Request and Receive Medication History Information

During the 45-minute usability test session, each participant was greeted by the moderator and observer. Each participant had already reviewed and signed an informed consent/release form (included in Appendix 3), and they were instructed that they could withdraw at any time. All participants had prior experience with at least one EHR system. The moderator introduced the purpose of the usability test, provided basic training for the software, and instructed participants to complete a series of tasks (given one at a time) using the EHRUT. During and after the session, the observer timed each task and recorded performance data electronically. Neither the moderator nor observer gave the participant assistance in 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 complete 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 has been de-identified – no correlation can 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-questionnaire and were compensated for their time with a $100 gift card. 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 (NISTIR7741)*, were used to evaluate the usability of the EHRUT. Table 1-1 is a summary of the performance and rating data collected on the EHRUT.

Measure	***N***	**Task Success**	**Path Deviation**	**Task Time**		**Errors**	Task Ratings (5 = Easy) Mean (SD)
Task	#	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Mean (SD)
1. E-prescribe New Prescription	10	100 (0)	1.3	33.6 (14.7)	1.7	0 (0)	4.9 (0.3)
2. Change Prescription (dosage)	10	100 (0)	1.1	12.7 (4.6)	0.9	0 (0)	5 (0)
3. Cancel Prescription	10	100 (0)	1.2	16 (15.7)	1.8	0 (0)	4.7 (0.5)
4. Refill Prescription	10	100 (0)	1.0	14.1 (3.7)	1.1	0 (0)	5 (0)
5. Receive Fill Status Notification	10	100 (0)	1.4	9.2 (6.6)	1.5	0 (0)	4.8 (0.6)
6. Request and Receive Medication History Information	10	100 (0)	1.3	13.5 (8.9)	1.5	0 (0)	5 (0)

Table 1. Task Success and Satisfaction Rating Summary

The results from the System Usability Scale (SUS) Questionnaire (see Appendix 5) scored the subjective satisfaction with the system based on performance with these tasks

to be: **98.25.** This score is very high and agrees with the participants qualitative comments about perceiving the system to be very easy to use. The lowest SUS score for any participant was **95**, and five of the ten participants rated it **100**. Table 1-2 contains the calculated average SUS score and the overall task success percentage.

Overall Summary	
SUS (n=10)	Task Success (n=10)
98.25	100%

Table 2. System Usability Score (SUS) and Task Success Summary

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

Major findings

- All participants successfully completed all tasks in a timely manner.
- The participants' deviations from the optimal path were not significant in terms of causing the participant to fail. They were deviations that added time but did not interfere with success.
- The SUS score is extremely high and aligns with the participants' verbal comments about the ease of using the software.
- All participants – regardless of whether they identified as a prescriber or non-prescriber as their occupation – successfully performed all prescribing actions.
- Several participants complimented the design of the Change Prescription task, noting that the steps they were required to perform were clear and efficient.
- Several participants commented that the Rx Fill Notification would be useful for patient care and improving their workflow.
- The majority of path deviations were minor or trivial in terms of severity, such as not finding the particular button that they wanted to use (while still knowing what they were looking for) or clicking on an extraneous button (that did not deleteriously interfere with their intentions).

Areas for improvement

- Two participants clicked an unnecessary button during the Change Prescription task. While it did not cause a failure, it led to an unnecessary click. Adding help text or placing the button in a different area may help users avoid that button until they need to use it.
- Some participants commented that deleting a prescription did not clearly indicate in advance that this action would also send a cancellation to the pharmacy. Help text could be added to more clearly indicate what the result will be of using the delete button.

- One participant suggested that seeing a reason why the pharmacy was requesting a change to the prescription would help them decide whether to approve the change or not. It's not clear if the pharmacy can send a reason in their message, but if supported, it would be helpful to add it to the user interface.

2. INTRODUCTION

The EHRUT tested for this study was FDB MedsTracker, v8, a beta version e-prescribing and medication management system. Clinicians (physicians, nurses, pharmacists, and support staff) use this application at the point of care to manage patient medications, medication reconciliation and electronic prescribing in both the inpatient (hospital) and ambulatory (primary care clinic) settings.

The purpose of this study was to test and validate the usability of the current user interface and provide evidence of usability in the EHR Under Test (EHRUT). This report briefly describes how easy or difficult it was for new users to be able to accomplish basic tasks, the length of time they took to complete them, and the deviations made in completing them within this version of the FDB MedsTracker EHR application. Quantitative and qualitative measures of effectiveness, efficiency and user satisfaction (e.g., time on task, deviations from optimal path, and satisfaction rating metrics) were captured during the usability testing.

The usability tasks attempted to represent realistic tasks and exercises that would be performed by typical prescriber (physicians, nurse practitioners, etc.) and non-prescriber (nurse, pharmacist, etc.) users of the system when managing patient prescriptions and related medication functions.

3. METHOD

1.1 Participants

A total of ten participants were tested on the EHRUT. Participants in the test were physicians, nurse practitioners, physician assistants, nurses, pharmacists, and clinical support staff. Participants were recruited by Dasi Howell and Katie Bailey of First Databank and were compensated with a $100 gift card for their time. Participants had no direct connection to the development of the EHRUT, but two-thirds were former end-

users of an older version of MedsTracker used in the inpatient setting. Participants were provided with a basic MedsTracker Primer when the session was scheduled and received a short training overview at the start of the session before their tasks. Due to time constraints, study participants received less training than end users would have received before they began using the system in an actual healthcare setting.

For test purposes, end-user characteristics were identified and documented in a recruitment screener used to solicit potential participants. This screener is provided in Appendix 1.

Recruited participants had a mix of backgrounds and demographic characteristics conforming to the recruitment screener. Table 3-1 shows the participant characteristics, including demographics, professional experience, and EHRUT experience. Participant names were replaced with a participant ID so that an individual's data cannot be tied back to individual identities.

Participant Identifier	Gender	Age	Education	Occupation or Role	Professional Experience (months)	Computer Experience (months)	Product Experience (months)	Assistive Technology Needs
P01	Female	30-39	Master's Degree	Speech-Language Pathologist	120	300	0	No
P02	Female	40-49	Master's Degree	Nurse practitioner	48	360	36	No
P03	Male	40-49	Master's Degree	Nurse practitioner	12	288	2	No
P04	Female	60-69	Associate degree	Clinical-Physician Informaticist / Clinical Support	456	336	0	No
P05	Male	40-49	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Pharmacist	240	288	24	No
P06	Male	40-49	Doctorate degree (e.g., MD, DNP, DMD, PhD)	Family Physician	216	216	24	No
P07	Female	40-49	Bachelor's Degree	Registered Nurse	138	300	48	No
P08	Male	30-39	Master's Degree	PA-C	66	240	0	No
P09	Male	20-29	Master's Degree	Product Manager (former RN)	72	240	0	No
P10	Female	50-59	Master's Degree	Division Director of Education Programs (RN)	384	240	24	No

Table 3. Participant Demographics Summary

Each participant was scheduled for a 45-minute GoToMeeting session with sufficient time in between each session to reset the EHRUT to the proper test conditions. Although the participants were a mix of prescribers and non-prescribers, the tasks do not differ in

terms of number of steps or the path required to perform them, so all participants received the identical training and primer.

1.2 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 could be made.

During the usability test, participants interacted with a single EHR. Each participant used the web-based system from their own remote location but was provided with the same instructions. The EHRUT 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.

1.3 Tasks

Six tasks were constructed that are realistic and representative of the kinds of activities a user might do with this EHR, including:

- Requesting and reviewing a patient's previously filled prescription(s)
- Creating a prescription and sending it to a pharmacy
- Cancelling a prescription
- Renewing a prescription
- Changing a prescription (dosage)
- Receiving updates from the pharmacy about the prescription fill

Tasks were selected based on their frequency of use, criticality of function, and those that may be most troublesome for users. These tasks represent core functionality of the system that all types of clinician (prescriber and non-prescriber) routinely perform in the application. Extensive training should not be required for the participant to be able to accomplish the tasks. All users of this application should be able to confidently understand these particular tasks and perform them efficiently and without undue error in order to be able to utilize the system effectively and safely.

1.4 Procedures

To ensure that the test ran smoothly, two FDB staff members participated in the test. One was the Moderator, who has over ten years experience testing and documenting the application, as well as directly training and supporting customers of the system. The second person was the Observer, who is not directly involved with the MedsTracker product but is a product manager for a different FDB software product.

Potential participants responded to an email solicitation about the study. Selected participants were sent a Non-Disclosure Agreement and Informed Consent form (see Appendix 3) that could be electronically signed. Each participant was also provided a short MedsTracker Primer via email that described the basics of how to use the core features of the EHURT. It did not describe the exact tasks to be tested during the session.

At the start of the session, the participants were greeted by the Moderator and the Observer. The participant's identity was verified by the Moderator using two questions to compare against their answers on the screening questionnaire.

The Moderator led the session, administering instructions and tasks. The Moderator also obtained the ranking data, took notes on participant comments, and compiled all the data in this report (task times, task success, path deviations, number and types of errors). The Observer performed several backend technical tasks during the study sessions and managed all participant forms.

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

- As quickly as possible making as few errors and deviations as possible
- Without assistance; Moderators were allowed to give immaterial guidance and clarification on tasks; but not instructions on use.

- Without a think aloud technique.

For each task, the participants were given a written description of how the task in general is performed within the MedsTracker Primer (see Appendix 7), but not the exact task they would be asked to do during the session. The exact task was given only verbally to the participant during the session. Task timing began once the Moderator finished reading the task and said "Begin". The task time was stopped once the participant indicated they had successfully completed the task. Scoring is discussed below in Section 3.9.

Following the session, the Moderator asked the participant the final open-ended questions to solicit comments about what they liked and didn't like, administered the post-test questionnaire (the System Usability Scale, see Appendix 5), and thanked each individual for their participation. After the session, the Moderator sent each participant a $100 gift card. Upon receipt, the participants were asked to sign and return the Incentive Receipt and Acknowledgment Form (see Appendix 6).

Participants' demographic information, task success rate, time on task, errors, deviations, verbal responses and the post-test System Usability Score (SUS) questionnaire were recorded into a spreadsheet.

1.5 Test Location

Because the testing was conducted remotely, the test location was at the preference of the participant. The individual was asked to confirm that they had access to suitable technology within the screening questionnaire, and in the session appointment, the Moderator requested that the participant select a location where they could have a quiet one-hour session without significant distractions. No significant background noise or disruptions were observed during any of the sessions.

While using GoToMeeting, the Moderator and the Observer could see the participant's screen and listen to audio of the session but could not observe their face.

1.6 Test Environment

The EHRUT is used by clinicians (physicians, nurses, pharmacists, and support staff) at the point of care to manage patient medications and create prescriptions in both the inpatient and ambulatory setting. For this test, the application was configured in a way that is commonly used by current customers in an ambulatory (outpatient clinic) setting.

The participants utilized a variety of hardware (desktop with mouse and keyboard or laptop with trackpad) when interacting with the EHRUT, and the participants also selected their preferred browser (the EHRUT supports all modern browsers). The participants used a variety of screen sizes and resolutions. The web-based application was set up by the Moderator and used a test database with test patients. The system performance (i.e., response time) was representative to what actual users would experience in a healthcare setting.

1.7 Test Forms and Tools

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

1. Screening Questionnaire
2. Non-Disclosure Agreement and Informed Consent
3. Moderator's Guide
4. MedsTracker Primer
5. System Usability Score (SUS) Questionnaire
6. Results spreadsheet
7. Incentive Receipt and Acknowledgement Form
8. GoToMeeting application

The participant's interaction with the EHRUT was captured and recorded using GoToMeeting. It recorded both the screens and the verbal comments of each participant. In addition, user actions were captured in the audits of FDB MedsTracker.

1.8 Participant Instructions

The Moderator read the instructions aloud to each participant (see the Moderator's Guide in Appendix 4).

Following the procedural instructions, participants were shown the EHR and given a 10-minute demonstration showing how to perform the basic functions, similar to what a new user would receive as training before they began to use the system in a healthcare setting. After this was complete, the administrator gave the following instructions:

> *Now we'll begin with the first task. I'll describe the scenario to you and ask you to proceed with the task after I say Begin. When you're done, please say Done or OK.*

Participants were instructed on how to log in to the demo environment and then given six tasks to complete. Tasks are listed in the Moderator's Guide in Appendix 4.

1.9 Usability Metrics

According to the *NIST Guide to the Process 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 participants 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 FDB MedsTracker, v8 by measuring participant success rates and errors
2. Efficiency of FDB MedsTracker, v8 by measuring the average task time and path deviations
3. Satisfaction with FDB MedsTracker, v8 by measuring ease of use ratings

1.10 Data Scoring

The following table (see Table 3-2) details how tasks were scored, errors evaluated, and the time data analyzed.

Measures	Rationale and Scoring
Effectiveness: Task Success	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. The total number of successes across all participants was calculated for each task and then divided by the total number of times that task was attempted (which is the number of participants who attempted the task). Each task was only attempted once by each participant. The results are provided as a percentage. Task times were recorded for successes. Observed task times divided by the optimal time for each task is a measure of optimal efficiency. Optimal task performance time, as benchmarked by expert performance under realistic conditions, was recorded when constructing tasks. Target task times used for task times in the Moderator's Guide was defined by taking two measures of optimal performance (performed by an expert user of the system) and multiplying by a factor (1.25) that allows some time buffer because the participants are not trained to expert performance. Thus, if expert, optimal performance on a task was 20 seconds, then allotted task time performance was 20 * 1.25 = 25 seconds. This ratio was aggregated across tasks and reported with mean and variance scores. For simplicity, the target task times used for maximum task times in the Moderator's Guide was 120 seconds. The ratio of actual performance to optimal performance was reported as a mean and SD for each task.

Measures	Rationale and Scoring
Effectiveness: Task Failures	If the participant abandoned the task, did not reach the correct result, performed it incorrectly, or reached the end of the allotted time before successful completion, the task was counted as a "Failure." No task times were taken for errors. 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 were counted as errors. This was also expressed as the mean number of failed tasks per participant. On a qualitative level, an enumeration of errors and error types was collected.
Efficiency: Task Deviations	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. Optimal paths (i.e., procedural steps) were recorded in the Moderator's Guide and task deviations were recorded.
Efficiency: Task Time	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.
Satisfaction: Task Rating	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 section, the participant was asked to rate "Overall, this section was:" on a scale of 1 (Very Difficult) to 5 (Very Easy). These data are averaged across participants. Common convention is that average ratings for systems judged easy to use should be 3.3 or above. To measure participants' confidence in and likeability of FDB MedsTracker overall, the testing team administered the System Usability Scale (SUS) post-test questionnaire. Questions included, "I think I would like to use this system frequently," "I thought the system was easy to use," and "I would imagine that most people would learn to use this system very quickly." See full System Usability Score questionnaire in Appendix 5.

Table 3-2. Detail of how observed data were scored

4. RESULTS

1.1 Data Analysis and Reporting

The results of the usability test were calculated according to the methods specified in the Usability Metrics section above. No participants failed to follow session and task instructions, so no data was excluded from the analyses. No irregularities or issues affected the data collection or interpretation of the results.

The usability testing results for the EHRUT are detailed below (see Table 1-1). The results should be seen in light of the objectives and goals outlined in Section 3.2, Study Design. The data should yield actionable results that, if corrected, yield material, positive impact on user performance.

Measure	***N***	**Task Success**	**Path Deviation**	**Task Time**		**Errors**	Task Ratings (5 = Easy) Mean (SD)
Task	#	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Deviations (Observed / Optimal)	Mean (SD)	Mean (SD)
1. E-prescribe New Prescription	10	100 (0)	1.3	33.6 (14.7)	1.7	0 (0)	4.9 (0.3)
2. Change Prescription (dosage)	10	100 (0)	1.1	12.7 (4.6)	0.9	0 (0)	5 (0)
3. Cancel Prescription	10	100 (0)	1.2	16 (15.7)	1.8	0 (0)	4.7 (0.5)
4. Refill Prescription	10	100 (0)	1.0	14.1 (3.7)	1.1	0 (0)	5 (0)
5. Receive Fill Status Notification	10	100 (0)	1.4	9.2 (6.6)	1.5	0 (0)	4.8 (0.6)
6. Request and Receive Medication History Information	10	100 (0)	1.3	13.5 (8.9)	1.5	0 (0)	5 (0)

Table 4. Task Success and Satisfaction Rating Summary

1.2 E-prescribe New Prescription

This task was designed to test whether the user could create a new prescription, electronically sign and send it to the patient's preferred pharmacy. The participant was trained on two possible paths to create the prescription, but all chose the more efficient path of selecting a Favorite that had all of the prescription details pre-built for them. In addition to being the most efficient path, this path also has the advantage of reducing the likelihood of a mis-key error. The only observed deviations were when participants

started to edit the Favorite (rather than saving it as is) or the unsigned prescription, but the participants realized that they did not mean to click on those places, cancelled their actions, and proceeded on the optimal path. One participant also did not notice that the preferred pharmacy was already saved and began to search for it, but then realized it was there and proceeded down the rest of the optimal path.

This task had a **100%** success rate with a task satisfaction average of **4.9**, indicating that 9 out of 10 participants thought the task was "Very Easy" to perform (one assessed it as "Easy").

1.3 Change Prescription (dosage)

This task was designed to test changing of a prescription dose. The users were trained to choose the prescription that reflected the dose required in the patient scenario and then sign the prescription. This task had a **100%** success rate with an ease satisfaction average of **5**, indicating that all participants judged this task as "Very Easy." The only deviations occurred when two participants unnecessarily clicked on the "Make Changes" button after they had already selected the correct changed prescription. While this did not cause them to make an error, it added an extra step, reducing efficiency. Regardless, this was the second shortest task on average.

Overall, participants liked this workflow, and one participant suggested that knowing why the dose was being changed would be useful.

1.4 Cancel Prescription

The cancel prescription task was predicted to be the easiest and most straightforward of all the tasks because there is only one true step required of the user (clicking the trash can button). The two additional steps in the Optimal path are simply clicking "OK" to dismiss two confirmation messages that occurred in succession. The task had a **100%** success rate and a task satisfaction average of **4.7**.

One participant deviated when she could not locate the trash can button (it was located further down on her screen when she was asked to begin the task) and navigated to two other pages to look for it. She stated that she knew she was looking for the trash can but wasn't sure where it was. The other interesting observation of this task is that two participants did not think deleting the prescription from the list would necessarily be equivalent to cancelling the prescription at the pharmacy. They stated that the concepts

weren't necessarily clearly linked and think a clearer indicator of the cancellation result would be useful in the UI.

1.5 Refill Prescription

This task was designed to test the approval of a prescription refill as requested by the patient's pharmacist. This task had a **100%** success rate with a task satisfaction average of **5** (Very Easy). This task had no deviations at all. All users efficiently performed it following the optimal path, including users who typically do not perform this particular workflow in their current professional roles.

1.6 Receive Fill Status Notification

This task was designed to test whether users could find and understand the Rx Fill notification sent from the pharmacy about the fill status of a prescription. This task had a 100% success rate with a task satisfaction average of **4.8** (one participant rated it a 3, Neutral, and the rest rated it 5). The first deviation on this task was when a participant couldn't remember where the button was located and navigated to a different page to look for it. The only other deviation was when a participant accidentally clicked on a different button, but they stated that it was an accident and they knew that wasn't the correct button to choose.

Several participants commented that they thought this notification would be helpful in their workflow and weren't aware of the potential for pharmacies to send it before their session.

1.7 Request and Receive Medication History Information

This task tested the retrieval of medication history data for a patient. In the EHRUT, there is only one button to push, as all of the requirements are managed for the user, so it has been designed to be as efficient as possible. The results of this study agree because this task had a **100%** success rate and task satisfaction average of **5**. This task had no deviations at all either.

5. DISCUSSION OF THE FINDINGS

1.1 Effectiveness

Overall, the task success rate of 100% for all six tasks indicates that the participants were highly effective with minimal training. None of the participants experienced outright errors, but a few experienced minor deviations as described in the next section.

1.2 Efficiency

There were a low number of deviations across all tasks, indicating that the design did a good job of keeping users on the correct path and making them efficient. Even when they deviated, they were able to quickly self-correct and return to the optimal path. Notably, two of the participants who had never used the system before made no deviations in any of their tasks.

The most common path deviations were when the participants took extra steps to complete the task because they didn't know where a button was placed (and went elsewhere to look for it) or by simple accident clicked where they shouldn't have. In the case of not knowing where to look, the participants were able to quickly review the other places and conclude that they were not in the correct place, rather than giving up or proceeding down an erroneous path. So, in all cases, the participants took a valid alternate, but less efficient path instead of the optimal path, and they still successfully completed the task (despite the deviations).

One other deviation that happened twice was when users chose a button that appeared after their previous action, which made it seem to be required but wasn't. This occurred during the Change Prescription task. We speculate that the wording of the button could be changed to make it clearer when it needs to be used. The styling of the button is also different than the signing button, potentially making it more prominent than it could be if it was designed to look like the other buttons.

The other measure of efficiency is task time. When we measure the mean task times for participants who did not deviate from the Optimal paths, they are very close to the Optimal task time (as performed by an expert user of the EHURT). Because several of the deviations were when the users navigated to a different page, they significantly increased the task times.

1.3 Satisfaction

As can be seen below in Table 4-8, the majority of participants rated the tasks as either 5 (Very Easy) or 4 (Somewhat Easy).

Task	Number of Ratings				
	Very Difficult or Somewhat Difficult	Neither Difficult nor Easy	Somewhat Easy	Very Easy	Total
1. E-prescribe New Prescription	0	0	1	9	10
2. Change Prescription (dosage)	0	0	0	10	10
3. Cancel Prescription	0	0	3	7	10
4. Refill Prescription	0	0	0	10	10
5. Receive Fill Status Notification	0	1	0	9	10
6. Request and Receive Medication History Information	0	0	0	10	10
Totals	**0**	**1**	**4**	**55**	**60**

Table 5. Satisfaction rating breakdown by section

Participant opinions were captured at the end of the study during the open-ended question and answer time. The following excerpts represent several key comments that we want to highlight.

Question 1: What was your overall impression of this system?

1. I found that it was very easy to use. It seems really organized, and it's easy to read, and easy to understand.
2. This is great. This is very easy to use, very intuitive. I read through the sheet that you sent me and you going over it a few minutes at the beginning and it's very easy to use. Just from that, I feel like I could jump right in and use it every day without any problems.
3. Very straightforward. It's just very clean, very simple and I think straightforward is the most accurate description because things were where you expected them to be.

Summary: These and other comments (not shown) reflect the high success rate experienced by the participants in their tasks. Overall, most participants were very satisfied with the ease-of-use of the EHRUT.

Question 2: What did you like most about this system?

1. I think the way this system steps you through things when you're conducting a task makes a lot of sense. So, I think that's what I like the most about it, which is

always what I've liked the most about it, because it's a system that engages the user, not just throws things on a screen. … I'd put this in one of the things I liked the most, was in your change request, you gave me two options and *then* things changed depending on which option I chose. So, it was very clear, I just need this one or that one. If I pick the second one, then it's going to ask me to do things, but if I pick the first, it's going to ask me to do things, but that isn't cluttering my decision making up front. So, it very very clear requests specifically, so I liked that a lot.

2. I like your RxLogs. Because normally… I've worked with different computer systems and I've not seen them, a log come back from a pharmacy. And I like your Prescription History and this [RxFill] note. I think that's very helpful.
3. One thing I did like is where you use color or not. Specific buttons or specific things you would want to click on to move faster are highlighted so your eyes naturally slide to them anyway, which is a very simple thing, but when you're moving fast in a very busy day, little things can matter.

Summary: These comments highlight several features in the application that were specifically designed to make the user interface efficient and effective. They correlate with the overall section ratings documented in earlier sections of this report.

Question 3: What did you like least about this system?

1. The only thing I kinda questioned was the trash can. Because it says when you hover over it, it says Delete Prescription, but it's also a Cancel prescription, so I don't know if that's a little confusing to people or not. Although if I click on it and it wasn't sent to a pharmacy, it's probably just going to delete it. If was sent to a pharmacy, it's going to ask me if I cancelled. So again, the system is likely to step me through whatever that trash can means. Which makes sense that you're going to get rid of it, but I could see someone saying "I want to cancel it, I don't want to delete it" because I don't want to delete it because I just need to send it to a different pharmacy. So that would be one negative, so to speak.
2. There were a couple of areas where, although it was easy to use, it wasn't necessarily clear from end to end. In particular, cancelling a prescription because it sort of looks like you're deleting it just from your list. And then it's not until you get the confirmation message, which is helpful, that it's clear that you're cancelling it to the pharmacy and not just deleting it within MedsTracker. But overall, I thought it was very easy to use.

Summary: As noted in our earlier discussion, these comments indicate an opportunity to enhance the Cancel Prescription button.

Question 4: What features were you surprised to see in this system?

1. Yes, I was surprised that you can see … the status of the prescription being filled. (RxFill notification).
2. The little emblem, where I saw care with liver. That I thought was interesting. Where it says "Adjustments" that was surprising because I don't normally see that kind of adjustment. That I did like, and it was surprising, and I thought it was a very nice touch.

Summary: Multiple participants were surprised by the RxFill Notification feature and noted that it would help to have that information in their workflow.

Question 5: Was there anything that you think was missing in this system?

1. No, I can't think of anything. I've always liked MedsTracker software but this part of the outpatient prescribing, I wasn't that familiar with, but it had more features than I was expecting. So, there wasn't anything that I thought was missing at all.
2. The one thing I didn't see was when you cancel it, you just cancel it. There's no reason for cancelling. … So, I don't know if that's an option, much like when you change something, there's a list that says why you're changing it. Because it's sometimes nice to communicate to the pharmacy, hey I'm cancelling this because I'm really sending it to retail or mail order, or this was sent by accident. Or please don't fill this prescription.

Summary: While the majority of participants responded that nothing was missing, the comment about being able to enter a reason for cancelling a prescription is a good one and may provide an opportunity to design this into the system.

Question 6: Can you briefly compare this system to other similar ones you've used before?

1. I've used Epic and I think that this is a lot easier to use than that. This seems much more clear. This seems really simple compared to that.
2. I liked it better than what I was just using at the hospital, which would be Cerner.

3. This is more streamlined. The other ones I've used are… they can be kinda overwhelming. A lot of different choices as far as decision making on medications. This is a lot more streamlined.
4. This blows away the others I've seen and that I've used. The ease of finding medications, this was easier. We didn't go on to looking for pharmacies, but I'm sure this would be easier as well. Cancelling a prescription, this is much easier than the other ones I saw. All around, a better product. Others that I saw are just clunky, a lot more clicks, so this is a lot more streamlined, a lot easier to use all around. A lot better product.

Summary: These comments favorably compared the EHRUT to the EHR system the participants usually use in their current or former positions.

Question 7: Would you recommend this system to your colleagues?

1. Absolutely. [1]
2. Absolutely. It's just a really straightforward and effective system.
3. Yeah, it seems like this is geared more towards clinic outpatient work, but yeah, it's got all the benefits I mentioned before. It can give you a lot of information in one spot. Being able to pull in prescriptions from other pharmacies, other areas, other people. Yeah, overall, I would definitely recommend it. It was pretty efficient.

Notes:

[1] Multiple participants gave this response with no additional comments.

1.4 Major Findings

Overall, this study tested all of the core prescribing and medication-related functions that clinician (prescriber and non-prescriber) end-users typically use in a primary care clinic setting – sending prescriptions, refilling prescriptions, changing prescriptions, and managing prescription history information. Participants successfully completed all tasks in a timely manner and did not deviate from the optimal path in a significant fashion. The consistent comments across all types of participants indicate that the system is straightforward and pleasing to use. The extremely high average SUS score also indicates that participants find the system highly usable. The usability rating confirms that our process of system design and development led directly by a physician with input from many other clinicians (spanning multiple roles) has generally been successful.

With minimal verbal training, the participants completed the tasks with a failure rate of zero. Deviations off the optimal path were minor and infrequent. Four of the ten participants had never seen or used the EHRUT before this study, which means it is not just seasoned users of the system who find it easy to use.

1.5 Risk Analysis

The table below summarizes the risk potential of each of the tasks relative to each other along with the observed participant deviations. There are several features in the system that are designed to help avoid these risks and we speculate that these features were used by the participants during their tasks, resulting in no errors and just minor deviations.

E-prescribe New Prescription

- All users used the pre-built "Favorite" prescription, rather than manually entering all of the details from scratch. They thereby avoided transcription errors.
- A red label distinguishes unsigned prescriptions from ones that have already been sent to the pharmacy, helping to ensure that users do not forget the final act of signing the prescription (after creating it and saving it to the pending list).
- The preferred pharmacy does not have to be entered every time the prescriptions are being sent, which helps increase efficiency and lessen the chance that users will select the wrong pharmacy.

Change Prescription

- All users chose the correct changed dose. We think this is because the design of the UI makes it clear which is the original prescription and which is the changed prescription, and the users can inspect both side-by-side.
- The prescription remains in the queue until signed, making it clear that they need to sign in order to complete the process.

Cancel Prescription

- The deletion of a prescription that is no longer desired, along with the cancellation message to the pharmacy are tied together. It's possible that a new user would not understand this, but they would call the pharmacy instead, making this a low risk feature.

Refill Prescription

- Just as in the Change Prescription workflow, the UI presents the appropriate "next step" after the user begins down their chosen path (in this study, approval of a refill). This helps ensure they are not distracted by extraneous choices on the screen.

Receive Fill Status Notification

- This new notification, while being praised by participants as highly useful, is low risk because it does not interfere with or deleteriously impact other functions if not utilized.

Request and Receive Medication History Information

- This is similar to the Fill Status Notification in terms of risk. If not utilized, the provider may not have knowledge of some medications, but the information is not

intended to be a substitute for other processes that gather and track the patient's medication history.

Task	Description	Risk Status	Risk Potential	Deviations Observed
E-prescribe New Prescription	Create and send a new prescription to the patient's preferred pharmacy	High	- User does not enter the correct information. - User does not sign the prescription (and the prescription is not sent to the pharmacy). - User does not send the prescription to the *preferred* pharmacy.	Minor - User searched for the pharmacy, but it was already shown as the destination.
Change Prescription (dosage)	Change the dosage for a previous prescription (increase the dose)	High	- User does not understand the change being made and chooses the wrong option. - User does not sign the prescription (and the prescription is not sent to the pharmacy).	Trivial - Two users clicked a button that did not impact the workflow.
Cancel Prescription	Cancel the prescription so that the pharmacy does not give it to the patient and concurrently remove the prescription from the patient's list	Low	- User does not understand that the prescription is cancelled at the pharmacy (not just deleted on the list).	Trivial - One user could not find the button.
Refill Prescription	Renew a previous prescription (as requested by the pharmacy)	High	- User does not understand the request being made and chooses the wrong option (Approve vs Deny). - User does not enter the correct information. - User does not sign the prescription (and the prescription is not sent to the pharmacy).	None
Receive Fill Status Notification	View the notification sent by the pharmacy of how much of the prescription was filled	Low	- User does not see the notification.	Trivial - One user could not find the button. One user clicked on an unrelated button in addition to the correct button.

Task	Description	Risk Status	Risk Potential	Deviations Observed
Request and Receive Medication History Information	Retrieve the patient's prescription history	Low	- User does not see or utilize the available information.	None

1.6 Areas for Improvement

In general, the participants were satisfied with the system design and the ease of use, but a few recurring comments pointed to improvements that should be considered to increase usability.

In the Cancel Prescription workflow, the users wanted a clearer indicator at the start that deleting a prescription would also cancel it with the pharmacy. To some, these may be separate concepts, so indicating that they are linked in this system (for example, with a tooltip) would help.

Although the Change Prescription workflow is well designed, two participants clicked on a button that was unnecessary. While it did not interfere with their success, it added an extra click. This button may need to be positioned in a different area or styled differently or both to make it clearer when it should be used.

One participant suggested that seeing a reason why the pharmacy was requesting a change to the prescription would help them decide whether to approve the change or not. It's not clear if the pharmacy can send a reason in their message, but if supported, it would be helpful to add it to the user interface.

6. APPENDICES

The following appendices include supplemental data for this usability test report. Following is a list of the appendices provided:

1. Screening Questionnaire
2. Non-Disclosure Agreement (NDA) and Informed Consent Form
3. Moderator's Guide
4. System Usability Scale Questionnaire
5. Incentive Receipt and Acknowledgement.

1.1 Appendix 1: Screening Questionnaire

1. Email address
2. Name
3. Phone Number
4. Gender: Female, Male, Prefer not to say
5. Age: 20-20; 30-39; 40-49; 50-59; 60-69; 70-79; 80-89
6. Education Level: No high school degree; High school graduate, diploma, or the equivalent (for example: GED); Some college credit, no degree; Trade/technical/vocational training; Associate degree; Bachelor; Master's degree; Doctorate degree (e.g. MD, DNP, DMD, PhD)
7. Occupation?
8. Professional Experience
9. Experience using a computer
10. Experience using FDB MedsTracker
11. Do you have any assistive technology needs?
12. Please confirm you acknowledge this study requires access to a laptop or desktop computer and GoToMeeting.

1.2 Appendix 2: Non-Disclosure Agreement and Informed Consent

Non-Disclosure Agreement

THIS AGREEMENT is entered into as of _____ (date), *2018*, between _____ ("the Participant") and the testing organization First Databank located at 701 Gateway Boulevard, Suite 600, South San Francisco, CA 98040.

The Participant acknowledges his or her voluntary participation in today's usability study may bring the Participant into possession of Confidential Information. The term "Confidential Information" means all technical and commercial information of a proprietary or confidential nature which is disclosed by First Databank, or otherwise acquired by the Participant, in the course of today's study.

By way of illustration, but not limitation, Confidential Information includes trade secrets, processes, formulae, data, know-how, products, designs, drawings, computer aided design files and other computer files, computer software, ideas, improvements, inventions, training methods and materials, marketing techniques, plans, strategies, budgets, financial information, or forecasts.

Any information the Participant acquires relating to this product during this study is confidential and proprietary to First Databank and is being disclosed solely for the purposes of the Participant's participation in today's usability study. By signing this form, the Participant acknowledges that s/he will receive monetary compensation for feedback and will not disclose this confidential information obtained today to anyone else or any other organizations.

Signature: _____

Date: _____

Informed Consent

First Databank would like to thank you for participating in this study. The purpose of this study is to evaluate an electronic health record 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 45 minutes. At the conclusion of the test, you will be compensated for your time.

Agreement

I understand and agree that as a voluntary participant in the present study conducted by First Databank. I am free to withdraw consent or discontinue participation at any time. I understand and agree to participate in the study conducted and my activities and voice will be recorded by First Databank.

I understand and consent to the use and release of the recordings by First Databank. I understand that the information and recordings is for research purposes only and that my name and image will not be used for any purpose other than research. I relinquish any rights to the recording and understand the recording may be copied and used by First Databank 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 with outside of First Databank and First Databank's client. 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 leave 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: _____

1.3 Appendix 3: Moderator's Guide

See Supplemental document.

1.4 Appendix 5: System Usability Scale Questionnaire

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

1.5 Appendix 6: Incentive Receipt and Acknowledgment Form

Acknowledgement of Receipt

I hereby acknowledge receipt of $100 Amazon Gift card for my participation in a research study run by First Databank.

Signature (type your name):
Date:_____