EHR USABILITY REPORT

for eMDs Plus 4.0

October 2018

This document is a usability report for eMDs product **Plus** as part of 2015 Certification Safety Enhanced Design requirement.

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Testing Locations: Dedicated website
In-person, eMDs home office (7800 Shoal Creek, Austin, TX 78757)

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1) Executive Summary

A usability study was conducted on eMDs Plus version 4.0.

Plus is an eMDs web-based product that has been on the market for over 2 years. It has a feature set that lends itself toward many small to mid-sized offices throughout the country.

The primary purpose of this study was to evaluate the usability of a subset of features for Plus 4.0, specifically related to creating orders, prescribing medications, clinical decision support tools, updating the health summary, and the reconciliation of medical information with what is already contained within the EHR.

The study was a web-based study. Participants included individuals employed in a medical role or software role. All participants had no familiarity with the Plus product. When participants agreed to join the study, they received login credentials to a dedicated test website. The survey administrator supervised the completion of the tasks, and documented the time on task and number of incorrect clicks. Following each task, the administrator asked the Single Ease of Use Question (SEQ). Following completion of all tasks, demographics data was obtained, and the participants were debriefed on the study. In total 10 participants completed the study. For each task participants were shown mock ups or screen shots of Plus and then asked to complete a specific task (e.g., click the icon you would use to prescribe a new medication). There were twelve tasks (scenarios) were included in this study, encompassing common clinical workflows including:

- Computerized provider order entry
- Prescribing medications
    - Prescribing workflows including the new messages types of RxCancel, RxChange and RxFill
- Provider clinical decision support
- Health summary reconciliation
- Updating demographics
- Updating implantable device lists

After analyzing the data from the study the following conclusions were drawn:

- Providers moved through the product with ease in most scenarios. A few exceptions were the clinical rules engine configuration, the clinical reconciliation module, and the medication history screens.
- Participants rated Plus with above average usability.
- The live application, versus the screenshots used in the study, provides more context that may have cued participants as to the functionality of the screen in question.
- All participants were able to successfully complete all tasks, even users without medical training or experience.

This study shows that the User Centered Design approach employed by eMDs has established a meaningful interface and workflow for a variety of users and roles within a medical or technology setting. The investments eMDs has made in usability consultants and professionals with extensive training has guided this product to a user interface that is well liked and understandable with few areas of confusion.

2) User Centered Design at eMDs

The User Centered Design (UCD) process can help software designers fulfill the goal of a product engineered for their users. User requirements are considered right from the beginning and included into the whole product development cycle. In addition, user requirements can be inferred by careful analysis of usable products similar to the product being designed.

The ISO standard 9241-210 (Human-centered design for interactive systems) describes six key principles that will ensure a design approach is user-centered. As a company, we meet these six UCD principles as indicated in the discussion below each principal.

Principal One – The Design is based upon an Explicit Understanding of Users, Tasks and Environments

eMDs was founded by a physician, and has multiple physicians at the management and executive level. From the beginning, the company has solicited feedback from clinicians that have an understanding of the diverse needs of users in many different environments and specialties. These clinical users consist of physicians, nurses, medical assistants, pharmacists and others within a typical medical office. Usability specialists within eMDs are able to translate the needs expressed by these users into usable features that are included with the applications.

Principal Two – Users Are Involved Throughout Design and Development

Along with eMDs employees that have worked in medical positions, we have a "champions" and beta testing program that includes several of our customers. Individuals in the champions group consist of a diverse group of providers from different specialties. The champions participate regularly in sessions to review new and future functionality and provide important feedback on workflow and usability issues. The champions have access to a "sandbox" environment that allows them to have personal interaction with new features and functionality in order to allow them to provide feedback. Our beta testing customers receive releases 4 weeks prior to general availability in order to provide additional feedback. Dr. Eric Weidmann, M.D. is the Chief Medical Officer of eMDs, and joined the company as a long-time user and beta tester of the Solution Series program. He is highly involved in the design process of our products, including Solution Series 9.0.

In addition to the champions and beta group we have a web-based user forum that offers a mechanism for users to provide feedback on current functionality. Based on the feedback received from the forum we evaluate the to-be added features and make adjustments.

Principal Three – The Design is Driven and Refined by User-centered Evaluation

The previous two points apply here, as the internal employees, current users, and champions' input all provide feedback on current and proposed future designs.

Principal Four – The Process is Iterative

We use an Agile methodology with four week sprints that by definition provide an iterative environment (e.g., feedback received during an in-sprint demo can be accommodated immediately). In addition to the iteration with internal clinicians and usability experts we also have an iterative process with the external customers that provide feedback on usability (e.g., the aforementioned beta program).

Principal Five – The Design Addresses the Whole User Experience

The implemented design has been created with consideration of all users (from front desk receptionists or schedulers, to doctors and nurses that provide care, to the billing staff that manages the claims and payments). The workflow for each of these types of roles starts from the login screen to detailed workflows within the application. Before any new features are coded the proposed designs are oftentimes reviewed by the internal medical professionals or presented to the champions group for feedback.

Principal Six – The Design Team Includes Multidisciplinary Skills and Perspectives

Our teams have members that range from the medical professionals mentioned above, to business analysts trained specifically for software, to usability specialists.

3) Introduction

This study was conducted as part of the 2015 ONC requirements. The product being tested focuses on eMDs Plus version 4.0**,** a product designed for providers of ambulatory healthcare in various specialties. The primary goals of the study included the evaluation of the product's features for creating orders (CPOE), prescribing medications, clinical decision support, updating health summary information, and reconciling external health summary data with the current EHR data.

Plus is the most modern and technologically advanced product offering from eMDs. In a typical office, users of Plus can include the entire range of healthcare workers – from the providers giving care to patients, to the supporting clinical staff, to the billing staff that generates the invoices and records payments.

The participants recruited to be part of this study align with the existing Plus users. Specifically, the following shows how many of each user type participated in the studies.

Providers	2
Clinical Staff	3
Other*	5

** The "other" category is comprised of individuals that are not explicitly labeled as medical professionals. These individuals were asked to participate in the study as a baseline comparison group. If a non-medical user could finish a given task then it can be assumed that the interface needed to complete the task was sufficiently self-revealing to indicate its expected use.*

Note that we did not include billing users as part of these studies since the tasks being evaluated were of a clinical, and not billing, nature.

We used a dedicated website to evaluate twelve test scenarios. The time-on-task for each scenario was recorded, along with the response to questions asked at the end of each task.

4) Method

4.1.1) Participants

A total of 10 participants were tested in this study. All of the individuals had no familiarity with the eMDs **Plus** product. They break down into the following number of participants per group.

- Providers: 2 participants

  Providers include individuals who provide direct care to patients, such as doctors, medical assistants, and physician assistants

- Clinical Staff: 3 participant

  This group includes individuals who work in an office, but are not necessarily involved with the direct (medical) care of the patient; individuals in this group identify themselves as receptionists, schedulers, or administrators

- Other: 5 participants

  As part of a "control" group individuals with no medical knowledge were recruited; the rationale is that if these persons could successfully complete a scenario, then the feature being tested provided sufficient self-disclosure of functionality to complete the task without additional instruction or knowledge

All of the study individuals were recruited with leads from colleagues.

4.1.2) Study Design

The study aimed to determine the effectiveness, efficiency, usability, and satisfaction within the Plus 4.0 application. The test was conducted via the web by presenting participants with twelve scenarios. Testing occurred from March 1, 2018 to September 28, 2018.

The study took between 20-30 minutes to complete. The first page viewed after login was an introductory page with instructions. The remaining 25 pages were the test scenarios followed by the Single Ease of Use Question (SEQ) usability rating for each task performed. The slides were followed by obtaining demographic data and overall usability ratings. For each task the participants' times were recorded. The mean time to complete task and the mean number of incorrect clicks per task was calculated, along with standard deviation for each task.

4.1.3) Tasks

There were a total of twelve tasks in this study. The tasks were selected based on the high likelihood of a user performing these tasks in the software. The tasks also correspond to the certification criteria of the program, including CPOE, drug-drug/drug-allergy interaction checks, demographics, problem list, medication list, medication allergy list, clinical decision support, implantable device list, clinical information reconciliation and incorporation, and electronic prescribing.

4.1.3.1) Tasks I –III - Computerized Provider Order Entry (CPOE) – Medications, Laboratory, Diagnostic Imaging

The participant was asked to add a new medication order to the patient's chart. Next, the participant was asked to add a laboratory order to a patient diagnosed with Type II diabetes. Next, the participant was asked to add a diagnostic imaging order a patient diagnosed with multiple open bone fractures.

4.1.3.2) Task IV – Drug-Drug, Drug-Allergy Interaction Check

In this task the participant was asked to view the drug-drug or drug-allergy interaction check notifications for a patient prescribed Amiodarone, Celebrex, and Penicillin.

4.1.3.3) Task V – Demographics

In this scenario the participant was asked to update the patient's demographic information.

4.1.3.4) Task VI – Problem List

In this scenario participant was asked to add a diagnosis to the patient's problem list.

4.1.3.5) Task VII– Medication List

In this scenario participant was asked to add a medication to the patient's medication record.

4.1.3.6) Task VIII – Medication Allergy List

In this scenario participant was taken to the Add Allergy window, and asked to document that the patient is allergic to penicillin.

4.1.3.7) Task IX– Clinical Decision Support

In this scenario, participant observes the patient's clinical reminders as displayed in the chart. They are asked to order the recommended annual depression screening.

4.1.3.8) Task X – Implantable Device List

In this scenario participant was asked to add a new implantable device to the patient's record.

4.1.3.9) Task XI – Clinical information reconciliation and incorporation

In this scenario participant was shown the clinical reconciliation window, and asked to display the medication history as captured from insurance benefits.

4.1.3.10) Task XII – Electronic Prescribing

In this scenario participant was asked to prescribe a new medication from the Health Summary window. They then were asked to complete the workflow for the new ePrescribing features of RxCancel, RxChange and RxFill. The Medication History process was also part of this task.

4.1.3.11) Risk Assessment of Tasks

Here is a risk summary of the above tasks. Following each task is an estimate of the patient-risk associated with the task.

Tasks I-III CPOE

- Create / Change / Review orders
  - **Medium Risk** – The creation, review, and changing of orders is a medium risk.
- Prescribe / Change medications
  - **Medium Risk** – Prescribing medications can always be risky, but the consequences of prescribing medications are related to the later tasks (i.e., reviewing medication and allergy list; seeing any possible interaction warnings).

Task IV – Drug-Drug/Drug-Allergy Interaction Check

- Review potential allergy / medication interactions
  - **Very High Risk** – While reviewing the current medication and allergy lists is a must in the prescription workflow, the consequence for missing a warning related to potential interactions could range from an irritating adverse reaction to a life-threatening interaction.

Task V – Demographics

- Update patient demographics
  - **Medium Risk** – Ensuring accurate demographic information is necessary to convey test results or other patient healthcare reminders.

Task VI – Problem List

- Update patient problem list
  - **High Risk –** Providers need to keep patient problem lists updated to be aware of any condition's contraindication with medications.

Task VII – Medication List

- Update patient medication list
  - **High Risk –** Providers need to keep patient medication lists updated to be aware of any contraindication with medications, procedures, or conditions.

Task VIII – Medication Allergy List

- Update patient medication allergy
  - **Very High Risk –** The consequence for incorrectly prescribing a medication the patient is allergic to can be life-threatening

Task IX-- Clinical Decision Support

- Order suggested depression screening as recommended by Clinical Decision Support rule
  - **Low Risk** – Missing a recommended order or medication could result in a reduced patient care experience.

Task X – Implantable Devices

- Update implantable device list
  - **Medium Risk –** Providers need to be aware of implantable devices patient has in the event of a recall or other malfunction.

Task XI – Health Summary Reconciliation

- Review the imported CCD against the patient's current problems, allergies, and medications
  - **High Risk** – This is similar to importing the CCD. If the data cannot be imported, reviewed, and reconciled, there is a patient risk.

Task XII—Electronic Prescribing

- Prescribe a new medication from the Health Summary window

- **High Risk –** This is one of the many windows to prescribe a medication. The provider will now be aware of other icons' meanings (drug-drug, drug-allergy interactions) based on earlier assigned tasks.

4.1.4) Procedures

Participants logged into a Learning Module System (eMDs Engage) to complete the usability tasks. The survey administrator was an eMDs employee who sat with the participant to time the amount of time spent on each task, record feedback on usability, and record demographic information. Administrators were not permitted to give instructions on the tasks.

4.1.5) Test Location and Environment

By conducting this study via the web the test location was unique for each participant. There were no restrictions on internet browser or operating system.

4.1.6) Test Form and Tools

See Tasks, (p. 9) for details of the tasks tested in this study. See Appendix (p. 21) for details on demographic data obtained.

4.1.7) Participant Instructions

See the Appendix (p. 24) for details of the instructions in this study.

4.1.8) Usability Metrics

The primary metrics collected in this study were time on task, incorrect attempts, and questions asked after each task (e.g. how usable is this feature). Participants were encouraged to use unlimited attempts at completing the task; however, they did have the option to skip the task (which would have been recorded as failing the task). No participants chose to skip or fail any tasks.

The goal of this study was to determine:

1. The effectiveness of the program by measuring the participant's success rate and incorrect attempts.
2. The efficiency of the program by measuring the average time to complete the task as well as deviations.
3. The satisfaction with the program by measuring ease of use ratings.

4.1.9) Data Scoring

Measure	**Rationale and Scoring**
Effectiveness	A task was counted as a failure if the participant chose to abandon the task. The number of incorrect clicks was calculated, and the mean value for each task, along with standard deviation was determined.
Efficiency	The amount of time to complete each task was measured in seconds. Qualitative data in the form of verbalized comments about the program was also recorded.
Satisfaction	The single ease of use question (SEQ) was asked after each task, with the participant advised to rate the usability of each task on a scale of 1-5. Qualitative data in the form of verbalized comments about the program was also recorded.

5) Results

5.1) Study I

5.1.1.1) Mean Time on Task in Seconds, n=10

Task	Time on Task	Standard Deviation
Task a1.1 Computerized Provider Order Entry (medication)	8	5
Task a1.2 - Change medication via CPOE	26	5
Task a1.3 - Display changed CPOE medication order	2	1
Task a2.1 Computerized Provider Order Entry (laboratory)	13	4
Task a2.2 - Change lab order via CPOE	14	3
Task a2.3 - Display changed CPOE lab order	2	1
Task a3.1 Computerized Provider Order Entry (diagnostic imaging)	9	5
Task a3.2 - Change imaging order via CPOE	10	4
Task a3.3 - Display changed CPOE imaging order	2	1
Task a4.1 Drug/Drug, Drug/Allergy Interaction check	7	4
Task a4.2 - Trigger drug-allergy interaction by entering new medication order via CPOE	4	3
Task a4.3 - Adjust severity level of displayed drug-drug interaction	5	6
Task a5.1 Record patient's preferred language, date of birth, birth sex, race, ethnicity, sexual orientation, gender identity	18	6
Task a5.2 - Change patient demographic information	11	4
Task a5.3 - Display patient's changed preferred language, date of birth, birth sex, race, ethnicity, sexual orientation, gender identity	4	2
Task a6.1 Record a diagnosis to patient problem list	8	3
Task a6.2 - Change a problem on the problem list	11	3

Task a6.3 - Display active problem list	2	1
Task a6.4 - Display historical problem list	3	1
Task a7.1 Record a medication to the medication list	8	5
Task a7.2 - Change a medication on the medication list	10	4
Task a7.3 - Display the active medication list	3	2
Task a7.4 - Display the historical medication list	4	3
Task a8.1 Record a medication allergy	7	6
Task a8.2 - Change a medication allergy	11	4
Task a8.3 - Display active medication allergy list	3	2
Task a8.4 - Display historical medication list	4	1
Task a9.1 Add a CDS intervention for problem list	40	4
Task a9.2 - Add a CDS intervention for medication list	33	4
Task a9.3 - Add a CDS intervention for medication allergy list	42	5
Task a9.4 - Add a CDS intervention for at least one demographic	38	5
Task a9.5 - Add a CDS intervention for laboratory test	41	4
Task a9.6 - Add a CDS intervention for vital signs	56	6
Task a9.7 - Add a CDS intervention for a combination of 2 of the elements above (medication list + demographic)	75	5
Task a9.8 - Trigger the CDS intervention for problem list	11	3
Task a9.9 - Trigger the CDS intervention for medication list	10	3
Task a9.10 - Trigger the CDS intervention for medication allergy list	9	3
Task a9.11 - Trigger the CDS intervention for at least one demographic	7	3
Task a9.12 - Trigger the CDS intervention for laboratory test	11	5

Task a9.13 - Trigger the CDS intervention for vital signs	6	4
Task a9.14 - Trigger the CDS intervention for a combination of 2 of the elements above (medication list + demographic)	23	7
Task a9.15 - View the intervention information using the Infobutton standard for data elements in the problem list	5	2
Task a9.16 - View the intervention information using the Infobutton standard for data elements in the medication list	4	3
Task a9.17 - View the intervention information using the Infobutton standard for data elements in the demographics	3	2
Task a9.18 - Trigger the CDS intervention information using the Infobutton standard for data elements in the problem list by incorporating patient information from a TOC	11	4
Task a9.19 - Trigger the CDS intervention information using the Infobutton standard for data elements in the medication list by incorporating patient information from a TOC	13	5
Task a9.20 - Trigger the CDS intervention information using the Infobutton standard for data elements in the medication allergy list by incorporating patient information from a TOC	14	5
Task a9.21 - Access the bibliographic citation, developer, funding source, release/revision date for a triggered CDS intervention for problem list	4	5
Task a14.1 - Implantable Device List - Record UDI	10	3
Task a14.2 - Change UDI Status	4	4
Task a14.3 - Access UDI, device description, identifiers, and attributes	4	2
Task b2.1 - Clinical Reconciliation - Incorporate CCDA and conduct reconciliation of medications, medication allergies, and problems with the information currently in patient's record	14	6
Task b2.2 - Generate a new CCDA with reconciled information	35	6
Task b2.3 – Display Medication History	12	4
Task b3.1 - Electronic Prescribing - Create a new prescription	9	3
Task b3.2 - Change prescription (dose or duration)	11	3

Task b3.3 - Cancel prescription	5	5
Task b3.4 - Refill prescription	7	4
Task b3.5 - Receive fill status notification	15	6
Task b3.6 - Request and receive medication history information	16	7

Mean Time on Task (Seconds)	13.45
Standard Deviation	3.82

5.1.1.2) Mean Usability ratings per task, n=10

Task	Usability Rating	Standard Deviation
Task a1.1 Computerized Provider Order Entry (medication)	4.1	0.21
Task a1.2 - Change medication via CPOE	3.8	0.48
Task a1.3 - Display changed CPOE medication order	4.7	0.35
Task a2.1 Computerized Provider Order Entry (laboratory)	4.4	0.73
Task a2.2 - Change lab order via CPOE	4.1	1.40
Task a2.3 - Display changed CPOE lab order	4.5	0.42
Task a3.1 Computerized Provider Order Entry (diagnostic imaging)	3.3	0.67
Task a3.2 - Change imaging order via CPOE	4.0	1.4
Task a3.3 - Display changed CPOE imaging order	4.3	0.50
Task a4.1 Drug/Drug, Drug/Allergy Interaction check	4.0	1.38
Task a4.2 - Trigger drug-allergy interaction by entering new medication order via CPOE	3.1	0.74
Task a4.3 - Adjust severity level of displayed drug-drug interaction	2.9	0.65
Task a5.1 Record patient's preferred language, date of birth, birth sex, race, ethnicity, sexual orientation, gender identity	3.3	1.24

Task a5.2 - Change patient demographic information	4.1	1.02
Task a5.3 - Display patient's changed preferred language, date of birth, birth sex, race, ethnicity, sexual orientation, gender identity	3.8	0.37
Task a6.1 Record a diagnosis to patient problem list	4.7	0.41
Task a6.2 - Change a problem on the problem list	4.0	0.64
Task a6.3 - Display active problem list	4.4	0.46
Task a6.4 - Display historical problem list	4.2	0.33
Task a7.1 Record a medication to the medication list	4.5	0.34
Task a7.2 - Change a medication on the medication list	4.6	0.53
Task a7.3 - Display the active medication list	4.6	0.43
Task a7.4 - Display the historical medication list	4.8	0.68
Task a8.1 Record a medication allergy	4.6	0.54
Task a8.2 - Change a medication allergy	4.7	0.23
Task a8.3 - Display active medication allergy list	4.5	0.48
Task a8.4 - Display historical medication list	4.3	0.33
Task a9.1 Add a CDS intervention for problem list	3.1	1.53
Task a9.2 - Add a CDS intervention for medication list	3.3	1.39
Task a9.3 - Add a CDS intervention for medication allergy list	3.7	2.01
Task a9.4 - Add a CDS intervention for at least one demographic	4.2	0.52
Task a9.5 - Add a CDS intervention for laboratory test	3.6	1.16
Task a9.6 - Add a CDS intervention for vital signs	3.8	1.24
Task a9.7 - Add a CDS intervention for a combination of 2 of the elements above (medication list + demographic)	3.4	1.59
Task a9.8 - Trigger the CDS intervention for problem list	4.5	0.84

Task a9.9 - Trigger the CDS intervention for medication list	4.2	0.56
Task a9.10 - Trigger the CDS intervention for medication allergy list	4.6	0.67
Task a9.11 - Trigger the CDS intervention for at least one demographic	4.4	0.77
Task a9.12 - Trigger the CDS intervention for laboratory test	4.6	0.81
Task a9.13 - Trigger the CDS intervention for vital signs	4.7	0.52
Task a9.14 - Trigger the CDS intervention for a combination of 2 of the elements above (medication list + demographic)	3.8	1.16
Task a9.15 - View the intervention information using the Infobutton standard for data elements in the problem list	4.5	1.52
Task a9.16 - View the intervention information using the Infobutton standard for data elements in the medication list	4.7	0.34
Task a9.17 - View the intervention information using the Infobutton standard for data elements in the demographics	4.6	0.62
Task a9.18 - Trigger the CDS intervention information using the Infobutton standard for data elements in the problem list by incorporating patient information from a TOC	3.3	1.23
Task a9.19 - Trigger the CDS intervention information using the Infobutton standard for data elements in the medication list by incorporating patient information from a TOC	3.2	1.76
Task a9.20 - Trigger the CDS intervention information using the Infobutton standard for data elements in the medication allergy list by incorporating patient information from a TOC	3.3	1.45
Task a9.21 - Access the bibliographic citation, developer, funding source, release/revision date for a triggered CDS intervention for problem list	4.7	0.46
Task a14.1 - Implantable Device List - Record UDI	4.7	0.46
Task a14.2 - Change UDI Status	4.9	0.41
Task a14.3 - Access UDI, device description, identifiers, and attributes	4.2	0.24

Task b2.1 - Clinical Reconciliation - Incorporate CCDA and conduct reconciliation of medications, medication allergies, and problems with the information currently in patient's record	3.5	0.46
Task b2.2 - Generate a new CCDA with reconciled information	3.4	1.4
Task b2.3 – Display Medication History	4.2	0.34
Task b3.1 - Electronic Prescribing - Create a new prescription	4.5	0.42
Task b3.2 - Change prescription (dose or duration)	4.6	0.21
Task b3.3 - Cancel prescription	4.8	0.64
Task b3.4 - Refill prescription	4.5	1.02
Task b3.5 - Receive fill status notification	3.4	1.62
Task b3.6 - Request and receive medication history information	3.7	2.43

5.1.1.3) Mean Software Usability rating, n=10

Mean Usability Score (Likert Scale)	4.1
Standard Deviation	0.81

5.1.1.4) Summary of Verbalized Comments

- Demographics
  - Demographics management module is not intuitive on how it is accessed.
  - Demographics management module involves too much scrolling.
- Clinical Reconciliation
  - Accessing the Clinical Reconciliation module is not intuitive and requires training.
  - Use of the Clinical Reconciliation module is click intensive.
- General Comments
  - The health summary is easy to use and quickly understandable.
  - Data on screens is spread far apart forcing the user to move the mouse long distances.
  - Buttons are small.
  - Text is very small.
  - Medication History takes too many steps to access
  - Rules are difficult to understand and trigger.

5.1.2) Discussion of Findings and Summative Findings

Time on Task

The measured time on task was in line with our expected findings. The average time on task for all tasks was 12.4 seconds, which included reading the description of the task. In the future, the study could be improved by separating the task of reading the task description and completing the task. The standard deviation for time on task ranged from 2.81 to 7.24, depending on the individual task. This standard deviation indicates there is a large variance between results depending on the user completing the task. We found that users whose occupations are in a clinical capacity (provider or clinical staff) completed the tasks faster than other users.

In tasks with similar steps (for example—CPOE steps for ordering laboratory tests and diagnostic imaging are very similar by design), we found the second task was completed faster because the user was familiar with the process from an earlier task. This suggests an intuitive and easily learnable design.

Incorrect Clicks

Incorrect clicks were recorded when the user would click the wrong icon or button to complete the task description. The number of incorrect clicks remained low, with the average number being 0.53 across all tasks. This indicates that users, both clinical and otherwise, were able to find the correct icon or button relatively quickly, and on average, on the first try.

Usability

The single ease of use question (SEQ) was asked for each task – we asked participants to rate the ease and usability of each task on a Likert scale of 1-5, with 5 being the easiest, and 1 being the most difficult. The usability scores across all tasks ranged from 3.1 to 4.9, with the average score across all tasks being 4.1.

Users were also asked the SEQ for the software as a whole, and the scores ranged from 4-5, with an average score being 4.1 out of 5.

Summative Findings

The task success percentage was 100%, with zero failures. A success in this test scenario was defined as the user being able to successfully complete tasks. A failure would mean the participant was unable to identify the correct answer for any given task.

Conclusion of Findings

The twelve tasks presented in this study were completed by all of the participants. The errors or incorrect clicks that were reported would not have adverse consequences in the live software environment (e.g., clicking the add button for adding an indication instead of prescribing a new medication carries no adverse risk). Finally, we found that participants with a medical background or experience (providers, assistants, and administrative support staff) completed the tasks faster and rated a higher level of usability than other participants. This is likely because the former individuals are more familiar with common icons and abbreviations (e.g. Med Hx for medication history) used in the medical industry. Participants without a medical background or experience still successfully completed all tasks and rated overall usability as a 4 or above.

6) Conclusion

6.1) Effectiveness

Plus is a relatively new product that has been on the market for a few years. The data collected in this usability confirms that as an EHR, Plus is an effective application for providing patient care and storing patient health data.

- The usability rating metric collected in the study resulted in scores that are above average.
- All tasks in both studies were completed by the users, including the "other" users that did not have any medical training.
- Users commented that Plus is easy to use and was pleasing to learn and work in.

The ratings on ease of use shows that users that know what needs to be done in a given task, and providers and other clinical staff are especially adept at completing the task.

The number of incorrect clicks per task was low, with an average of 0.53 across all users and tasks. This means the overwhelming majority of the time, the user was able to identify the correct button or link to complete the task on the first try. This indicates the software is effective in its design.

6.2) Efficiency

The time on task data indicates participants were able to complete tasks in an average time of 11.31 seconds, which included the time it took to read the task description, analyze the window, and complete the task. In addition, tasks with similar workflows showed improvement with use. For example, adding information to the health summary is uniform across the sections tested (problem list, medication list, implantable devices). When the user completed one section, such as problem list, we found that the next section would take less

time. Uniformed and consistent icons are utilized to improve efficiency of the application, and are clearly successful in Plus 4.0.

A future study should use a live application, as the addition of hover hints would likely further improve the time on task and reduce the number of incorrect clicks. Secondly, a future study should eliminate the time it takes to read the task description to remove the variable of reading speed effecting efficiency.

6.3) Satisfaction

Plus has not been on the market for very long but has loyal customers that are satisfied with the clinical areas of the product. Of course, there are always areas for improvement, but in general, users of Plus are happy with the functionality in the EHR. The data presented here seems to support this claim. Participants rank Plus as above average on usability and comments were received that indicate Plus is intuitive and can be adapted quickly to a practice's workflows. This adaptability makes the application easier for new users to learn.

The average usability rating per task was 4.1 out of 5. The overall usability of the software was rated as 4.3 out of 5. These scores indicate the application is intuitive and useable, lending itself to good levels of user satisfaction.

6.4) Use, Tested Performance, and Error Rates

Users did not experience any error messages throughout the process of testing the tasks. If a user clicked an incorrect button or icon (as in the case of the Incorrect Clicks) in a live environment, it would not pose any threat to the integrity of the data or patient information.

For example, a common incorrect click button was in the Medication History permissions window. Users often clicked the button to close the window when they were actually wanting to show details about the medications. This would not pose any risk to the patient; this action would take the user out of the window and force reentry when they simply wished expand on details about the medications.

There were no testing irregularities or issues observed that would hinder the interpretation of this study's data.

6.5) Major Findings

The primary goal of this study was to evaluate the Plus application's effectiveness, efficiency, and usability ratings. Based on our findings, Plus performs well in all three categories. The application is effective, as all users were able to successfully complete all tasks in a reasonable amount of time with few incorrect clicks (path deviations), despite for all users, it was their first exposure to the application. This study highlighted the Plus application's Health Summary sections, which are highly intuitive and easy to learn. The Plus application utilizes the same icons for add, edit, delete, and more for all sections in the Health Summary, meaning that a user can quickly discern these icons regardless of what section they are modifying.

The Plan section of the encounter note also uses the same Orders link for laboratory or diagnostic imaging orders, making it easy for a user to identify where to place a computerized provider order entry. The results found that when a user completed a task in one section, for example, Medications, and later encountered a task with similar design, such as Implantable Devices, performance on the second task was improved.

Usability ratings for both individual tasks and the overall application indicate an above average level of satisfaction and usability. Software is generally considered as easy to use with a usability rating of 3.3, and Plus performs above that in both tested tasks and overall application, with scores of 4.1 and 4.30, respectively.

6.6) Areas for Improvement

Feedback from participants shows that the application has areas that can be improved. The following list outlines changes to be considered in future releases:

- **Font Size**. One comment received was that the font was hard to read, and we feel a general font setting could improve users' accessibility and satisfaction.
- **Health Summary Reconciliation**. Users commented the Clinical Reconciliation window was difficult to find. They would prefer a direct access option from the patient chart rather than accessing through a menu list.
- **Rules Engine.** Several users commented that the configuration and management of the health maintenance rules was robust but was cumbersome and could become frustrating if they needed to use it frequently. We agree that this module is an area for an intensive review and UI/UX redesign.

7) Appendices

7.1) Study I – Scenarios and Demographics

The study was completed as a web-based, self-directed study. Each participant received unique login credentials to access the LMS system where the survey was contained. The participant completed the study in person with an eMDs representative. The eMDs representative asked the participant the Single Ease of Use Question (SEQ) – rate the ease and usability of the task you just performed on a scale of 1-5—after each

assigned task. See page 10 for descriptions of all tested tasks. At the completion of all twelve tasks, the eMDs representative gathered the demographic data below. After obtaining the following demographic data, the participant was debriefed on the purpose of the study.

7.1.1) Introduction

The following text was displayed on the first slide of the survey:

This is a usability study required as part of our ONC 2015 Certification. This study will investigate the usability of common workflows in the Plus 4.0 software.

Each slide will present a task. Simply click where you would expect to perform the function. Your interviewer will ask a question related to the usability of each task, and at the conclusion of the study, you will be asked basic demographic data. Please note—your personal identifying information will remain anonymous.

Please click the red eMDs logo to begin:

7.1.2) Demographics

The following text was included on the study administrator's packet:

1) Participant's sex:
    a. Male
    b. Female

2) Age
    a. Less than 30 years old
    b. 30-39
    c. 40-49
    d. 50+

3) What is your highest level of education?
    a. No high school
    b. High school diploma or GED
    c. Some college, no degree
    d. College degree
    e. Master's degree
    f. Doctoral degree (Ph.D., M.D., D.O., D.C., etc.)

4) Do you work in a medical office?
    a. Yes
    b. No

5) If you answered yes to the above question, what is your role?
    a. Provider
    b. Nurse, Medical Assistant, Other provider support staff (respiratory technician, radiology technician, etc.)
    c. Front Office, Scheduling, or Billing
    d. Other (please describe)
    e. Not applicable

6) If you do not work in a medical office, what is your occupation?

    _____

7) How familiar are you with computers?

    a. Advanced (technical background with development or programming experience)
    b. Very familiar (knowledge of multiple software programs)
    c. Somewhat familiar (use a computer for daily tasks such as email or internet browsing)
    d. Low familiarity (do not regularly use computers)

8) Have you ever used an electronic medical record software?
    a. Yes
    b. No
        i. If you answered yes, which one? _____

9) Have you ever used eMDs Plus?
    a. Yes
    b. No

10) Please rate the overall usability of the software you just tested.
    a. 5 - Very High (intuitive, easy for all tasks)
    b. 4 - High (intuitive, easy for most tasks)
    c. 3 - Moderate usability (some tasks completely unclear)
    d. 2 - Somewhat unusable (majority of tasks were difficult or unclear)
    e. 1 - Unusable (all tasks were difficult; poor usability and design)

11) Please provide any suggestions on how we could improve the usability of the tasks you just tested. *(please notate "none" if participant has no suggestions).*

12) How long have you used a computer?

13) How long have you been in your current occupation?

7.1.3) Debriefing

Thank you for participating in this study. The primary goal of this study was to test the usability of primary systems within our Plus 4.0 application. The systems tested include the order entry process, medication prescribing, health summary updates, and clinical decision support.
If you have any questions please do not hesitate to contact Rebecca Richardson at rrichardson@emds.com

Thank you again for your time.
-eMDs Product Team

8) References

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