Electronic Health Record (EHR) systems have become highly important in health care and consequently in Health Informatics research. Although, some advances have been made, users’ experience of modern commercial EHRs remain challenging at best and unsafe at worst. This paper implements a prototype of EHR system to visualize the history of patient visits in the context of psychiatric care. It reports on a usability study which compared the use of the simulated EHR system by subjects of various experience levels. The study has verified the importance of prior knowledge in the field of EHR. It proposes several suggestions to improve the usability of EHR systems by implementing a temporal data organization scheme to present critical data.

Headings:

Electronic Health Record

Usability evaluation

Visualization
IMPLEMENTATION AND USABILITY EVALUATION OF AN ELECTRONIC HEALTH RECORD SYSTEM BASED ON PATIENTS' TEMPORAL VISITING DATA

by
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A Master’s paper submitted to the faculty of the School of Information and Library Science of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Master of Science in Information Science.

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I. INTRODUCTION

Electronic Health Record (EHR) systematically collects, stores and visualizes patient health information in a digital format. EHR is being increasingly adopted by health care industries in order to facilitate physicians to effectively and efficiently access patients' demographic, medication and visiting records. However, some existing EHR systems on the market are so complex that most of the EHR practitioners would find it difficult to seek information with the technology; the usability of EHR system has already become a challenge, even though it is “possibly the most important factor hindering widespread adoption of EHR” [1]. Thus, the area of this paper would mainly focus on designing an EHR system based on patients' temporal visiting histories and analyzing the outcomes from related usability evaluation.

This study has implemented a web-based EHR system, which supports presenting patient visits data in a temporal way and facilitates choosing granularity of time range to view all records on a more centralized interface. It addresses the concerns of implementation of a full-stack EHR, including both back-end, fulfilled by relational database, and an interactive front-end. Physicians can view records of users' visit history, organized by time line, while browsing some other information like demographic profiles of patients,
notes accompanied by each visit, and treatment by medicine or therapy history in multiple forms. This master’s paper also conducts a usability evaluation on this EHR system, in order to improve the interactive interface and to be adapted to the working practice of system users, thus storing and presenting all temporal patient information, as well other types of medical knowledge effectively.
II. LITERATURE REVIEW

1 Usability principles

Several papers ([1], [2], [3], [4], [5]) have pointed out the gist for designing usability studies. As pointed out by [1], usability principles are increasingly prevalent since they could guide health information technology researchers to develop user-centered outcomes and to clearly articulate design issues in current applications. Some of the principles, such as “simple, natural, minimizing cognitive load and effective information presentation”, are rightly helpful to this study's usability tasks planning step.

[5] proposes a definition of user-centered systems design (UCSD) as a process focusing on usability throughout the entire development life cycle. It also describes the results of applying the findings into real software development projects, leading to several principles such as user focus, active user involvement and simple design representations. Accordingly, a usability test will be conducted prior to final delivery; that is, it has involved stakeholders into development process, thus adapting the system to practical work-flow of health informatics practitioners.
2 Usability evaluation methods

Usability evaluation methods are developed to guide each phase of designing human-information interactive systems. Since each approach would have its specific range of influence and effect, it is important to review other research articles, thus selecting the most appropriate ones to EHR design process.

[6] has presented a case study to track issues predicted by several methods, including “Claims Analysis”, “Cognitive Walkthrough”, “GOMS”, “Heuristic Evaluation”, “User Action Notation” and “Specification”. The study compared predictions with results of user tests, coming up with a substantial statement that, usability tests should expose problems and lead to design changes to motivate the programmers to modify codes. Also it proposed a framework called “Effectiveness Tree” to evaluate usability methods' predictive performance. This is undoubtedly helpful in selecting usability measurement for EHR, based on which decisions can be made regarding modifications necessary to the user interface.

[2] gave out a toolkit of conventional usability test methods employed most frequently in EHRs. By identifying and describing each method with consideration of EHR settings, it raised its criteria such as environment of primary care settings and the method being able
to provide quantitative or qualitative results as summary. It allowed us to choose scenario-based inspection as a means to collect quantitative data.

[4] is a case study on a commercial EHR. Though it mainly focuses on Heuristic Walk-through, one of the most popular predictive methods in usability tests, it is in fact a long-term EHR project that has been challenged by more changing requests and usability bottlenecks than usual short-term ones. By following the clinical work-flows through each system component, it summarized a very detailed and consistent usability evaluation throughout the implementation process. This has enlightened this paper; multiple in-test tasks would be assigned to testers. They could therefore access and evaluate the overall performance of this EHR in a qualitative manner and permitting comparison across users with different backgrounds.
III. METHODS

This chapter will discuss both the data sources for system development and the user groups selected to participate usability testing. Then it will present an application of scenario-based inspection as well as a heuristic approach through questionnaire.

3 Data Sources

Though the first chapter has mentioned that, some sensitive information, such as patients' demographic information, prescriptions on medications and drugs and visiting notes composed by doctors, will be essential to the system's major functionality, however, the main purpose of this research is merely an implementation of EHR to visualize this information and a usability testing to evaluate the designs. Therefore, it is ensured that all data records in database will be artificially generated to mimic real situations, thus no practical and sensitive data or inputs will be actually required. On the other hand, the usability testing phase would collect subjects’ feedback on UI design and functionality, in the formatting of surveys and ratings. They are simply used for developers to evaluate the usability of the system, thus improving design and organization. Meanwhile, the tests have informed them not to disclose their personal information prior to the experiment.

Some other publicized data resources are utilized. Physicians' Desk Reference [7] is a compilation of prescription drugs that is widely available by medical specialists. Multiple
EHR systems have already integrated it directly. This EHR system will also provide information regarding medicine categories and drug names with the help of this public information.

The database will also store a critical scale called the Clinical Global Impressions (CGI). CGI was designed to provide a stand-alone assessment of the patient's functioning through medical inspections [13]. It can provide physicians an overall summary on the patient's condition accompanied by each visit. The CGI scores will be the core values to be visualized through time line; by observing a series of historical CGI scores, physicians can thus generate his or her own professional judgment and knowledge on the patient's therapy and progress. For the convenience of usability study, several visiting records, as well as their related CGI scores will be simulated to approach real-world medical circumstances.

4 User Groups

This study has invited user groups from two different backgrounds to join the experimentation. First, this research would fit into the perspectives of clinician users, including physicians, nurses, pharmacists, physical therapists, respiratory therapists and medical students who are getting practical training on EHR systems [1]. Their professional experience would obviously provide valuable opinions into both the construction of system skeletons and the design of usability tasks. This study eventually invited a physician who has professional expertise over 10 years, a researcher in the area for 5-9 years and a medical school intern with less than 2 years' experience.
The experiment's second user group has invited three graduate-level students who have been trained on human-information interaction and usability testing. They can also provide unique judgment on the overall performance and easiness to seek information and describe their information needs in a more scientific way; they will be considered as amateur due to their lack of medical background.

We invited 3 medical researchers and students who have relations to the medical school of University of North Carolina at Chapel, as well as 3 graduate-level students from the School of Information and Library Science, to participate the usability study. As for the next section, some more technical specifications will be discussed.

5 System Design Strategies

This is a Full-Stack EHR project that the developer is responsible for end-to-end designs, implementation, testing, documentation, and delivery of all the services. In general, the application is following MVC design pattern and RESTful architectural style, utilizing a Java framework called “Play framework”, which is a lightweight, stateless and web-friendly architecture that can backup highly scalable applications. The project is based on RESTful web application because some front-end techniques such as JavaScript libraries can provide fruitful choices to deploy time-line based visualization. The technical specification of this EHR will be briefly introduced according to the Models, Viewers and Controllers, i.e. the MVC pattern.

Models
The models store data in the format of relational database management system (RDBMS) that can be retrieved by commands and requests from controller. One thing to note is that the relations or tables in back-end can be accessed from an object-oriented language, say Java, with the technique of Object-relational mapping (ORM). The ORM layer facilitates developing classes and objects persistent to the fields of each relation in database.

**Views**

The views will interact with end users and represent all information based on changes in models. This is critical to the effectiveness for user groups to judge the usability of the system. This project has applied a dynamic and browser based visualization library called “vis.js” [8]; this library has provided easy manipulation on temporal data to display a customizable and interactive time-line. Some other techniques such as Bootstrap [9] template, jQuery [10] and AJAX are also helpful in data representation.

**Controllers**

The controllers will send requests to the models to update the models’ state and will send requests to associated views to change presentation of the model. All these requests will be built through RESTful web services and thus resources can be identified, related and transferred easily through HTTP protocols.

6 **Scenario-based Inspection**

As defined by [11], usability inspection is the generic name for a set of methods by walking through the software's interface. Scenario-based design, according to [12], describes usage of system during development process to fulfill practical work-flows. The main purpose of this EHR is to support presenting historic patient visits data and their profiles in an interactive and effective way. It would then provide an assessment of
overall patient health conditions, i.e. CGI scores. The experiment will guide user groups to become familiar with the UI and the functionality of the EHR system through several step-by-step tasks. Each task has been purposefully designed to evaluate a certain part of system functions; the task is also an appropriate representation of medical working practices. By conducting these tasks, the users are required to answer some questions through a questionnaire thus helping the study to quantitatively analyze the clearness and easiness of functionality. This section will explain these key EHR tasks in detail.

............6.1 Clinical Scenario 1: Review specific patient history.

In this initial scenario, users are guided to input a given patient's ID and look up his or her demographic and diagnosis information on the dashboard.

Task 1: Enter a patient's MRN ID number (e.g. 15).

Task 2: Identify the patient by age, gender and race.

Task 3: Identify all current co-morbid diagnosis of the patient.

Figure 1. The main console to input a patient's MRN ID
Figure 2. The section on dashboard for patient's demographic and diagnosis data

----------6.2 Clinical Scenario 2: Examine patient condition.

During the usability study, the users would be asked to scroll back and forth through the Graph View and give out some feedback concerning this representation of all CGI scores. For example, they will be asked questions like “What is the CGI score for the visit on January 12, 2011?” and make inference about “Is this patient doing better or worse than his/her last visit based on the CGI score for the visit on May 4, 2011?”. By hovering mouse over each point on the Graph View, physicians can also view the visiting notes written for each unique visit in a much straightforward action, without redirection to other pages or isolation to the work flow.

Task 1: Locate the Graph View.

Task 2: Identify the CGI scores on a specific visit.

Task 3: Infer whether the patient is making better or worse.

Task 4: Identify the visiting notes on a specific visit.
Figure 3. The Graph View of CGI scores by a patient. The x-axis denotes time-line while the y-axis denotes CGI scores. Each point on the curve is a visit.

Figure 4. The visiting note accompanied by each visit. The panel will be displayed when hovering mouse over the point of visit on the graph.
............ 6.3  Clinical Scenario 3: Examine patient treatment.

Users can drag left/right on the Time-line View to get all drugs and therapies over time.

Task 1: Locate the Time line View.

Task 2: Identify the latest or current treatment of that patient.

Figure 5. The Time-line View to show all treatment over time.

............ 6.4  Clinical Scenario 4: Combine rating with treatment as diagnosis.

In this scenario, users will face a scenario to select a treatment that the patient responded MOST well to, which is common to decision making process of clinicians.

Task 1: Locate both the Graph and the Time line View.

Task 2: Read into the charts and make professional judgment.
Clinical Scenario 5: Relate assessment to previous visits.

The EHR should enable physicians to generate knowledge from the assessment history, including how often does the patient have the medications during the period of time, when she might stop taking them, what are the possible side-effects and extra conditions based on historic data. The users would test on this EHR and answer questions about if they are at ease to interact with this part to list all previous visits in a tabular form.

Task 1: Select the tabular option.

Task 2: Search a specified date.
Task 3: Identify the CGI score and visiting note associated with this visit.

<table>
<thead>
<tr>
<th>Date</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-01-05</td>
<td>CGI Score: 2 Mrs. Brigham is a 44 year old woman who complains of worsening mood swings. Her husband, Mark, is a 48 year old man who recently retired. They have 2 children, ages 12 and 16. He has been taking lithium carbonate and risperidone for the past year.</td>
</tr>
<tr>
<td>2011-01-12</td>
<td>CGI Score: 7 Mrs. Brigham is a 44 year old woman who continues to complain of mood swings. Her husband, Mark, is a 48 year old man who recently retired. They have 2 children, ages 12 and 16. He has been taking lithium carbonate and risperidone for the past year.</td>
</tr>
<tr>
<td>2011-03-03</td>
<td>Notes for patient # 15</td>
</tr>
<tr>
<td>2011-03-09</td>
<td>CGI Score: 6 Notes for patient # 15</td>
</tr>
<tr>
<td>2011-03-23</td>
<td>CGI Score: 3 Notes for patient # 15</td>
</tr>
<tr>
<td>2011-04-30</td>
<td>CGI Score: 2 Notes for patient # 15</td>
</tr>
</tbody>
</table>

Figure 7. A tabular view of all visiting records for a specific patient over time.

6.6 Clinical Scenario 6: Diagnose from detailed visiting records.

This test case serves as listing the details of medications prescribed on a particular visit.

Task 1: Pick dates to view all medicines and therapies prescribed till the date.

Task 2: Identify drug name, classification, start date and end date.

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Group</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithium Carbonate</td>
<td>U</td>
<td>2011-05-07</td>
<td>2011-06-09</td>
</tr>
<tr>
<td>Quetiapine</td>
<td>U</td>
<td>2011-09-01</td>
<td>2012-04-30</td>
</tr>
</tbody>
</table>

Figure 8. A tabular view of all medication records for a specific visit.
Clinical Scenario 7: Prescribe medications based on drug history.

It is also vital for the physicians to prescribe medication for their patients. Though this EHR don't support order placement, it can still serve as taking record of prescriptions, accompanied by each visit. Users would also conduct this task and tell if this would be relevant to their working routines.

Task 1: Click on Dashboard button on left navigation bar.
Task 2: Click to view all medication history of this patient.
Task 3: Identify all drugs and medications records.

![Figure 9. A tabular view of all medication records for a specific patient over time.](image-url)
IV. Usability Testing Report

According to [3], how well an EHR serves the medication tasks in a complex clinical environment is the direct result of its interface, through collecting, organizing and presenting patient information. And the work-flows of EHR are closely aligned with that interface to serve clinical users. This chapter thus would summarize the feedback from users and evaluate the implications from experiment. It will be organized in the following order: the pretest, in-test and post-test.

7 Findings of Pretest Questionnaire

Since many pretest questions require a background in medicine, the study only required the first group of users to complete it. This survey simply collects information regarding primary area of practice, professional expertise length, frequency to work with EHR and the most familiar rating scales that can quantify patient's progress from visit to visit. Again, the background data collected was only utilized to determine appropriate experience level with EHR systems; according to the IRB guidelines, the data were protected and only used for analysis associated with this study. We have recruited a physician with over 10 years of practice, a PhD researcher with over more than 5 years of experience, and a medical school intern who is familiar with EHR operations.
Sample Size: 3 researchers or students with medical background

Q1. PRIMARY AREA OF PRACTICE

Figure 10. Pretest result - What is your primary area of practice?

Q2. PROFESSIONAL EXPERTISE

Figure 11. Pretest result - What is your Professional expertise?
Q3. FREQUENCY TO WORK WITH HER?

![Bar chart showing frequency of work with patient's EHR]

Figure 12. Pretest result - How often do you work with patient's EHR?

Q4. THE RATING SCALE TO QUANTIFY PATIENT’S PROGRESS FROM VISIT TO VISIT

![Bar chart showing rating scales used]

Figure 13. Pretest result - What is the rating scale you use to quantify your patient's progress from visit to visit?
8 Findings of In-Test Questionnaire

This section will summarize the findings from the survey that is designed to ask users several questions concerning information seeking and decision making through their exploration on the screen. The tasks were completed according to the order of the seven scenarios presented earlier. After completing the tasks, users were requested to rate the ease of use.

The charts will present analysis on errors and the ease of rating. The results will be reported in two parts, representing the two separate user groups.

Sample Size: 3 researchers or professionals with medical background

Figure 14. Counting for errors and Rating for easiness on the seven-scenario tasks from the professional user group.
Sample Size: 3 students outside of medical field but with experience of usability testing

Figure 15. Counting for errors and Rating for easiness on the seven-scenario tasks from the amateur user group.

8.1 Task 1: Review specific patient history.

This task simply asked users to seek patient’s demographic information, including age (Q1), gender (Q2) and race (Q3) on the dashboard (again, all these data are created to mimic real situations). However, there was one case where one of the amateur users did not read the questions well and she filled in her own profile at the initial phase. The results became obviously better after all following users were given tips that this was not asking for personal information.
Task 2: Examine patient condition.

Q4: What is the patient's current co-morbid diagnosis?

Some issues came up with this question because students from information school did not understand the meaning of co-morbid diagnosis, thus they might raise questions about it. The first user groups had no such issue.


Q6: Based on the CGI score for the visit on May 4, 2011, is this patient doing better or worse than his/her last visit?

For this task 3, there was one common mistake among both of the professional and amateur teams. Most users would lack prior knowledge of CGI scales, which was also revealed by the pretest survey; but one of the trickiest part of CGI is that, the higher the score is, the worse is the condition of that patient. It is undoubtedly counter-intuitive.

In one case, two testers, one physician and one student had both noticed a minor curve between the two points on the chart, instead of the fact that they were still same values. The curve was just a decoration but it added risk of false interpretation. In another case, one simply misinterpreted the statement of “doing better” as higher score; he did not try to connect the previous data points as a clue. It is suggested that the performance might be better if another group of two visits, with larger difference in CGI, could be selected as questions.

Q7: Where would you find this patient's visiting note on January 12, 2011?
All of the three professional users had given positive feedback on finding visiting notes with the Graph View directly; it is “straightforward” and “helpful” to just hover the mouse on that point on the line chart as a visit, and then concentrate on the overall trend of patient’s condition. They had complained about some workarounds with their current EHR systems where viewing visiting notes are isolated on additional pages and they had to navigate back and forth to view multiple notes on a time line. But some users had provided a precious suggestion that it would be even better to close the panel after mouse leaving the data point. This will be adopted into further refinement on the UI as next step.

............8.4  Task 4: Combine rating with treatment as diagnosis.

Q9: Select a treatment that the patient responded MOST well to:
This question was designed to ask for diagnosis and judgment on treatment. Compared with amateur students outside of this field, the first user group was better at synthesizing both CGI scores and medication histories. It again proved the importance of prior knowledge to interact with the system and to guide further information behaviors in the context of EHR.

............8.5  Task 5: Relate assessment to previous visits.
This task simply listed all visiting history of the patient in tabular form and asked for a specific CGI score. Neither group has made any error.

............8.6  Task 6: Diagnose from detailed visiting records.
Q6: Identify all groups of drugs that were prescribed till that date.
This task simply listed all drugs prescribed till one visit. However, two testers from the first group have made a common error because they misinterpreted the problem that all
records, including the drugs that were no longer prescribed, should be checked. The study considers it a limitation in designing the questions and would replace the words in future.

8.7 Task 7: Prescribe medications based on drug history.

This task simply listed all medications, drugs and therapies for the patient. Neither group has made any error.

9 Findings of Post-test Questionnaire

In general, the first user group of professionals in health informatics area would give more positive ratings on this EHR; where the latter group of information school graduates would disagree more on details such as UI design and layout.

![Figure 16. Summary of evaluation on easiness and affordance of the EHR system.](image-url)
The length of time to finish the overall test, including three surveys, would take around 10 to 20 minutes for both teams. It might indicate that the EHR system, as well as the guidance through this questionnaire, is not too complicated to new users and that its major functionality is easy to learn and operate. Most users would rate the tasks from the questionnaires as “straightforward”.

Sample Size: 6 users who have participated the usability testing phase.

Figure 17. Counting for number of testers by their time spent on the testing.
V. IMPLICATIONS FROM USABILITY TESTING

As a summary, this study has implemented a web-based EHR system to present temporal patients’ visiting data. It also invited two groups of users to participate a usability test. The usability evaluation compared the findings between the professional and the amateur groups. Here are some implications that can be inferred from that usability phase.

Our hypothesis was the lack of health science knowledge will become a barrier in answering the survey questions and it will likely decrease the accuracy associated with assessing diagnosis. For example, students from information school have made more errors due to the erroneous interpretation on the CGI scores. This also seems to be a required knowledge for the first group to judge the condition of a certain patient. As another example shows, experience on diagnosis would contribute to the formation of the assessment by combining both conditions and treatment.

Next, it is a milestone, according to some professionals, to have a mouse-hover effect on displaying visiting notes through the visual graph of all visits. But it is better to close the panel after mouse-leaving that point, as an improvement to visualization.

Furthermore, one physician had proposed to add a feature of “dosage” for both treatments on Time-line View and on the list of medications on tabular form. The professionals are
likely to make decisions on prescriptions not just based on duration of drug use but also the frequency of use. In that case, it is proposed that the EHR system will modify both database storage and UI representation in future.

Finally, it is clearer to display records in a tabular format, despite the fact that it may delay establishing and tracking actual data values. Several users suggested offering a way to sort records based on start and end time, item name, and other dimensions. The sorting is likely to improve browsing and interaction with the data and should be given serious consideration.
BIBLIOGRAPHY


8. vis.js: http://visjs.org/, a dynamic, browser based visualization library.


10. jQuery: https://jquery.com/, a fast and feature-rich JavaScript library for HTML document traversal and manipulation, event handling, animation and Ajax.


APPENDIX I. PRETEST QUESTIONNAIRE

1. What is your primary area of practice
   — Psychiatry
   — Internal Medicine
   — Family Practice
   — Pediatrics
   — Other, please specify

2. What is your Professional expertise?
   — PGY-1
   — PGY-2
   — PGY-3
   — PGY-4
   — Attending $\leq 5$ yrs
   — Attending 5-9 yrs
   — Attending $\geq 10$ yrs
   — Other, please specify

3. How often do you work with patient's electronic health records?
   — Almost daily
   — Weekly
   — Monthly
   — Quarterly
   — Less often/NA
4. What is the rating scale you use to quantify your patient's progress from visit to visit? Please check all that apply:

____ None
____ Montgomery-Ashberg Depression Rating Scale
____ Hamilton Rating Scale
____ Carroll Rating Scale
____ Clinical Global Impression Ratings
____ Beck Depression Inventory
____ Other, please specify
APPENDIX II. TEST QUESTIONNAIRE

Task 1

Please enter the patient's MRN ID number: 15, and then identify the patient by answering the following questions:

1. Age (check the category that applies)
   _____ Under 12 years’ old
   _____ 12-17 years’ old
   _____ 18-24 years’ old
   _____ 25-34 years’ old
   _____ 35-44 years’ old
   _____ 45-54 years’ old
   _____ 55-64 years’ old
   _____ 65-74 years’ old
   _____ 75 years old or older

2. Gender
   _____ Male (M)
   _____ Female (F)

3. Race (check the category that applies)
   _____ White (W)
   _____ Hispanic or Latino (H)
   _____ Black or African American (B)
   _____ Native American or American Indian (N)
   _____ Asian/Pacific Islander (A)
How easy was it to complete Task 1?
_____Very Easy (5)
_____Easy (4)
_____Neutral (3)
_____Hard (2)
_____Very Hard (1)

Task 2

4. What is the patient's current co-morbid diagnosis? Please check all that apply:
_____Anxiety disorder
_____Borderline personality disorder
_____Bipolar disorder
_____Eating disorders
_____Major depressive disorder
_____Obsessive compulsive disorder
_____Panic disorders
_____Schizophrenia
_____Substance/Medication-induced depressive disorder
_____None

How easy was it to complete Task 2?
_____Very Easy (5)
_____Easy (4)
_____Neutral (3)
_____Hard (2)
_____Very Hard (1)

Task 3
5. Please look closely at the Graph View of CGI curves. What is the CGI score for the visit on January 12, 2011? (You may drag left/right, scroll back/forth and hover mouse over each data point on the Graph View)
   _____1
   _____2
   _____3
   _____4
   _____5
   _____6
   _____7

6. Please look closely at the Graph View of CGI curves. Based on the CGI score for the visit on May 4, 2011, is this patient doing better or worse than his/her last visit? Please note that the higher the CGI score is, the worse the patient is. (You may drag left/right, scroll back/forth and hover mouse over each data point on the Graph View)
   _____Improved
   _____Remains the same
   _____Doing worse

Physicians would usually record a patient “visiting note” related with each unique visit. Please answering the following questions. (You may drag left/right, scroll back/forth and hover mouse over each data point on the Graph View)

7. Where would you find this patient's visiting note on January 12, 2011? (check the category that applies)
   _____Patient demographic information area
   _____Patient co-morbid diagnosis information area
   _____Data point on the Graph View
   _____Date on the x-axis of the Graph View
   _____Bar section on the Time Line View
   _____Date on the x-axis of the Time Line View
   _____Cannot find that specific note on this page
How easy was it to complete Task 3?

_____Very Easy (5)
_____Easy (4)
_____Neutral (3)
_____Hard (2)
_____Very Hard (1)

Task 4

8. What is the patient's CURRENT/LATEST treatment groups? Please check all that apply:

_____Psychotherapy
_____AAP
_____BUP
_____D2
_____LI
_____LTG
_____MRT
_____OLZ
_____RIS
_____SNRI
_____SSRI
_____TCA

9. Please select a treatment that the patient responded MOST well to:

_____BUPROPION-XL, CITALOPRAM, Psychotherapy
_____LITHIUM CARBONATE, OLANZAPINE
_____BUPROPION-XL, FLUOXETINE HCL

How easy was it to complete Task 4?

_____Very Easy (5)
Task 5

10. Please move to the top of the current dashboard. Click the first link to view all visiting history of this patient in tabular form. What is the CGI score for the visit on June 24, 2011?
   _____1
   _____2
   _____3
   _____4
   _____5
   _____6
   _____7

How easy was it to complete Task 5?
   _____Very Easy (5)
   _____Easy (4)
   _____Neutral (3)
   _____Hard (2)
   _____Very Hard (1)

Task 6

11. Please find the row of records on May 11, 2011. Click on the date and identify all groups of drugs that were prescribed till that date:
   _____Psychotherapy
   _____AAP
   _____BUP
   _____D2
How easy was it to complete Task 6?

_____ Very Easy (5)
_____ Easy (4)
_____ Neutral (3)
_____ Hard (2)
_____ Very Hard (1)

**Task 7**

12. Please click on the Dashboard on the left navigation bar and return to the dashboard page. Click the link to view all medication history of this patient. Please count total numbers of drugs and medications prescribed for this patient.

________

How easy was it to complete Task 7?

_____ Very Easy (5)
_____ Easy (4)
_____ Neutral (3)
_____ Hard (2)
_____ Very Hard (1)
APPENDIX III. POST-TEST QUESTIONNAIRE

1. The demographic information of the patient is easy to locate:
   _____Strongly agree
   _____Agree
   _____No opinion
   _____Disagree
   _____Strongly disagree

2. The patient's current diagnosis information is easy to locate:
   _____Strongly agree
   _____Agree
   _____No opinion
   _____Disagree
   _____Strongly disagree

3. In “Graph View”, the learning curve of the CGI chart is minimum:
   _____Strongly agree
   _____Agree
   _____No opinion
   _____Disagree
   _____Strongly disagree

4. In “Timeline View”, the learning curve to view all prescriptions and therapies is minimum:
   _____Strongly agree
   _____Agree
5. I am comfortable that this interface uses medication groups instead of individual medication for patient treatment or therapy.
   ______ Strongly agree
   ______ Agree
   ______ No opinion
   ______ Disagree
   ______ Strongly disagree

6. Which data view is the most helpful in terms of helping you make clinical decision for the patient treatment. Please check all that apply:
   ______ Graph View
   ______ Timeline View
   ______ All Visiting Records of a patient View
   ______ All Medication Records of a patient View
   ______ All Medication Records of a visit View

7. The color and UI design of this interface is intuitive and easy for navigation:
   ______ Strongly agree
   ______ Agree
   ______ No opinion
   ______ Disagree
   ______ Strongly disagree

8. The texts, characters and highlighting on the screen is user-friendly:
   ______ Strongly agree
   ______ Agree
   ______ No opinion
9. The layout of information on the system screens was clear and matches the clinician's workflow:

_____Strongly agree
_____Agree
_____No opinion
_____Disagree
_____Strongly disagree

10. How long have you worked on this system?

_____≤10 minutes
_____10-20 minutes
_____20-30 minutes
_____≥30 minutes

11. The use of terminology throughout the system relates well to the work you are doing:

_____Strongly agree
_____Agree
_____No opinion
_____Disagree
_____Strongly disagree