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User Manuals for a Primary Care Electronic Medical Record System: A Mixed Methods Study of User- and Vendor-Generated Documents

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Abstract

Research problem—Tutorials and user manuals are important forms of impersonal support for using software applications including electronic medical records (EMRs). Differences between user- and vendor documentation may indicate support needs, which are not sufficiently addressed by the official documentation, and reveal new elements that may inform the design of tutorials and user manuals.

Research question—What are the differences between user-generated tutorials and manuals for an EMR and the official user manual from the software vendor?

Literature review—Effective design of tutorials and user manuals requires careful packaging of information, balance between declarative and procedural texts, an action and task-oriented approach, support for error recognition and recovery, and effective use of visual elements. No previous research compared these elements between formal and informal documents.

Methodology—We conducted an mixed methods study. Seven tutorials and two manuals for an EMR were collected from three family health teams and compared with the official user manual from the software vendor. Documents were qualitatively analyzed using a framework analysis approach in relation to the principles of technical documentation described above. Subsets of the data were quantitatively analyzed using cross-tabulation to compare the types of error information and visual cues in screen captures between user- and vendor-generated manuals.

Results and discussion—The user-developed tutorials and manuals differed from the vendor-developed manual in that they contained mostly procedural and not declarative information; were customized to the specific workflow, user roles, and patient characteristics; contained more error information related to work processes than to software usage; and used explicit visual cues on screen captures to help users identify window elements. These findings imply that to support EMR implementation, tutorials and manuals need to be customized and adapted to specific organizational contexts and workflows. The main limitation of the study is its generalizability. Future research should address this limitation and may explore alternative approaches to software documentation, such as modular manuals or participatory design.

Index terms

Electronic medical record; minimalism; tutorial; user-generated documentation; user manual; workflow

Introduction

The use of computer software applications has penetrated every aspect of our lives. The design, user interface, and usability of software have improved significantly over the past decades. However, users still often get frustrated with computers, which may lead not only to personal dissatisfaction and low self-efficacy but also to time loss and reduced productivity [1], [2]. Users often need help learning to use software applications, how to solve problems with, or how to perform unfamiliar tasks using them [3]. This is especially important for complex health information systems such as clinical decision support systems (CDSS), electronic medical records (EMRs), and electronic health records (EHRs).

Health Information Technology (HIT) in general, and EHRs and EMRs in particular, are being promoted around the world for their potential to improve patient safety, quality of care, and cost effectiveness of the health care system [4]–[6]. While there is some research evidence to support these claims [7] there is also a consensus among researchers and practitioners in health informatics that often these systems are not used to their full potential [8], [9]. Support has been widely acknowledged as an important factor for successful implementation and realization of the abovementioned benefits of HIT [10].

For the purpose of this study, we broadly define end-user support as “any information or activity which is intended to help users solve problems with, and better utilize, information systems” [11]. To date, only a handful of studies have attempted to provide in-depth insight into support and its impact on HIT implementation and these studies were often limited to the formal technical support provided by information technology (IT) units within health care organizations [12]–[14]. However, end-user support may take various forms; some of which are formal and others, such as local experts or assistance from colleagues, are informal [15]–[17]. Munkvold adds that both formal and informal support may be personal or impersonal [15] (that is, provided by resources other than a person such as documents and websites). It has been argued that “quality user documentation can provide continuing and often cost-effective point-of-need support for both full time and intermittent users” [18]. Yet, little attention has been paid to the structure and role of impersonal support sources in HIT implementation.

Two of the most common forms of impersonal support documents for using software applications are reference guides and tutorials. Reference guides—which for simplicity we refer to as “manuals” throughout—are comprehensive documents that provide instructions for all major tasks a software (or other) product performs. Tutorials on the other hand are usually designed to teach only the basics of using the software and therefore cover only a limited set of features. Although other forms exist (such as online tutorials, online help, and illustrative videos), printed documents are still prevalent and sometimes are the only source of support available to the users [19]. Various studies measured the impact of using tutorials and manuals for software applications on time to complete tasks, task performance, retention and transfer of information, and user satisfaction. This body of research generally demonstrates the effectiveness of tutorials and manuals in software learning although most of the studies we found focused on a specific approach for designing tutorial and manuals in comparison to a ‘standard’ approach (such as minimalist vs. conventional manual, and video vs. text-based tutorials) [3], [19]–[21].

Somewhat in contrast to the findings on the effectiveness of tutorials and manuals, during a case study of primary care EMR implementation in Ontario we found that user groups (family health teams) often developed their own tutorials and manuals for the software—although they had been provided with a user manual by the EMR software vendor. This, behavior of users seeking help from sources other than those supplied by the vendor and the availability of such informal resources are not unique, especially with the advent of Web 2.0 applications and online user-generated content. Furthermore, as shown by Spinuzzi [22], users often generate their own solutions to problems of using information system. Nevertheless, there has not been much research on user-generated software tutorials and manuals in particular. This study is an attempt to partially fill in this gap. The rationale behind it is that differences between user- and vendor-generated tutorials and manuals may indicate user support needs, which are not sufficiently addressed by the official documentation and current practices of technical writing, and reveal new elements that may inform the design of tutorials and user manuals for EMRs as well as other software applications. Thus, the research question for this study is: What are the differences between user-generated tutorials and manuals for an EMR and the official user manual from the software vendor?

After a brief review of relevant literature—specifically theories and approaches which informed our data analysis—we present the methodology and findings from an analysis of tutorials and manuals generated by users and an EMR vendor. We then discuss the findings and their implications for HIT implementation and for the design of tutorials and user manuals in general. We end the paper with limitations of the present study and directions for future research.

Literature review

This section situates our study in the literature. We begin this section with a disclosure of the theoretical orientation guiding our study and a description of how we selected ion of the literature. Then, for readers who may not be familiar with HIT, an overview and definitions of EHR and EMR, their implementation status, and research on support for HIT are provided. We then review some of the theories and approaches that informed our data analysis: structured writing (information mapping), procedural and declarative information, Minimalism, and use of visualization on tutorials and user manuals. Finally, we discuss some of the literature on user-generated help.

Theoretical Orientation

The theoretical orientation of this study is cognitive approach to documentation. Although our study was guided by several of the theories mentioned above, we reviewed and applied them in the context of the user interaction with the tutorials or manuals. In particular, substantial part of our analysis focused on the application of the principles of Minimalism in the user- and vendor-generated documents.

Selection of Literature for the Review

We began our literature search with two purposes in mind. First, we searched for empirical research on user-generated guides for software applications and tutorials and manuals for HIT in an attempt to understand what is already known about these topics and identify gaps in research. We used the terms “user guide”, “tutorial” or “user manual” in combination with “user-generated”, “health information technology (or system)”, “electronic medical record” or “electronic health record”. These searches did not retrieve any relevant studies. Second, we sought literature on theories and approaches for designing software tutorials and manuals.

The purpose of this search was to identify relevant frameworks that could guide our data analysis. Key words included “user guide”, “tutorial”, “user manual”, “design”, and “theory”. A key article we retrieved early on this search was that of van der Meij, Karreman, and Stehouder [23], which provides a historic perspective of research and practice on software tutorials. We expanded our search by looking for citations of, and references from, this paper.

Electronic Health and Medical Records

Currently, there is no universally accepted definition of an electronic health record (EHR) and the term is often used interchangeably with electronic medical record (EMR),

computerized patient record (CPR), and electronic patient record (EPR). For the purpose of this study we will use the US National Alliance for Health Information Technology (NAHIT) definitions, according to which EHR is “an electronic record of health related information on an individual that conforms to nationally recognized interoperability standards and that can be created, managed, and consulted by authorized clinicians and staff across more than one health care organization” [24]. However, many systems today still lack the full interoperability of an EHR and are locally managed within one health care organization. These systems are usually referred to as electronic medical records (EMRs) [24].

The implementation of EMRs and EHRs in Canada and the US has been relatively slow compared to other developed countries [25]. While there are many reasons for this, some barriers discussed in the literature include potential impact on clinical workflow and clinicians’ workload, and insufficient training and support [26], [27]. Studies on support for HIT are scarce and they usually focused on formal personal support. For example, Fernando studied the experience of technical support staff in three Australian hospitals with a focus on privacy and security. She reported that support tasks were often fragmented and that support staff perceived clinicians as compromising privacy and security. Clinicians, on the other hand, believed that the support from IT staff was not adequate to ensure information privacy and security [14]. In another study of technical support in Danish hospitals, Petersen described the structure of support services, the multiple roles and skills of support staff, and the tools they used in their everyday work. The study suggested that support work is complex and highlighted its importance for keeping the hospital’s information technology in working order [12]. In contrast to personal and formal support, we were unable to find any research on impersonal support for HIT in general and particularly on informal technical documentation. In this study, we address this gap by examining tutorials and manuals developed for an EMR system and comparing formal and informal documents.

Concepts of Software Documentation

Below is a summary of some of the concepts and approaches for designing tutorials and manuals which informed our data analysis process for this study.

Structured Writing (Information Mapping®)—The concepts of structured writing emerged from research aimed at making learning in information rich environment an easier and faster process [28]. One widely marketed form of structured writing is information mapping; the three major principles of which are:

1. Information should be carefully packaged in small units that the users can easily digest. The basic units, called blocks, usually constitute of no more than 9 sentences and aggregate information that is relevant to one main point. Blocks are then organized in larger units, called maps, of 1–9 blocks related to a specific topic [28].
2. Units of Information (maps and blocks) should be clearly labeled to facilitate access and navigation. Structured writing offers systematic criteria for headings

and subheadings related to specific types of information (such as purpose, definition, rule, and example) [28].

3. Uniform presentation format should be used. Similar types of maps and blocks have to be presented in the same way to facilitate recognition by the user. Structured writing provides systematic specifications for graphics and text formats [23].

Additionally, the use of quick access points such as a table of contents, list of illustrations, or an index allows for easy navigation of tutorials and manuals.

Procedural and Declarative Information—Users read manuals for various reasons: to perform immediate tasks (“reading to do”), to collect and retain information for future recall (“reading to learn”), or both (“reading to learn to do”) [28], [29]. Procedural information which “is directly action related, encompassing information about the actions themselves, about their conditions for use, and about the results of these actions” [23] supports primarily reading to do. Declarative information “includes various forms of explanatory information about the program” [23] and therefore supports mainly reading to learn. Reading to learn to do is supported by combining both types of information. Designing tutorials and manuals that support all types of readings is a challenging task. As discussed below, some scholars suggest that tutorials and manuals should contain mostly procedural information and keep the amount of declarative information to the minimum necessary. In contrast, experiments conducted by Ummelen [30] “revealed that declarative information in user manuals is used spontaneously and that declarative information is useful when users have to work with software more than once. Moreover using declarative information does not seem to take extra time.” Therefore, she recommends including declarative information in user manuals; however, the questions of what type of declarative information should be included and in what format remain open.

Minimalism—The minimalist approach to software documentation was developed by Carroll and his colleagues in the 1980s. Observing how novices learn to use software applications, Carroll et al. noticed that users try to perform meaningful, real-life tasks as soon as possible [31], [32]. They attempt to learn systems by exploration rather than by following step-by-step instructions and while doing so, they often skip important information and make mistakes from which it may be difficult to recover. Carroll et al. [31] developed the minimalist approach in an attempt to support the way novices learn to use software applications. Where a non-minimalist manual would try to minimize reading problems by adding “control information” (such as sections on how to use the manual itself), thereby increasing its size, proponents of minimalist documentation would recommend the inverse—that is to “slash the verbiage” as much as possible [33]. The four main principles of minimalism are: 1. taking an action-oriented approach; 2. Anchoring the tool in the task domain; 3. Supporting error recognition and recovery; and 4. Supporting reading to do, study and locate [34], [35].

Visualization and Use of Screen Captures—Visual elements, and screen captures in particular, are commonly used in software tutorials and manuals [23]. Screen captures are

graphics or images of the computer desktop. They support a number of cognitive processes, including: 1. developing a mental model of the software; 2. switching attention between the manual and the screen by providing a quick entry point; 3. verifying screen states; and 4. identifying and locating specific objects and window elements. Design issues relevant to these processes include the positioning, coverage, and size of screen captures; the use of visual cues such as highlighted menu selections; drawing circles around objects; and using arrows or hairlines to point out window elements [36].

User-Generated Help

In his seminal work “Tracing genres through organizations,” [22] Spinuzzi argues that the common discourse in human-computer interaction (HCI) portrays the user as the victim of poorly designed systems and the designer as the hero coming to save her. However, he continues, users are not just sitting and waiting to be rescued. Rather, they develop their own solutions to problems. Through his “tracing genres” methodology, Spinuzzi examined these solutions and how workers use them to mediate their work. The solutions (or genres) identified include notes, maps, reports, node tables and forms. However, none of the genres described by Spinuzzi seem to fully fit the characteristics of tutorials or user manuals as defined above.

In recent years, there has also been much discussion of user-generated content within the context of Web 2.0. [37]. Most relevant to this study, software users often share information and offer help to other users through blogs, online communities and discussion forums, instructional videos posted on YouTube, and more. Despite this proliferation, there has not been much research on online user-generated software help and we were unable to locate any studies on user-generated tutorials or manuals. Thus, the current study fills in a gap in the work on user-generated help by examining a specific genre, user-generated tutorials and manuals, which has not been extensively studied.

Methodology

The purpose of this section is to provide in-depth description of the methods and the means for establishing rigor and trustworthiness we employed, so that researches can replicate, clearly evaluate, and improve the current design. The research question of this study was: what are the differences between user-generated tutorials and manuals for an EMR and the official user manual from the software vendor? We begin this section with an overview of the study design and the choice of research methodology, followed by descriptions of the research setting, data collection procedures, the qualitative data analysis process, and two focused quantitative analyses of error information and visual elements. Finally, we describe triangulation with interview data.

Choice of Research Methodology

We employed an embedded QUAL(uan) mixed methods approach to compare the manuals and tutorials developed by users at family health teams (FHTs) with the manual provided by the EMR software vendor. An embedded design is “a mixed methods [research] design in which one data set provides a supportive, secondary role in a study based primarily on the

other data type ... The premises of this design are that a single data set is not sufficient, that different questions need to be answered, and that each type of question requires different types of data" [38]. Our research question lends itself to qualitative research methodology. However, during the qualitative analysis we identified subsets of the data that could be quantitatively analyzed and corroborated with qualitative findings. This resulted in an embedded QUAL(quan) research design in which the primary source of information was qualitative and quantitative analyzes of subsets of the data provided additional and complementary insights. While the use of mixed methods is useful for ensuring trustworthiness, generalizability remains a concern. As in most qualitative research, this study is based on in-depth analysis of a small number of documents and it may not be generalizable to other software or settings. These limitations are further discussed below.

For the qualitative data, we employed a framework analysis approach. Framework analysis is similar to many other qualitative research approaches in that it is generally interpretive and follows similar stages including familiarization with the data, coding, and thematic analysis. However, in contrast to other approaches such as grounded theory, it allows for the inclusion of predefined as well as emergent concepts—for example in coding [39], [40]. Framework analysis was selected over more inductive qualitative research approaches since it allowed for the incorporation of concepts and principles from the abovementioned theories and approaches of software documentation into the data analysis process, thus making the research theory-informed.

How Data Was Collected

In this section we describe the process of data collection in detail. We begin with an overview of the research setting. We then describe the procedures for collecting document and the process for sampling and reviewing documents that match the characteristics of tutorials or manuals.

Research Setting—The subject of this study is tutorials and manuals for specific commercial software, which is one of the three EMRs most widely used by family physicians in Ontario, Canada. The system combines a clinical module with administrative functions as well as some interoperability with other systems (such as laboratories). The clinical module includes patients' medical histories, progress notes, specialist consultations, medications, lab results, and other clinical data. Administrative functions include patient registration, appointment scheduling, and billing. The EMR is an off-the-shelf product. The vendor installs the system and configures it for the users. However, because clients are usually small networked physician offices or clinics rather than large health care organizations, it offers only limited customization.

Our study involved four family health teams (FHTs) that use the same EMR system. The FHT is an emergent model of primary care in Ontario; first introduced in 2004 and currently serving approximately two million people [41]. FHTs are inter-professional organizations which, in addition to family physicians, usually involve nurse practitioners, registered nurses, pharmacists, other health professionals (such as social and mental health workers, dietitians, and physiotherapists), and administrative staff [42]. Physicians in FHTs are

compensated by the Ontario Ministry of Health and Long-Term Care on the basis of blended funding models that combine regular payment (on a capitation or salary basis) with additional fees for specific services and bonus payments for meeting targets defined by the ministry for preventive care and screening procedures (such as immunizations, mammograms, colonoscopies, and follow-up tests for patients with diabetes) [42]. All other staff members are funded by the FHT. These characteristics are common to all FHTs; however, there is great variation between FHTs in other attributes such as size, location, geographic distribution, and affiliation with hospitals.

Procedure for Collecting and Reviewing Documents—We collected documents from four FHTs that use the same commercial EMR system. Members of the research team reviewed all documents and selected those that met the definitions of tutorials or manuals (which will be referred to as “user tutorials” or “user manuals, respectively”) for analysis and comparison with the official user manual provided by the EMR vendor (the “vendor manual”). All of the tutorials and manuals included in the study were available in print, as well as electronic (MS-Word or PDF file), format. The vendor usually provided one copy of the printed manual for each clinic, but the PDF manual was installed on all users’ computers together with the EMR software.

We reviewed short tutorials of 4 to 24 pages in full. For the longer vendor and user manuals, we employed a purposive sampling strategy. First, we screened the tables of contents and sorted chapters into four categories on the basis of their intended audience: all users, system administrators, office administrative staff, or clinicians. For each of these categories, we reviewed the first five pages of the first chapter in the category plus eight consecutive, randomly selected, pages. In one FHT (D), two separate manuals were developed; one was intended for system administrators and the other for regular users. For the purpose of this analysis, we treated the system administrators’ manual as equivalent to the chapters for that group in the vendor manual. Thus, we reviewed a total of 52 pages from the vendor manual and 52 pages from the combined two user manuals (14% and 29% of the manuals, respectively, excluding tables of contents, indexes, and appendices). We employed this strategy rather than simple random sampling since it allowed us to determine whether the manuals take an action oriented approach from the start and begin with procedural information and real-life tasks.

How Data Was Analyzed

In this section we describe the data analysis process in detail. First we describe the qualitative analysis of tutorials and manuals including coding, matching data elements to theoretical concepts and identification of recurring themes. Next we describe the methods used to compare error-related information between the user and vendor long manuals. We then explain the processes by which we analyzed the type and potential roles of visual elements and compared the types of cues for identifying specific window elements in screen captures between the user and vendor manuals. We briefly describe the interviews conducted for the broader case study and how interview data were triangulated with the qualitative document analysis. Finally, we discuss the means we employed to ensure trustworthiness and credibility of the analysis.

Qualitative Document Analysis—Two researchers (AS and RD) independently reviewed the contents of selected texts against the principles and practices of technical documentation described earlier. We first read and annotated the documents to familiarize ourselves with the data and identify preliminary issues. Then, using the framework analysis approach described earlier, we employed open coding and charting to identify and match specific data elements with corresponding theoretical concepts from the literature and from the familiarization stage. We (AS and RD) then individually interpreted the data, looked for patterns and themes and identified emergent concepts. Initial agreement on themes was high (88%), and we discussed our interpretations in the research team to further refine concepts and reach consensus. Additionally, we conducted focused analyses of error information and visual elements in the long manuals as described below.

Focused (Quantitative) Analysis of Error Information—Two researchers (AS and RD) independently searched the sample pages from the vendor and long user manuals and prepared lists of comments interpreted as intended to prevent or correct errors. We included all of the comments identified by both researchers in data analysis, and reviewed all other comments, identified by either one of the researchers, with a third team member (CM). At the end of this process, we prepared a unified list of comments which all three researchers agreed contained error information. We (AS and RD) then classified these comments independently, using a 2×2 system based on comment type (information intended to prevent or correct errors) and type of error (that is, whether the error primarily related to working with the EMR system or to the workflow/work processes of the FHT). Initial agreement on categorization was good (Cohen's Kappa=0.760) and we discussed disagreements with a third researcher (CM) until reaching consensus. We used Fisher's exact test to test the significance of the differences in comment type and type of error information between the vendor and user manuals.

Focused Analysis of Visual Elements (Mixed Methods)—We reviewed all images in the short tutorials and sample pages from the long manuals in context and recorded the type of each image (such as photograph, flow chart, or screen capture). For screen captures, we determined the main cognitive process supported by the image and related design considerations using the theoretical framework described earlier as guidance. We also noted emerging themes. To ensure rigor, two researchers (AS and RD) conducted the analysis independently. For each document, one researcher reviewed all images in the sample pages (or full document in the case of short tutorials), and the other reviewed a subset of 25% of the images (randomly selected). Initial agreement on themes was high (90%) and we discussed disagreements to reach a consensus. Finally, we quantitatively analyzed the use of visual cues in screen captures for identifying specific window elements. First, we compared the proportions of screen captures, which contained such cues, between the two long manuals using Fisher's z-test. Then we employed a Chi-square test to compare the difference in the type of cues in the two manuals.

Triangulation with Interview Data—We conducted forty-two semi-structured interviews with EMR users, including some who were involved in developing user manuals and tutorials, for the broader case study research [43]. Ethics approval for the interviews was

obtained from the research ethics boards of the University of Toronto and participating family health teams (where applicable). We obtained written informed consent for interviews from all participants. Interviews were audio recorded, transcribed, and coded in NVivo 8 qualitative data analysis software using a coding system which included support source (informal/formal; personal/impersonal). For this study, we extracted and reviewed all information coded as “impersonal”, and corroborated it with the findings from the document analysis at the theme level.

Assuring Trustworthiness and Credibility—The main method we employed to establish trustworthiness is researcher triangulation [44]. As discussed above, two researchers independently analyzed the data and resolved disagreements through a consensus building process. Similarly, in the focused analysis, two researchers compiled the list of error comments and classified them and inter-rater reliability was calculated. Second, we employed methodological triangulation [44]. This was achieved by the mixed methods design, which involved a combination of qualitative analysis and quantitative focused analyses of subsets of the data, and triangulation of findings from the document analysis and interview data at the theme level.

Results

The results section provides a detailed description of the mixed-methods research findings. We begin with a brief account of characteristics of the FHTs from which data were collected and the documents included in this analysis. We then describe the main qualitative findings, followed by results pertaining to error information and the use of visual elements.

Characteristics of Participating Family Health Teams (FHTs)

We collected a total of 27 documents from four FHTs which use the same commercial EMR system. As presented in Table I, one large, one medium size, and two small FHTs participated in the study. Two FHTs (B and D) were co-located in an urban area and affiliated with teaching hospitals. One FHT (C) was co-located in a suburban area and another (A) was distributed in multiple locations in a rural area. FHT members included family physicians, nurses, administrative staff, and allied health professionals, which varied from one FHT to another (such as pharmacists, mental health workers, and dieticians). Various functions of the EMR were used by different members of the FHT depending on their roles.

Seven documents from two FHTs (A, C) and two documents from a third FHT (D) met the definitions of tutorials and manuals, respectively. We analyzed and compared these documents with the vendor manual as described above.

Main Qualitative Findings

The main qualitative findings pertaining to information mapping, action-oriented approach, generic vs. customized information, and support for learning by exploration is presented below. The findings indicate several differences between the user and vendor generated documents.

Information Mapping—All tutorials and manuals packaged information in small units that were clearly labeled; however, they did not necessarily conform to the structure of blocks and maps. User generated documents were less consistent in labeling units of information than the vendor manual: while both the user and vendor long manuals were generally consistent in their use of headings and subheadings, font types and sizes for headings and subheadings in user tutorials were not consistent and varied within the same tutorial. Both the user and vendor-generated manuals, but not tutorials, contained quick access points: tables of contents and indexes.

Action-Oriented Approach; Declarative and Procedural Information—The vendor manual contained more declarative information than the user tutorials and manual. As a result, the vendor manual was longer (371 pages; excluding features such as tables of contents and indexes) than the two user manuals from FHT D combined (179 pages). Tutorials ranged in length from 4 to 24 pages and only contained procedural information. Declarative information was particularly common in the first 2–5 pages of each section of the vendor manual, which started with an overview of the system, configurations, descriptions of data fields and EMR functions, and information about the manual itself. In contrast, all tutorials and all but one section of the user manual, started with procedural, task-oriented information.

Generic vs. Customized Information—The vendor manual seemed to be more generic than user tutorials and manuals and overlooked the specific workflows and procedures of the FHTs. Information in user tutorials and manuals in contrast, was customized to various user roles, the specific workflows of the FHTs, patient types, and other characteristics of the FHT (such as a hybrid paper–electronic environment).

Adaptation to various user roles was demonstrated in several ways. First, tutorials were often intended for a particular group of users (such as administrative staff, residents, or physicians) and only included tasks which are relevant to them. FHTs A and C, prepared a number of tutorials—each for a different user group—and FHT D had separate manuals for users with system administrator privileges and all other users (which, as described in the methods, we treated as a single manual for the purpose of this analysis). The long user-generated manual clearly indicated which groups of users are allowed to change preferences and settings for various functions such as drug interactions or letter templates. Another example is the description of the log-in process in the vendor and user manuals. The vendor manual described one generic log-in process with an indication that some users may be prompted to enter additional information depending on their roles. The user manual, on the other hand, provided different log-in instructions for various user groups (such as administrative staff, nurses, residents, or staff physicians) and the text clearly identified the users for which each log-in instructions apply.

Workflow-related information included instructions for various tasks of which EMR use is only part of the process. Examples include preparations before clinic starts, processes to follow when registered or new patients arrive, details of what information needs to be gathered from patients while booking appointments, problems which might arise when two administrative assistants attempt to book a meeting in the same time slot, or what to do with

unfinished progress notes. Some tutorials also included additional tasks for staff, which are not related to EMR use at all; such as answering the phone and cleaning the exam rooms.

Additionally, the user tutorials and manual were customized to the FHTs by inclusion of specific information, which is only relevant to them, such as names of specialists with whom the FHT works and lists of customized templates and forms available in the system. Finally, some instructions in the user-generated documents reflected the fact that the FHTs still work in a hybrid paper-electronic environment such as indications that if the electronic record is incomplete or whether paper charts need to be pulled out.

Interview data further supported the finding that user-generated documents were customized to their specific needs. One user, for example, contended that “the manual you get from the vendor is very generic. It’s how to run their system—it’s not how to run their system in your environment”. Another interviewee indicated that users purposely integrated workflow processes into their tutorials and manuals: “we know what our workflow processes are, which [vendor’s name] doesn’t know”.

Support for Learning by Exploration—None of the documents examined contained explicit invitations to explore such as “on your own” or exercise sections. However, the user-generated materials, but not the vendor manual, frequently presented learners with alternative ways of carrying out tasks. For example, several sections of the user manual offered the readers two ways to perform the same task. These were labeled “the long way” and “the short way”, thus indicating the recommended one. In other documents and sections of the user manual, alternative ways to perform the same task were indicated by labels such as “you can also...”, or by presenting menu selections and their keyboard shortcuts side by side.

Error Information

All tutorials and manuals contained information intended to prevent or correct errors. There was no consistency in the way this information was labeled in any of the tutorials and manuals, making it hard to distinguish from other types of information. Error information could appear within the same document under the headings “Note:” or “Tip”, or simply as part of the text. Some of the error comments were not directly related to using the system, but rather referred to errors in the work processes or workflow; such as “do not hang up the phone with the patient until the appointment is actually booked”. To further investigate this issue, we compiled a list of 53 comments containing error information from the 52-page samples of the vendor and user long manuals (23 and 30 comments, respectively). Thirty-five (35) of these comments were independently identified by two researchers and 18 were added from a list of 56 comments identified by either one of the researchers after review and discussion with a third team member. Table II presents the number of error-related comments, classified by type of comment (such as error prevention or correction) and type of error (such as errors related to using the system or to the work process).

Of 30 comments in the user manual, 18 (60%) referred to errors in work processes, and 12 (40%) to errors of working with the EMR system. In contrast, only 4 of 23 error comments (17%) in the vendor’s manual were related to work processes, and the other 19 were

associated with system use. This difference was statistically significant ($p=0.002$, Fisher's exact test). When examining comments intended to prevent or correct errors separately, there was significant difference only in preventive error information: of 20 comments in the user manual, 13 (65%) were related to work processes, compared to 3 of 16 comments (19%) in the vendor's manual ($p=0.007$, Fisher's exact test).

Use of Visualization

The most common form of images in all manuals and tutorials was screen captures. Except for one table which showed mailing label printouts produced by the EMR, this was the only type of image we found in the sample pages from the vendor manual. In contrast, the user tutorials and manuals also contained photographs (such as a "tap and go" health card reader) and flow charts. As demonstrated in Figure 1, these flow charts described teamwork processes and the integration of EMR use with the FHTs' overall workflows. They often indicated different actions for professionals who fill various roles within the FHT (such as, administrative staff, nurses, or physicians). Similar to Unified Modeling Language (UML) activity diagrams, several flow charts had an algorithm-like structure, using yes/no questions for decision steps (Figure 1).

Most of the screen captures in the vendor manual were positioned after text blocks containing action steps. They usually showed the results of performing these actions rather than the window on which they are performed. Although it was not always indicated in the text that the image showed the result of the actions described before it, this design was consistent throughout the manual. One exception was some screen captures, especially in the first chapter of the manual, which demonstrated the actions described in the text and their outcomes. Some of these screen captures showed the options which would be opened by clicking an item from the menu bar. In other cases, an image illustrating the actions described in the text was followed by a second image which demonstrated the results of these actions. The design and positioning of screen captures in the user tutorials and manuals was less consistent; some presented screens on which actions are performed and others presented the outcomes of various actions.

Another difference between the vendor and user manuals and tutorials was the use of visual cues to point out specific window elements. As seen in Table III, cues were found in 35% of screen captures from the vendor manual and the main type of cues was highlighted selections (fields, menu choices, and list items) as they would appear on the screen. One of the user tutorials did not include any images, and another included only a schematic representation of a window but not the actual screen capture. The proportion of screen captures containing visual cues in user tutorials and manuals which did use screen captures ranged from 37% to 86% of all screen captures. Forms of cueing varied, with highlighted selections and circling specific window elements (such as fields, text and buttons) being the most common types.

As a subset of the data, we compared the proportion and type of cues on screen captures on the 52-page samples from the two long manuals (from the vendor and user). There was no significant difference in the proportions of images containing visual cues to specific window elements between the two manuals (Fisher's z-test; $z=0.724$, $p=0.469$). However, the

difference in the type of cues employed was statistically significant ($\chi^2(df=3, N=86)=32.985, P=0.000$), with highlighting selections and circling being the main types of cues employed in the vendor and user manuals, respectively.

Conclusions, Limitations, and Suggestions for Future Research

Conclusion

In this study, we examined the differences between tutorials and manuals developed by users for an EMR system and the official user manual provided by the software vendor. Although as far as we can judge the vendor manual is a comprehensive and thoughtfully designed document that cannot be regarded of poor quality, it differed in several key aspects from the tutorials and manuals developed by users. These differences and their implications are discussed below.

In terms of the overall purpose of the manual, the vendor manual seemed to support all three types of readings discussed in the literature review: “reading to do”, “reading to learn”, and “reading to learn to do”. First, it included more declarative information than the user generated documents, especially in the beginning of the document and the main sections. Second, the use of screen captures in the first chapter of the vendor document to demonstrate actions and their outcomes suggests that their role is to support forming a mental model of the EMR. These findings suggest that the vendor manual is intended not only to support actions but also to educate the readers about the EMR and help them form a correct mental model of how it works.

In contrast, the user tutorials and manuals took an action-oriented approach by providing mainly procedural information and allowing users to act immediately. In the 1980's, Carroll [32] argued that “novices try to learn systems by exploration, although this strategy is not advisable—that is, from a more expert perspective—and, as our studies make painfully clear, is not supported by either the interface design or the manual design of current systems”. Both user interfaces and manuals have since significantly improved and Minimalism has become one of the most influential approaches in tutorials and manuals' design [23]. However, our findings suggest that this tension between developers, trainers, and technical writers' need to educate users and help them develop a mental model of the software and users' needs for immediate action and meaningful tasks still exists. We cannot conclude from this study which approach is better. In fact, determining the right balance between declarative and procedural information is one of the challenges for technical writers and, as Redish pointed out, users often read manuals to get help with specific tasks but sometimes they turn to them for learning purposes [29], [45]. Still, it is important to note the users' preference for task oriented manuals, as indicated by the documents they designed, which is consistent with the principles of Minimalism.

Second, screen captures on the vendor manual usually presented the outcomes of performing actions. Some screen captures, especially in the first chapter of the vendor manual, demonstrated actions followed by their outcomes. These designs suggest that the main role of screen captures in the vendor manual is to help users verify screen states and, to some extent, help them develop a mental model of the system. The role of screen captures in user-

developed documents was less consistent. However, they used visual cues which are more explicit (such as drawing arrows to, and circles, around objects rather than highlighting selections). As pointed out by Gellevij and van der Meij [46], visual cues can guide users' attention to, and help them easily locate, window elements and thereby reduce task complexity. Our findings suggest that users assign greater importance to the cognitive role of screen captures in helping identifying specific window elements than to the other cognitive roles described in the literature review. Developers of tutorials and manuals should take this preference into account when preparing software documentation.

Finally, while the vendor manual was generic user tutorials and manuals were adapted to the FHTs' specific inter-professional contexts by integrating EMR use with workflow information, tailoring information to different user roles, and accommodating for various patient types. This was evident from the qualitative analysis, the inclusion of workflow diagrams in the user tutorials and manuals, as well as from the greater proportion of work process-related error information in the user manuals.

The importance of context has been widely acknowledged in the technical communication literature, especially for complex tasks such as using HIT. Redish, for example, argues that "the task-oriented procedural manuals and help systems that are the mainstay of modern technical communication aren't sufficient for these complex situations" [47]. Mirel suggests that the focus of documentation for complex tasks and advanced users should become "activity in context" and that instruction should be designed around problems faced by users in the workplace [48]. Others argue that technical writing for complex tasks requires good understanding of the knowledge domain in which the system is deployed [49].

However, understanding the general knowledge domain may not be enough. Health care settings are complex environments, each with its own unique characteristics, routines, and workflows. It is now widely acknowledged that implementing HIT often results in changes to work processes, and that understanding the organizational workflow is crucial for HIT successful design and implementation [27], [50], [51]. Preparing contextualized tutorials and manuals specifically tailored to the FHTs and their work processes may be seen as part of an implementation strategy but, until now, not much attention has been paid to the way tutorials and manuals for EMRs are structured and the impact this may have on systems' assimilation and use. To our knowledge, this study is the first to provide an in-depth analysis of user generated tutorials and manuals and describe how they are adapted to the specific contexts of the users.

Our findings suggest that, even when it is fairly task oriented and embodying domain knowledge, generic documentation provided by vendors may not be sufficient. Tutorials and manuals need to look at the broader goal of the users and the overall work context of software usage [45]. These work contexts may be highly specific, which raises some questions about vendors and users' responsibilities. For example, is it the role of the vendor to customize help documents to each client's setting, especially if the product itself is customized? It is our position that alternative approaches to preparing better contextualized user manuals should be sought. Such approaches may include providing lists of generic workflows, diagrams, and worksheets in tutorials and manuals or modular manual designs,

which can be adapted and rearranged by the users in various ways, depending on specific contextual factors. These ideas are consistent with Spinuzzi's suggestion that "trained information designers can contribute much to the emergent innovations of workers, not by replicating those innovations with centralized solutions, but by helping to design systems that workers can modify." Another approach may be participatory design, which involves users in the preparation of tutorials, user manuals, and other forms of impersonal support—similar to the now widely accepted participatory approach to system design [52]. Specifically for EMRs, these approaches may especially be beneficial for small family practices which do not have the time or resources to invest in preparing their own manuals.

Limitations

The small sample size of tutorials and manuals, and the fact that they were all for the same EMR system, are the main limitations of our study. This is typical of qualitative research which seeks to provide in-depth insight into phenomena but is often based on case studies or small samples. Even though our findings provide some interesting insights for the development of tutorials and manuals, they may not be generalizable to other settings and software applications. Second, because tutorials are short documents, which are limited to specific aspects of using a system, only long manuals, from which equal numbers of pages were sampled, could be statistically compared. Due to the small number of documents included in this analysis and the fact that the vendor provided only a manual but not tutorials, we could not analyze tutorials and manuals separately. Finally, although interviews provided some insight into users' reasons for developing their own tutorials and manuals, they were not specifically designed for this study and therefore only provided limited information.

Suggestions for Future Research

This study opens several directions for future research. First, more research is needed to determine whether our findings are generalizable. Future research needs to include a larger sample of tutorials and manuals for various types of software (not necessarily EMRs) and from additional user groups. Although similar themes were identified through our qualitative analysis, future research should strive to compare tutorials and manuals separately.

Second, in this study we took an indirect approach, which allowed us to identify user preferences for and potential design elements which may be included in tutorials and manuals for EMRs and other software (such as explicit visual cues on screen captures, action oriented approach, and contextualization). However, more explicit research methodologies are required to better understand the reasons for, and the process of, developing tutorials and manuals by users and their design considerations. This may be done by in-depth interviews with users who developed their own tutorials and manuals or ethnographic research that would follow the development of user-generated software documentation.

Finally, printed documentation is not the only form of impersonal support available to users. Many software vendors, for example, provide animated tutorials or instructional videos on their websites and many user-generated video tutorials are available on social media such as

YouTube. Building on the current research approach, comparing vendor- and user-generated assistance may help reveal unmet user needs and design elements which could be incorporated into these other forms of impersonal support.

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Figure 1.

A flow chart from the user-generated manual demonstrating integration of EMR use into the FHT's workflow. MD=Physician, RN=Nurse, SY=Secretary, SC=Scanning Clerk. Used with permission.

Table I

Characteristics of participating family health teams (FHTs)

FHT Attribute	A	B*	C	D
Size	Large (>30 physicians)	Small (<10 physicians)	Small (<10 physicians)	Medium (10–30 physicians)
Area	Rural	Urban	Suburban	Urban
Distribution	Distributed	Co-located	Main + satellite sites	Co-located
Affiliation with a hospital	None	Yes	None	Yes
Time using the EMR (months)	> 24	>24	12–24	7–12
In-house or hospital technical support	None	In-house, hospital	In-house (partial)	In-house (partial), hospital

* FHT B did not provide documents for our study; however, interviewees from this FHT indicated they had developed and used their own manual.

Table II

Number of error-related comments in the 52-pages samples from the vendor- and user-generated manuals

Comment type		Error type		
		EMR system	Process/workflow	Total
Preventive	Vendor	13	3	16
	User	7	13	20
	Total	20	16	36
Corrective	Vendor	6	1	7
	User	5	5	10
	Total	11	6	17
Total	Vendor	19	4	23
	User	12	18	30
	Total	31	22	53

Table III
Number of screen captures with visual cues on vendor and user manuals and tutorials

Document	All screen captures (N)	Highlighting specific window elements	Circling around window elements	Arrows or lines	Total*	% of all screen captures
FHT A; referring patients to the FHT (tutorial)	0	0	0	0	0	0
FHT A; entering reports tutorial	1 (schematic representation of a window)	0	0	0	0	0
FHT C; new employee orientation guide (tutorial)	27	9	8	0	16	59.3
FHT C; resident orientation guide (tutorial)	35	8	5	0	13	37.1
FHT C; referral process for physicians (tutorial)	7	3	2	0	4	57.1
FHT C; referral process for administrative staff (tutorial)	7	4	6	0	6	85.7
FHT D; manuals (sample pages)**	32	0	16	1	17	53.1
Vendor manual (sample pages)**	54	20	2	1	23	42.6

* Each screen capture may contain more than one type of cueing. Therefore, the total number of images with cueing may be smaller than the sum of individual cue types.

** Proportions and type of visual cues compared quantitatively.