Cautious, but Optimistic:
An Ethnographic Study on Location and Content of Primary Care Providers using Electronic Medical Records

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***Abstract*—The integration of technology into primary care facilities has the potential to improve patient care, but also may disrupt provider workflows. Technologies that are designed to fit the use patterns and ideal interactions of providers will be better accepted and utilized. Our ethnographic study of Electronic Medical Record (EMR) usage by 10 primary care providers identified *where* providers utilize the EMR system and what tasks they complete at those locations. Because the majority of providers only wanted to view and extract information from the EMR system in the exam room, we suggest a more cautious approach to deploying technology in primary care facilities. Until EMR technologies are designed to fit provider documentation workflows, providers should focus on retrieving information from these systems in exam rooms instead of inputting information. We present design considerations for technology to support data viewing, documentation, and collaboration in primary care.**

I. Introduction

The transition from paper medical records to Electronic Medical Records (EMRs) can revolutionize the way healthcare providers care for patients. Providers can collect, access, and share more information about their patients than ever before. Unfortunately, these systems sometimes hamper the way providers work because of complex information input [4, 22] and viewing mechanisms [30, 36, 37]. Designing these systems without consideration of providers' needs and ideal usage scenarios leads to inefficient workflows.

Researchers have investigated how to infuse technology into clinical care environments [3, 21] and improve clinical documentation input mechanisms [1, 6, 20, 23]. In addition, researchers have qualitatively explored patient and provider experiences in clinical environments [13, 14, 33]. We answer some of the questions raised by previous work [14] with regards to the practicality of using technology from the provider perspective. More specifically, we provide an understanding of how an EMR system impacts clinical documentation workflow for primary care providers.

We collaborated with a small clinic at a large, public university to evaluate their EMR system usage. In this paper, we report on our ethnographic study, which led us to identify differences in *where* 10 providers complete their clinical documentation. After 52 hours of shadowing and 7 individual interviews, we found that providers who completed their documentation in a shared office space prioritized the coordination of patient care. Whereas providers who documented in the exam room completed their EMR tasks more quickly. Overall, we found that providers created their own workarounds to overcome issues with the EMR.

From these findings, we discuss the possible role of pervasive technologies in primary care practice. Although there have been many technological innovations in healthcare, we caution the community to consider the goals and workflows of providers before designing technology to support input, viewing, and collaboration. In some cases, the best solution may be to limit the role of technology in the practice of primary care medicine. By considering workflows specific to primary care, appropriate technologies can be developed for this domain.

II. Related Work

We provide a brief overview of the importance of documentation in healthcare settings, research that has investigated documentation workflows, and the role of pervasive computing in addressing issues with information input and retrieval. We conclude with a summary of EMR usability findings relevant to EMR design.

A. Documentation and Workflow

Clinical documentation plays an important role in patient care, billing, public health, and legal defense [9, 40]. Providers use information in medical records to support their decision making process for providing care [11, 27, 29]. Tang et al. found that providers constantly referenced paper-based patient records to provide care, however they could not always find the information they needed. Almost half of the providers could not determine what had been done by past providers. This forced them to make decisions without information [29]. From these findings, we can deduce that documentation generated by providers must be clear, complete and concise and that technology must support this process.

Researchers have studied the role of EMR systems in the documentation process. Many of these studies have looked at how providers enter information into the EMR system for documentation [2, 32] and how that influences the quality and completeness [31]. Walsh combined his personal experiences with a literature review to discuss the impact of the computer

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on the provider documentation process [34]. Our study looks at a similar topic, documentation in the EMR, however we expand on this work by completing an observational study with multiple providers.

Fewer studies have explored how documentation into EMR systems influences the overall workflows for providers. Recently, Chen identified the objects providers used to record information in an emergency department EMR [8]. These "transitional artifacts" impacted the way providers completed electronic documentation - influencing *when* providers documented patient encounters. This study focused on a hospital setting, whereas our study investigates EMR documentation in primary care workflows.

To augment the EMR documentation process, researchers have explored introducing pervasive technologies into the healthcare facility. Speech recognition software is a possible solution to the time consuming process of documentation [1], however this technology is immature and performs inconsistently in most clinical use [10]. More efficient login mechanisms suggested by Bardram [3] would support easier access to the EMR and potentially increase utilization of a stationary computing health system. Recent research has suggested integrating mobile computing as a way to improve EMR access and usage [6, 20, 23].

B. Usability in EMR Systems

Usability problems are a serious concern in EMR systems and one of the major barriers to their adoption among physicians [7, 15, 38]. Chief among these are problems with information presentation, excessive user interface customizations, complex or excessive user interface interactions, and data entry problems [4, 22]. Systems overwhelm practitioners with excessive data presented in non-meaningful ways [30, 36, 37]. The way EMR systems allow providers to input data has also proven problematic for providers. Either systems demand a large amount of input from the provider or fail to collect enough information [35, 39].

The previous research on the importance of information input and presentation in EMR systems, and a lack of research on the topic directly in primary care medicine motivated our team to focus on information presentation as one of the themes for our study. Researchers must understand the needs and practices of users to design usable technology for this domain. Because primary care workflow and treatment focus differs from other specialties [25] there is a need to understand the technology usage behaviors in this environment.

III. Methodology

Administrative staff from the health center approached our team about decreased patient throughput after the implementation of an EMR system a year prior to the study. We collaborated closely with administration, staff, and ethics groups for two years to design and deploy the study as described here.

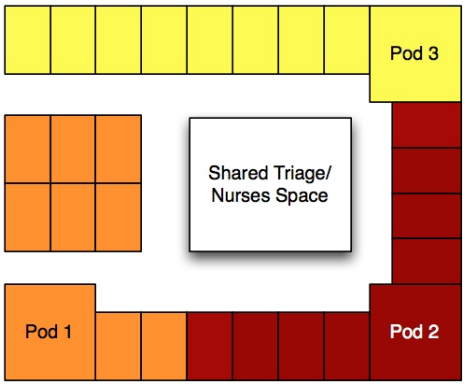

Fig. 1. The layout of the primary care clinic. The colored rooms without labels are exam rooms that are managed by the same colored pod

A. The Facility

An on-campus university health center hosted our research study. This health facility served a campus with an undergraduate population of over 27,000. The primary consumers of health services were students, both graduate and undergraduate, typically ranging from age 18-24 years. The on-site services included a primary care medical clinic, sports medicine, psychological health and psychiatry, women's health clinic, pharmacy, X-ray, and laboratory. All the services utilized a single EMR system.

This study focused only on the primary care service operated by 15 providers and additional support staff. Providers were assigned to one of the three pod spaces that served as shared office spaces. Each pod had a laser printer, secure prescription printer, white board, shared computer stations for medical assistants, and assigned computer workspaces for each provider. As shown in Figure 1, each pod was assigned a set of exam rooms to see their patients. Staff within each pod coordinated exam room utilization by verbal communication and white board usage.

Each exam room contained a computer workstation in addition to standard medical equipment and supplies. These computer workstations provided full access to the EMR system, but operated noticeably slower than pod space computers. Providers logged into these systems by typing their username and password.

B. Participants

After we sent out an email recruitment message to the providers, an administrative staff member followed up with 10 providers to recruit them in person. Our study included direct observations of four physicians and six nurse practitioners. We conducted individual interviews with four physicians and three nurse practitioners from the original ten participants.

For simplicity, we refer to both physicians and nurse practitioners as "providers." All providers are referred to as female to protect confidentiality. The providers in the clinic worked as primary care providers - they all interacted with patients in a one-on-one setting, completed documentation, reviewed

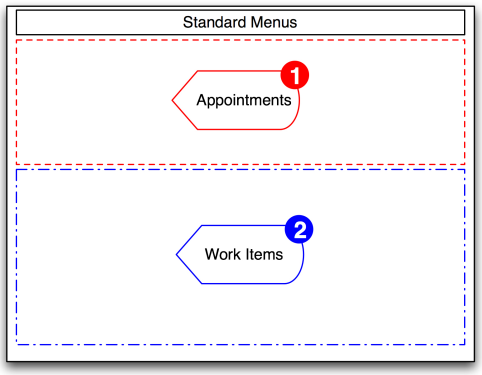

Fig. 2. Wireframe of EMR Home Screen: (1) Upcoming appointment information for providers; (2) Work Items for provider to access (e.g., SOAP notes, lab orders)

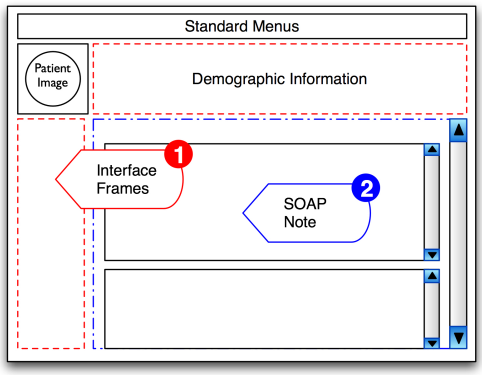

Fig. 3. Wireframe of EMR SOAP Note screen: (1) interface frames available on Patient Summary and SOAP Notes; (2) SOAP Note work area

test results, and managed referrals for patients. Each provider cared for 12 to 21 patients each day depending on the different reasons for visits.

Participating providers had worked at this clinic for as few as four months to as many as sixteen years. EMR usage experience also varied from a single EMR exposure (only the current system) to three (including the current system) different EMR systems. All participants self-reported that they were proficient at completing general computer tasks such as email, web browsing and word document production.

C. The Electronic Medical Record system

The EMR system used by providers had three main work spaces - the home screen, the Subjective, Objective, Assessment, and Plan (SOAP) note, and the patient summary screen. The *home screen* served as the main work space for the provider. It was broken into two windows on the screen. The top window (Figure 2 - 1) listed upcoming patient appointments, their arrival status, and the exam room designated for the patient. The bottom window (Figure 2 - 2) listed open work items that the provider needed to complete and provided navigation to other areas of the EMR. The open work items included incomplete patient documentation notes, completed lab test results that needed to be reviewed, and unread secure messages from patients or colleagues. Items were removed from this screen when they were completed.

The *SOAP note* (Figure 3) was used by practitioners to document patient visits. The note contained four main sections to correspond with the acronym. Within each of these sections was the option to add narrative free-text or templated data. The host facility designed the templates used by providers, while the EMR vendor developed the rest of the SOAP note. Providers interacted with a single screen to complete the SOAP note - only seeing additional screens when adding templates or orders. This means that providers scrolled down the long SOAP note screen to reach all of the sections. After working on a SOAP note, providers had the option to save a draft of the note or lock the note. If a note was "locked," it was immutable and sent to administration for billing purposes.

The *patient summary screen* showed providers relevant information regarding a specific patient. The main page of the patient summary screen listed pertinent history, allergies, medications, discontinued medications, family history, diagnosis history, learning barriers, and immunizations for the selected patient. Providers accessed notes from past visits to this facility, lab results, and X-ray history for a specific patient by clicking on a navigation bar in the left frame.

D. Data Collection

The focus of our ethnographic observations and interviews was to evaluate the EMR usage patterns of primary care providers. We created a data collection form and a clinic diagram to document observations of providers based on trial shadowing periods. We shadowed providers in the primary care unit while they worked, including meeting with patients. The final part of the data collection included interviews where we could discuss and confirm our observations.

1) Observations: Before beginning observations, we obtained Institutional Review Board approval for the study from the governing university and approval from the administrative leadership of the host facility. We observed providers for 3.5 - 5 hour sessions. An even distribution of observations occurred in the morning and the afternoon. Four providers scheduled two observation sessions, while the rest of the providers were shadowed a single time. We observed a total of 52 hours of provider work with written notes. The facility did not allow voice recording. All observations were collected by a single researcher and verified by the research team.

We observed 15 patient visits in the exam room to better understand the role of the computer system in the patient-provider interaction. Patients signed informed consent forms after researchers fully explained the study. Because our study focused on the computer interaction, we did not document any information regarding the patient. Instead we documented what EMR tasks, if any, the providers completed in the exam room and patient-provider eye contact.

2) Interviews: After completing the shadowing events, 4 physicians and 3 nurse practitioners participated in semi-

structured interviews. These events lasted between 22 and 55 minutes. We asked a small set of identical questions to all providers and questions specific to each provider about events we observed during shadowing. A total of 7 providers were interviewed. Four of the interviews were audio recorded, while the other three were only documented by writing due to scheduling constraints. The audio recorded interviews were transcribed for analysis.

E. Data Analysis

Our observation notes and interview transcriptions were open coded using the TAMS Analyzer Qualitative Research Tool. We used a deductive approach based on the initial agreed upon themes of interest, and an inductive approach that allowed new themes that the research team had not discussed to emerge from the data. Each primary code and its associated quotations were then reviewed and discussed by the research team. Discrepancies in analysis were discussed, revised, and synthesized into a core set of themes. Members of the research team identified quotes during analysis that were particularly illustrative of these themes. Once the data was coded, we confirmed observed behavioral commonalities with coding frequencies. We used co-frequency analysis to further refine a set of findings from our data.

IV. Findings

The question of where providers utilize technology and to what extent they use that technology in different locations has relevance to the design of pervasive technologies. One of the major interactions providers had with the EMR was for documentation of patient encounters. The process of documentation included recording all of the interactions a provider had with a patient during their visit. They entered subjective and objective data, an assessment of the patient, and their plan for care. This process was distinct from general use of the EMR system, such as viewing patient information or ordering tests and medications. Six providers accessed the EMR in the exam room when necessary only to view patient information or enter orders. Two different providers completed full documentation in the exam room. The last two providers had no interactions with the EMR in the exam room.

In our findings we group providers into those who documented the patient encounter in the exam room and those who did not, without considering general usage of the EMR in the exam room. We refer to these groups as providers who *documented in the exam room* and those who *returned to their pod* office space to document. We separated providers into these two groups because we identified the most meaningful patterns and behaviors between these two groups. Here we report different motivations, benefits and consequences related to documenting in each location.

A. Return to Pod to Document

Providers who returned to the pod to complete documentation had limited interaction with the EMR system during the patient visit. We observed that providers who used this workflow had more eye contact with patients, coordinated care with the medical assistants efficiently, and had more time to write detailed narratives. Since providers waited until they returned to the pod to document patient encounters, the documentation was sometimes completed hours after the encounter when notes could have been lost. In addition, we found that providers did not log out of the EMR system in the pod room.

1) Benefits: P1 demonstrated how not utilizing the EMR in the exam helped focus the visit on the patient.

> Case 1:[1]P1 walked into exam rooms and did not interact with the EMR at any point. For the entire visit, the provider maintained eye contact with the patient when conversing. After finishing the patient interaction, P1 returned to the pod to complete the documentation for the patient.

Returning to the pod for documentation allowed the provider to maintain more eye contact and talk to the patient.

This workflow also supported the providers ability to prioritize patient care even before seeing the patient. They could participate in the coordination of patient treatment more readily because they were present in the pod space more often than providers documenting in the exam room. If a patient required a test or treatment prior to seeing the provider, this could be communicated between the provider and medical assistant because they were more accessible.

> Case 2: P2 was completing documentation from a previous visit encounter as a medical assistant explained to her that the next patient had a sore throat and might need a strep test. The provider agreed and gave an order for the medical assistant to conduct a strep test on the patient.

If the provider had not been available, the medical assistant would have to wait until the procedure could be verified with the provider. This quick coordination made efficient use of everyone's time and kept the workflow moving.

Because providers shared exam rooms in this facility, they constantly needed to recycle the rooms for the next patients. This meant the time for providers to document the patient interactions in the exam room would be limited to the length of the visit, typically 15 minutes. It would be difficult to synthesize the visit and describe it in a detailed narrative in this time frame. Returning to the pod enabled providers to take more time narrating the encounter with the intent of capturing important details for future care. P10 felt this was important:

"Like I will write down everything on [a piece of paper] and then when I get back into my [pod], not only will I have had some more time to think about it, but if I had transcribed things directly as the patient said them, it would be kind of gobbelty gook ... [where] it doesn't make linear sense"'

Writing a narrative at a separate time from the patient encounter gave her the opportunity to think about the patient's problems as an easily discernable problem with a resolution instead of a disconnected set of facts.

[1]Cases are transcriptions from field observation notes.

2) Problems: The return to pod workflow displayed *problems* that may inhibit the provider from successfully completing patient documentation. All of the providers that returned to the pod to document wrote on pieces of paper, creating transitional artifacts [8], to temporarily save notes about patient encounters. Providers were at risk of losing their notes during the day. Two providers encountered this problem during shadowing, including P5:

> Case 3: P5 visited a patient during her day without using the EMR in the exam room. She interacted directly with the patient, taking notes of pertinent findings on a piece of paper. She returned to her pod space to enter a pharmacy order into the EMR system and drop off the notes from the visit. Once the order was entered, the practitioner returned to finish the patient visit. This visit was not documented until over two hours later. When the provider began documenting the visit, she could not locate the paper containing the visit notes. Even with the help of a medical assistant, the provider was unable to locate the note after fifteen minutes of searching.

A majority of providers expressed concern about missing visit documentation because of the amount of time that quickly adds up between seeing patients and being able to document their interaction. For some providers, there could be as many as eight hours between seeing a patient and documenting the visit. The problem was exacerbated if a note was lost, as in Case 3, or if a provider decided to not take notes during an encounter. This was a legitimate problem because providers rarely returned to their pod between patient encounters in the busy clinic. We found that the more time that passed between the visit and documentation, the more problem a provider had recalling information about that visit. Several providers commented that they tried not to leave visits undocumented for long because they could "forget what's go on" (P9) with that patient. The similarities among many acute care patients also made it more likely to forget specific details for a patient. P9 worried that after a while she might lose track of patients:

> *And yea, I don't like to leave charts sitting. Cus then I also forget what's going on ... I think there are safety issues there ... or like if there are a lot of things that are similar, then it can start being like - which patient is that?*

Another issue we found was that providers did not log out out of their pod space computers. Indeed, we only observed two providers lock their workstation at any point during our observational study, and even those providers were inconsistent with their logging in/out behavior. P9 told us that, *"the biggest barrier for me [to using the EMR] is logging in and out of the computer. It's just like one more thing to do."* This problem was more prevalent with individuals documenting in the pod because they returned to their pod computer more often than providers documenting in the exam room.

B. Documenting in the Exam Room

Two of the observed providers completed the entirety of their patient documentation in the exam room during and immediately after the patient interaction. These providers had the benefit of having all the patient information available during their visit and completing notes more quickly because they were working with the EMR during the visit. They were also less likely to forget information obtained during a patient interaction by documenting as they worked. A negative side effect of documenting in the exam room, however was the decreased eye contact with the the patient during a visit. In addition, sometimes the efficiency of real time note taking in the EMR increased the amount of work a provider had to complete whey they wanted to add notes after an encounter had been saved.

1) Benefits: During shadowing, we observed that providers who documented in the room would complete all the work for a patient before seeing the next patient. Here we highlight this *benefit* of documenting in the exam room:

> Case 4: During one shadowing period, P4 saw three patients at the beginning of the day before turning on the computer in the pod space. She went directly from one exam room to the next exam room without stopping to interact with any individuals. The researchers were unable to observe these patient interactions and the documentation associated with them, but P4 confirmed that the notes for all three patients were completed before touching the pod space computer. At this time, the provider had not fallen behind on her schedule.

This process appears to be effective for completing documentation and seeing patients. Neither of these providers had to spend much additional time working on their notes outside of the time spent in the exam room. The only time P4 was observed working on notes in the pod was when a patient arrived late and disturbed the workflow of seeing patients. Since these providers were inputting the information for the patient into the EMR as the interaction occurred, there was very little time between the interaction and the providers documentation of the interaction. This meant the information in the SOAP note had an increased chance of being more accurate.

Providers were able to quickly input templated information and retrieve information from the system while in the exam room because the provider was already working in the EMR. We observed P4 check the immunizations and histories for one patient during the visit - switching from the open SOAP note to the patient summary screen, then back. This provider would be more likely to check this information because she was already using the EMR and had completed the tasks of logging in and opening the patient's records.

2) Problems: There were *negative* consequences associated with documenting in the exam room. The most problematic was the distraction from the patient interaction due to the provider being engaged with the computer system:

Case 5: Before she began discussing the symptoms of the patient, P7 logged into the system and pulled up the patient's summary information. As they began discussing the problem, the provider started typing into the narrative section of a SOAP note about the encounter. As the conversation between the patient and provider continued, the provider kept documenting the interaction in the SOAP note - not verbalizing what she was doing in the system. Throughout the visit the provider conversed with the patient while looking at the computer screen.

It was intuitively clear that the computer distracted from the provider-patient interactions. Although P5 did not document in the exam room, she was able to clearly summarize the potential problem with documenting in the exam room:

> *Yes, I know that is the problem with the computer system - it just sucks you right in enough so that you move your focus. You move your attention to that. It takes attention away from the patient, whereas jotting notes doesn't.*

When a note was completed in the exam room, there was less time for the provider to review that note and think about any additional information that might be necessary. Often the providers would forget small details that were not crucial to the treatment of the patient at that moment - though they may prove useful in the continuity of care. Occasionally the missed information would be necessary to have in the note, so the provider would have to make sure this information was added into the system. This EMR system, however did not make that easy as demonstrated by the following case.

Case 6: We observed P7 during a patient encounter complete the entire note for the visit. She used several templates while speaking with the patient then flushed out the note with a small amount of free-text and orders before locking the note in the exam room. Before the provider left the exam room at the end of the visit, she realized she had not input the lab order for this patient. She then annotated the locked SOAP note with a note specifying that the lab test was ordered and to refer to a second SOAP note for the details. The provider then opened a second SOAP note for the same visit, added some required diagnosis information, completed the order, and locked this note.

In the end, what seemed to be a large savings of time by documenting in the room turned out to take extra time and created extra documentation clutter. The additional documentation did not add additional meaning to the visit, it only served to make sure the lab test was ordered and documented.

V. Discussion

Our study identified usage patterns of an EMR system by primary care providers with respect to *where* they document. Overall, we found that providers viewed some parts of patient data in the exam room, however most of them preferred to document after they had more time to think about the patient encounter in the privacy of their pod space. Documenting in the pod also gave providers more time for face-to-face care coordination discussions with other providers.

A. Short-Term Considerations

Each place - in the pod or the exam room - that providers documented patient encounters had benefits and barriers for optimal documentation. Based on our observations, interviews, and the EMR system available to the providers, we recommend that providers who use an EMR with similar limitations *document patient encounters in their office space (pod)*. We advocate, however that the *provider utilize the EMR in the exam room to view patient information, if necessary, to provide patient care*. Even if providers review patient information in their office space before the visit, it would be unreasonable to assume providers can remember all of this information, thus reinforcing the importance of reviewing it in the exam room.

B. Future Design Considerations

We acknowledge that there is a trade-off when designing EMR systems - designers must minimize the interaction time providers have with the system while maximizing providers' ability to accurately document encounters with the most meaningful information possible. We found that templates gave providers the ability to quickly document encounters in exam rooms, however they did not always support providers' need to detail more narrative information. Although one may argue that providers need more fields in the template to document the narrative data to easily compute some meaning, we believe that this would just increase the complexity of interactions and time investment with navigating the EMR. Thus, with this trade-off in mind, we provide some optimistic, yet cautionary design considerations to appropriately scope technology in primary care settings.

1) Support Viewing Information: Researchers introducing pervasive technology into the exam room must consider *what kinds of tasks providers prefer to complete in the exam room*. Frankel et al. [14] found that providers had varied goals and desired interactions with EMR systems in exam rooms. Our study extends this idea by identifying that the majority of providers wanted to use the EMR in the exam room to view information in the system - instead of creating documentation. This suggests that providers would only utilize a small set of EMR functions in the exam room - viewing patient information and ordering medications, labs, and imaging. We envision systems that augment current mobile reference applications (e.g., Physician's Desk Reference) with this subset of functionality to meet providers' needs while reducing the interface complexities for easier interactions.

Another part of viewing patient information is sharing the information with patients to educate them about their health [5, 28]. Although some researchers have suggested that large displays in exam rooms would enable patients and providers to view information together [33], we note that a majority of the providers were concerned with the computer

screen "sucking" them in and thus moving their attention from the patient to the computer. More research needs to be done in this area to better understand if this type of technology better facilitates or distracts from provider-patient communication. To decrease the possibility of distracting the provider with technology, we recommend that *information be graphically visualized with relevant clinical guidelines to help providers quickly identify trends and areas of concern*. This information could also be easily shared and communicated with patients to help them better understand their course of treatment and their health status. With this consideration, *technology should accent talking points instead of dominate the interaction*. An example of this is a care plan application where breast cancer patients and their providers could easily coordinate treatment with a visual interface based on the patient's schedule [17].

2) Facilitate Documentation: Independent of where providers documented, we found the input mechanisms in the EMR system to be deficient. Similar to Bardram et al. [3], we found that providers sometimes did not log out of the EMR and thus left patient information unsecure. In addition, free text narratives are time consuming and cognitively intense, while templates are unable to capture unique patient situations and atypical clinical information. *Faster, more complete mechanisms for patient documentation are needed to increase provider productivity and improve patient care.*

Previous studies have recommended voice recording, video recording [33], and ubiquitous sensing [13] as useful mechanisms for capturing information during the patient-provider interaction. However these tools must be scoped and designed appropriately to support the provider instead of requiring additional work. Providers do not have time to watch or listen to an entire visit, so there must be a way for them to locate relevant information. *Mechanisms for providers to enable and disable recording during patient interactions or tag important discussions at the point of care may help.* A system similar to CareLog [16], where special education teachers could press one button on a key fob to record a specific time before and after the button press, could give providers enough information to aid in documentation. Alternatively, the Abaris system [19] provides a nice example of how occupational therapists could tag patient skills during therapy for later review. Without these mechanisms they would need to sort through a recording of an entire visit to glean relevant details. Another consideration is to use the recorded data as "documentation," however the recordings would need to undergo extensive processing, both speech-to-text and natural language, that can identify relevant information and save it appropriately.

3) Promote Collaboration: Sensors and other ubiquitous technologies have been proposed to help track and coordinate provider movement and work [21]. In this study, the researcher was utilized as a beacon to provide a rough estimation of where certain providers were located in the clinic - either in the pod space or with a patient. Based on the preferences of the providers to have a rough estimate, instead of a specific location, we encourage the community to investigate *various abstractions of location awareness to provide individuals with some privacy while promoting collaboration* in primary care.

Work by Scupelli et al. [26] suggests that technology should help bring providers and support staff together to improve communication. Our findings support this finding - sensor technology cannot replace all the dynamic coordination of care conversations providers consistently have throughout the day in pod spaces. Currently, technology has limits in its ability to support consultation between providers on difficult cases and coordination of care between support staff. *Researchers studying primary care facilities must scope tracking technology appropriately to support interactions that already occur between staff.*

For the providers we studied, their computers in the shared pod workspace consistently brought them in close proximity to discuss patient care. *We suggest primary care facilities evaluate integration of a shared technology space* - whether this is in the form of a shared office workspace or large screen displays that provide relevant patient coordination information [12, 26].

C. Limitations

Since we studied only one primary care practice, we cannot guarantee these usage patterns are similar to other clinics. Studies have found that providers use EMR systems less in exam rooms at some facilities [24], while others have reported that a majority of providers utilized the EMR in the exam room [18]. Conflicting reports suggests many of these behaviors may be attributed to the specific healthcare facility or EMR adopted. We contend that the usability of data entry into the EMR contributes to the likelihood of providers documenting in the exam room, although more research is required to investigate this.

The providers in our study primarily created free-text narrative notes. Based on our discussions with them, we found that this was partly due to their belief that these notes improved patient outcomes. However, this is unverified and needs to be further studied. We cannot be sure that additional information documented in the note as a well-formatted narrative positively impacts patient outcomes. Our study was limited to only recording interactions with the system and did not look at the patient data because of ethical concerns. We encourage researchers to share their ethics protocols for clinical shadowing so that more clinical shadowing studies can be conducted with multiple data sources (e.g., EMR input and interactions).

VI. Conclusion

With the increasing use of EMRs in primary care practice, it is imperative to step back and understand the goals and workflows of providers before designing healthcare technology. Our study examined the EMR usage workflows in a primary care setting and found that the location where providers documented clinical data affected the way they practiced medicine - their documentation, collaboration and patient interactions. In designing healthcare technology, our study suggests that we must support input and viewing of information, and support collaboration between providers.

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