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Using Electronic Health Record Systems in Diabetes Care: Emerging Practices

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Abstract

While there has been considerable attention devoted to the deployment of electronic health record (EHR) systems, there has been far less attention given to their appropriation for use in clinical encounters — particularly in the context of complex, chronic illness. The Department of Veterans' Affairs (VA) has been at the forefront of EHR adoption and, as such, provides a unique opportunity to examine a mature EHR system in widespread use. Moreover, with a high prevalence of diabetes in its patient population, the VA provides a useful platform for examining EHR use in the context of chronic disease care. We conducted a sequential, exploratory qualitative study at two VA Medical Centers in the Midwest. First, we conducted observations of 64 clinical consultations with diabetes patients. These observations involved 31 different health care providers. Second, using insights from these observations, we conducted in-depth, semi-structured interviews with 39 health care providers focusing on their use of information in diabetes patient care. Field notes and interview transcripts were analyzed using a grounded theory approach. Our analysis generated several categories of EHR use in clinical encounters: *priming*, *structuring*, *assessing*, *informing*, and *continuing*. We also outline some mismatches between EHR system design and VA diabetes care practices. We conclude by discussing implications of these emergent system uses for improving the software design of EHRs to better support chronic disease care, as well as for our understanding of the integration of technologies in health care.

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1. INTRODUCTION

It is an exciting time for American health information technology (HIT) advocates, a time when long-pursued goals now seem within reach. The American Reinvestment and Recovery Act (ARRA) of 2009, which included the Health Information Technology for Economic and Clinical Health Act (HITECH Act), allocated an unprecedented \$22 billion for efforts to promote adoption and meaningful use of HIT in the United States. Major planned initiatives under this legislation include the establishment of incentive programs for providers that use certified electronic health record (EHR) systems and development of a national infrastructure to facilitate information systems interoperability. The stated rationale for this extensive federal investment in HIT is that wider adoption of EHRs will lead to reductions in health care costs, medical errors, and health care disparities, while improving health care quality and efficiency [10, 11].

Supporting these laudable policy goals, some prior research has shown that implementation of HIT systems, such as computerized physician order entry (CPOE) and clinical decision support systems (CDSS), can improve adherence to clinical practice guidelines [10, 52] and decrease use of health care services such as laboratory tests and office visits [13, 14]. Several studies have also shown that CPOE systems may be associated with a reduction in medication errors [13, 32], improved patient safety [38], and reduced mortality and patient complications in hospitals [4, 42]. And while there is limited data about actual cost savings of systems [13], some studies have found significant returns on investment for hospitals and office-based physician practices that introduced HIT systems [e.g., 31]. However, despite the appearance of documented success, adoption of HIT systems remains limited, with less than 20% of U.S. physicians using EHRs in their work [18].

Why would such seemingly beneficial technologies not be adopted rapidly and exponentially? The reasons for this are many, ranging from the fragmentation of the U.S. health system to problematic incentives for adoption [16, 35]. However, an underappreciated, yet critical, factor that may stand in the way of widespread, effective HIT adoption is the problematic work practice integration that has marked many previous HIT deployments. Moreover, systems may have unknown consequences for a vital part of care — clinical consultations with patients.

1.1 Work Practice Integration

Results regarding the impact of HIT on health care provider time are mixed, with some studies showing increases in provider time and the addition of more work as a result of HIT [6, 10, 40, 43] and others showing modest decreases in provider documentation time as a result of these systems [10, 38, 43]. HIT system introduction may also be accompanied by important unintended consequences, such as changes in power relations and work

distribution between providers [1, 9, 29, 33, 47, 49], disruptions in patterns of health care communication [20, 25], and shifts in the structure of patient care [21, 48].

It has been argued that these mixed effects of HIT adoption may be related to workflow disruption as a result of the introduction of new systems [41], such as when systems' decision rules conflict with the complexity and adaptability of actual clinical practice [12, 50]. New systems can also undermine clinicians' previous medical record writing and reading practices, thus making it more difficult to use this information effectively in clinical work [27]. Such challenges may result in poor integration of systems into clinical practice [6, 40]. Given the aforementioned problems with and uncertainties about HIT deployment, there is a need for careful investigation of the organization of health care processes [40, 53]. To address this need, we examine the ways in which an EHR system is integrated into the practices of clinical care for diabetes patients in the context of a mature EHR system in widespread use. Additionally, we extend prior research by considering the ways in which EHR technology becomes a resource for emergent care practices in a specific context.

1.2 EHRs and Clinical Consultations

While there has been considerable attention devoted to the deployment of clinical information systems, there has been far less attention paid to the impact of these systems on provider–patient relationships. Nevertheless, some preliminary research has suggested that EHRs and other technologies can have important impacts on provider–patient consultations [24, 29, 51]. In this stream of research, EHRs have been shown to both impede [36, 37, 51] and to facilitate [5, 7, 29] discussions between patients and providers.

The quality of communication between physicians and patients has been linked to improved psychosocial and health outcomes for patients [26]. Given this, there is an important need to understand the ways in which technologies are used in clinical consultations. Moreover, there is a specific need to understand these uses in the context of the care of chronic diseases, since such diseases put patients into long-term contact with the health care system.

Chronic diseases — prolonged illnesses that can be controlled but not cured — are the leading cause of death in the United States [39]. Diabetes is a serious, chronic illness that can be managed long-term with the aid of demanding treatment and self-care regimens. The VA population's high prevalence of diabetes [34], makes it a useful platform for examining EHR use in the context of chronic disease care. We contribute to research in this field by specifically examining the role of the EHR in clinical consultations for diabetes — a chronic condition whose management relies heavily on a strong relationship between clinician and patient. [15].

2. METHODS

We conducted a sequential, exploratory qualitative study at two VA facilities in two Midwestern states. First, we conducted observations of 64 clinical consultations with diabetes patients. These observations involved 31 different health care providers. Observations were recorded through detailed field notes. Second, using insights from the observations, we conducted in-depth, semi-structured interviews with 39 health care

providers focusing on their use of information in diabetes patient care. Altogether, data were collected from 41 providers, including physicians, nurse practitioners (NPs), registered nurses (RNs), licensed practical nurses (LPNs), doctors of pharmacy (who hold Pharm.D degrees, and are referred to as PDs), and residents (see Table 1). Interviews were audio taped and transcribed to facilitate analysis. A grounded theory interpretive approach [17] guided analysis of the field notes and interview transcripts. Data were categorized and open coded [17] using the constant comparison method [22]. NVivo qualitative data analysis software was used to conduct analyses.

3. BACKGROUND: THE SETTING

We conducted this study at two VA Medical Centers with a focus on EHR use in diabetes care. In both settings, LPNs completed check-ins of new patients, as well as health promotion-oriented clinical screening. At site 1, primary care was provided chiefly by physicians, and site 2 also relied heavily on NPs to serve this function. Both sites offered intensive case management services for diabetic patients with poor blood sugar, cholesterol, and/or blood pressure control. At site 1, this was accomplished via one-on-one consultations with RN case managers, and at site 2, through shared medical appointments (SMAs) led by clinical pharmacists and supported by an RN diabetes educator. At site 2, RNs also met one-on-one with patients for diabetes, lipid, or blood pressure-related management. In both settings, PDs acted as consultants to other providers and saw patients individually for medication intensification and patient education. Patients referred for these services typically had suboptimal control of their blood sugars, lipids, and/or blood pressure.

At both sites, the VA's Computerized Patient Record System (CPRS) is in widespread use. The CPRS is a part of the VA's Veteran's Health Information Systems and Technology Architecture (VistA) system. As a mature EHR system, the CPRS was implemented in 1999, and has been continuously maintained and updated by VA staff [34]. This system includes records for individual patients, which includes patient data summaries for use in clinical care, including active problem lists, allergies, vital signs, current medications, recent laboratory test results and patient history. Providers add notes to these records as they provide patient care. Notes have various structures, depending on the role of the specific provider, the practices of the particular clinic, and individual provider preferences.

Daily patient care is initiated by use of CPRS's check-in module, which is used primarily by LPNs. Once checked in, providers are notified that the patient is on site. CPRS provides computerized provider order entry (CPOE) capabilities with the ability to prescribe medications, request medical supplies, order laboratory tests, and refer patients for clinical consults. The CPOE system has real-time order checking to alert clinicians about potential problems before orders are processed. Clinical reminders are embedded in the system and are used to ensure clinical care standards are being met and to generate data for compliance, quality improvement, and performance measurement purposes. The system also has a notification system that generates alerts, prompting providers for action regarding clinically significant events, such as laboratory tests or clinical consultations.

At both sites, use of CPRS is complemented by use of paper documents, such as sheets employed to route patients through the clinic, medication lists for patients, and individual provider notes. These paper documents are utilized variously for encounter preparation, case presentation when being mentored or precepted by another provider, and for completion of notes documenting a patient visit prior to entering it into CPRS.

4. RESULTS

Our analysis generated several categories of patient-centered EHR use in clinical consultations: *priming*, *structuring*, *assessing*, *informing*, and *continuing*. We describe each of these categories below. Following this description, we outline some observed mismatches between EHR system requirements and the care of diabetic patients. In reporting data from this study, we include both direct quotes from interviewees and from vignettes, which are excerpts from field notes taken during observations of clinical encounters.

4.1 Priming

Diabetes is a chronic condition that requires ongoing control of blood pressure, sugar, and lipids in order to prevent serious long-term complications. Control of these biomarkers is subject to goals based on established clinical guidelines that are adopted widely within the VA. These guidelines state that diabetes care should thus be geared towards: meeting biomarker goals; providing ongoing surveillance for complications of the eyes, feet, and kidneys; encouraging adherence to medication regimens; and promoting helpful lifestyle choices, such as exercise, dietary modification, and smoking cessation.

With this picture of the goals of diabetes management, providers used CPRS in order to gain a summary picture of their patients before meeting with them, based on each of these considerations. To accomplish this, providers took several approaches, including the development of customized electronic worksheets in order to review results together, as this resident described:

“I often end up using the worksheets in...the lab section just so I can get a quick look at these. I have set up templates that automatically — I can just click on sort of the A1C and LDL and these sorts of things.”

Another approach involved the development of customized notes that were intended to “speak to” the user in the future — even if this duplicated information contained elsewhere in the record. For example, one physician created a specialized note, as he described: “my note almost serves as the summation of the medical record — everything that’s in there.”

Another provider also mentioned having developed clicking routines through various parts of CPRS in order to look for this information prior to each visit. This approach was also used by providers who saw patients on an occasional basis, such as PDs who were consulted to aid in medication intensification.

Providers used these pre-visit checks as a way of priming themselves for the visit, a need reinforced by the fact that the “reason for visit” provided on the schedule frequently did not reflect the complex nature of the care provided at the VA. As this physician said, he

reviewed his notes “before I see them so I know what I’m getting into.” Some providers also used their notes as a trigger for their memories, as this vignette shows:

“NP looks through her patients for the rest of the day — most of them she knows and knows their situations, as she looks through their records, she remembers more details.”

Additionally, primary care providers attempted to construct a timeline of significant events in between their visits with patients, and thus sought information in CPRS about the patient’s other clinical contacts. This often involved consult notes prepared by other providers such as specialists or case managers; nurses who took patients’ phone calls; details of emergency room visits; or check-in data compiled by the LPN at the beginning of the visit. In some cases, this historical data was reconciled with the patient’s self-report during the consultation itself. As this physician described:

“I try and put together everything that’s happened in the three months or whatever since I’ve seen them, with what they say is going on.”

An important part of primary care providers’ reliance on their prior notes involved picking up the thread of their prior assessment of the patient or reflections on a possible course of action, as this physician explained: “I check my last note if I’ve seen them before in terms of what my thoughts were or plan.”

Providers described this as a type of “agenda-setting” process, as this physician described: “...I try before I see them to look over my last visit with them or any interim visits they’ve had, try to see what the issues are from my end.” Such a process was necessary, this physician said, because the priorities of long-term diabetes management were not necessarily at the forefront for patients:

“...a lot of times what might be my priority is not their priority...I ask them what’s on their agenda, how they’ve been doing, then they’ll tell me their first presenting issue and we’ll start to talk about that and then I’ll mention their blood pressure, their blood sugar, whatever’s on my mind usually isn’t what’s on their mind.”

Another way that providers set their agendas prior to the clinical consultation was by starting their notes just before inviting patients into the office. This note might be a quick summary of significant events between visits or a list of the patient’s issues, as this vignette of a physician shows:

“She gets her note started in CPRS, telling me she is using a template...and she makes two lists, one of acute problems and one of chronic, numbering each issue.”

Several physicians also used templates to begin this note with data fields pre-populated or using the full previous note as a guide, as illustrated in this vignette:

“She opens a new note from her template, which automatically populates with her last note, which she uses as a guide for her notes.”

4.2 Structuring

At study sites, every observed clinical consultation involved some use of CPRS. The system was used to structure clinical encounters in several ways, including serving as an agenda for activities to be undertaken in the consultation, facilitating transitions between topics, and marking closure of the visit.

Providers used CPRS as an agenda to ensure follow-up of outstanding issues and the completion of priority clinical management tasks. This was helpful given the ongoing tension between the need to manage diabetes and its associated conditions over the long term and the need to respond to emergent patient concerns. Hence, providers used CPRS to structure the clinical encounter so that both ongoing and surfacing issues were covered in each visit. For instance, a physician assured the patient that he would get to “*your issues*” and “*my issues*,” using CPRS to lead the conversation and provide floor time for each.

Providers also ensured that agenda items were covered by completing clinical reminders generated by CPRS during the encounter. Clinical reminders are used in the VA to assist in the implementation of evidence-based clinical practice guidelines and to ensure that priority issues are addressed with patients on a regular basis. For example, once per year, patients were asked questions such as whether they had a medical will, whether they smoked, about their exercise levels, and whether they had any difficulty walking. Nursing-designated reminders were also implemented during check-in by LPNs and some RNs. The data generated by the completion of reminders triggered additional clinical follow-up that was in line with evidence-based clinical practice guidelines. Subsequently, results from reminders were also used by the organization for the purposes of performance measurement and facility accreditation.

Because completing reminders meant asking a disparate series of questions in rapid succession, asking these questions did not constitute a natural flow of conversation. In light of this, several providers told their patients what they were doing and why either before or during the process. For example, while completing clinical reminders, one MD said to her patient, “This is just for diabetic surveillance, which shouldn’t take long.”

Several providers said that they found reminders helpful, particularly as an aid to remembering infrequent clinical tasks, such as annual screenings. However, several providers indicated that they did not implement reminders unreflectively — as one physician noted, “*we do the ones we have to have.*” A nurse also noted that given her limited time with each patient, she regularly left some reminders for later in order to use clinical consultation time wisely. Additionally, some providers used their customized note templates to produce agendas for clinical encounters; these templates addressed issues that they had prioritized, in addition to those prioritized by practice guidelines and administrators.

Another form of structuring implemented during clinical consultations involved use of CPRS to facilitate transitions between topics and to assert the beginning of dialogue about diabetes management. For example, one physician closed a line of conversation by turning from the patient to the computer screen, saying that he wanted “*to finish going through things.*” In another consultation, a PD transitioned a mildly unwilling patient to the agenda

at hand using the CPRS record almost as a higher authority in the interaction, as shown in this vignette:

PD looks at CPRS record and says “Now to your blood pressure and diabetes.” The patient says “oh, no” and makes a joke about being “bad.”

In some observed encounters, providers also communicated their wish to transition to diabetes-related agenda through non-verbal interaction with the CPRS. Various, this involved silently looking at the computer and clicking through screens while a patient spoke about another topic; changing the subject to diabetes while looking at the computer screen; or by subtly refusing to engage in side issues raised by the patient by keeping a visual focus on the CPRS record on the computer.

Finally, at the end of clinical encounters, several providers used CPRS to signal closure of the visit. A striking approach was to send a discharge document or medication list to the printer, retrieve it, and then discuss it with the patient outside of the clinical encounter room as he or she was leaving. For example, this NP closed most of her visits by following such a pattern:

Then she motions towards the screen and tells him there’s a list of his medications in here and that will be printed out for him. She tells the patient she will get the list off the printer and then meet him at the coat rack up front.

4.3 Assessing

Diabetes care providers engaged in a significant amount of patient assessment, including evaluating the patient’s health status, disease progression, treatment, and behavior. From the point of view of providers, the most difficult challenges in diabetes care related to many patients’ non-adherence to treatment and lifestyle recommendations. Yet, this critical information was something most effectively gleaned directly from the patient him or herself, as this physician explained: “[it] is not anything you can get in the computer.” This physician expanded on this point by saying:

“I have a guy who has an A1c of 11 and every time I talk to him, says he just refuses to take his medicines...[t]he lab doesn’t matter, he’s refusing to take his medicine.”

Some strategies for assessing medication adherence involved leveraging existing CPRS features, such as the ability to graph prescription refills over time. Several providers noted that they review patient medication history in order to determine patients’ refill patterns. Though an imperfect measure of adherence, providers felt that this helped them to spot potential issues for follow up. For instance, in this vignette, a physician used medication refill information to identify a patient misunderstanding about how to take a specific medication:

MD comments that there is one blood pressure medication that patient hasn’t refilled since March. The patient first says that he doesn’t take the meds every day when he’s taking the steroids. As they talk, it comes out that he also does not take them if his blood pressure is low on a given day. The doctor clarifies that blood pressure medications are “not an as needed drug.”

Providers also referred to medication refill information to investigate ongoing problems, such as when looking for causes of persistently poor control of blood pressure or blood sugar. As this physician explained: “I do look at patients that are not, their A1C’s not getting better...[I] go and see when did they last fill it and are they filling it regularly to make sure that they’re compliant with their medications.”

Another commonly employed strategy was to formally “reconcile” the current medications list found in CPRS with the patient’s practices. At one site, most consultations included a process of medication reconciliation in which providers read out the patient’s list of medications from CPRS, while confirming that the patient was taking them and inquiring about any additional medications that s/he may have been prescribed elsewhere. As this resident described, “I usually go over all the medications with each patient during their visit to make sure that my list reconciles with their list.” During these discussions, misunderstandings about medications often emerged. Indeed, patients often struggled to recall the names of their medications, how much they actually took, and what time of day they took them.

Another technology-enabled approach for assessing adherence was to ask patients to monitor their blood glucose at home on an ongoing basis, and then import this information into the EHR. At site 2, there was a particularly concerted effort to gather and review this information. For example, patients often used a glucometer to track blood sugar, and the staff actively promoted a more advanced tracking system, the “Telebuddy.” Information from these devices was integrated with the CPRS record as much as technically possible or printed out for providers’ use with patients during consultations. Where available, this monitoring information was subsequently used to assess behavioral reasons for poor blood sugar control and to adjust medication dosages. Glucometer information also provided an opportunity for clinicians to learn more about patients’ daily experiences of diabetes management, including ups and downs in blood sugar levels. These daily experiences could otherwise be obscured by the widely used A1c lab measurement, which provides a proxy roughly equivalent to average blood sugar over a three-month period.

Providers also gathered information from CPRS in order to evaluate emergent patient concerns. In so doing, providers moved between asking questions, recording concerns, and clicking through CPRS in search of results of lab tests or consultations, the patient’s medications, or other information that might shed light on the concern. As this physician described: “...as the patient presents with complaints and concerns, I’m looking for other information. I do tend to look at the computer quite a bit while I’m in chatting with the patient.”

4.4 Informing

Effective diabetes management requires a great deal of effort on the part of most patients, from medication adherence to dietary changes, and from exercise to self-monitoring. Providers were quite aware of these demands, and many placed a high priority on informing patients about their health condition to increase their engagement in disease management. As a result, informing activities were integrated throughout clinical encounters, particularly as providers attended to clinical reminders, reconciled medications, and explained treatment

plans. Additionally, several providers defined information provision as a central component of their work and routinely provided referrals to services, such as nutrition consultations or shared medical appointments, in order to increase patients' knowledge of diabetes management.

Providers often strove to develop patients' understandings of their laboratory values and of the goals for their treatment based on these values. Providers also emphasized patients' risks for long-term complications if treatment goals were not met. As might also occur in a paper-based health care practice, informing activities that were directed to these concerns often focused on trying to personalize information about the patient's health status and to persuade him or her to take this information seriously. Consequently, providers often shared results of patient tests along with commentary that evaluated those results. Indeed, it was rare for providers to not say whether the numbers were "good," "fair" or "could be better."

Providers also engaged in patient-informing practices that built on the specific affordances of EHR use. The first practice focused on emphasizing key points to encourage patients to take recommendations to heart, as this RN explained: "...if I'm trying to make a point, I'll show them their labs." Emphasis was accomplished in two principle ways. First, several providers used visualization features present in CPRS to graph trend information for patients, as this vignette demonstrates:

[PD] says to the patient that she wanted to tell him is that his A1c is 8.9, up from 7.1, so his control has gotten worse. She points to the graph of A1c levels on the screen and explains to him that he should watch his insulin and his food and diet.

Additionally, some providers combined patient data sets in order to help patients understand the health consequences of their behavior as demonstrated by the physician in this vignette.

She turns the screen toward the patient and shows him his creatinine levels, which indicate kidney function, and shows that they've been high when he'd had heart problems before and a low BP and was drying out.

Similarly, as shown in the following vignette, some providers emphasized points by showing numerical test results on the computer screen to patients, while explaining consequences of observed values.

The doctor goes to his blood pressure readings on the screen and shows the patient the numbers on the screen, explaining the importance of keeping the bottom number down to prevent stroke.

Providers also shared on-screen CPRS data as an act of patient inclusion — particularly when educating patients about their treatment. For example, this NP shared the screen with a patient whose medications were changing:

She turns the computer screen toward him as she goes through the final CPRS screens, typing in her notes and reiterating the instructions for his medication changes as she types.

Additionally, providers often responded to patient questions by retrieving relevant data from CPRS and visually sharing it with patients, sometimes by tilting the screen towards the patient.

4.5 Continuing

With a chronic, progressive condition such as diabetes, providers allocated considerable effort towards keeping diabetic patients connected with VA care over the long term. This was especially important for achieving ongoing diabetes management goals related to blood sugar, lipids, and blood pressure.

Providers used various features of CPRS to try to ensure continuous patient care. Most obviously, it was very rare for providers to close a clinical encounter without making sure that the patient was arranging for a follow-up visit.

CPRS allowed providers to readily see patient's upcoming appointments across the VA, which might not have been possible in a paper-based environment. Providers then frequently used this information to verbally remind patients about these upcoming appointments. At site 1, reminder letters were also regularly generated using CPRS data and then sent to patients prior to their appointments. At this site, several providers also used CPRS to generate letters to patients that reported laboratory results and provided instructions for follow up. As this MD stated: "...we'll have them do labs and then I'll...send a letter saying, 'Things are good, don't change anything' or 'Things are bad, give us a call.'"

Providers also appropriated certain features of CPRS in order to ensure their own ongoing attention to issues or patients of concern. One approach was to use the alert feature of CPRS to remind oneself of something needing attention, particularly by leaving certain items "unsigned," as described in these vignettes:

[RN] will keep the CPRS record unsigned to keep it on her alerts, or if it gets to be too long, she opens an addendum so it will still be on the alert list.

RN receives a message from a patient. This is a guy with no phone, a sketchy contact number and out of control diabetes (based on his A1c level) that she is concerned about. She makes the call, leaves a message, then puts the note in CPRS, putting her partner on as a cosigner so that the patient "does not fall through the cracks" while she is out of the office. It will come up as an alert for her later.

As shown above, providers also ensured follow-up on issues by adding colleagues as a "co-signer" on a note, so that it would also appear in the other person's alerts. Additionally, several providers added follow-up items to visit notes for themselves and others.

4.6 Clinical Care—EHR System Mismatches

While many providers expressed satisfaction with CPRS, especially with the amount of information available to them, several common complaints emerged regarding mismatches between the system design and the specific nature of diabetes care. In terms of the practices outlined above, providers complained that the system particularly stood in the way of their priming efforts. In other words, although diabetes care required ongoing monitoring of

certain issues, the system did not bring diabetic patient-related information together in an easily accessible way. As this physician described:

“[CPRS is] not coordinated enough that if I have a diabetic patient, I’m just going to look in one spot for all the information.”

Similarly, a resident observed that the system did not appear to have any planned organization of diabetes patient information. Another physician said that he would like it if:

“...a patient with diabetes comes in and you generate a progress note, you can just put in last A1C, and there would be a template [with] last A1C, blood pressure, medications...you can just look at all of those things.”

With regards to the practice of structuring, providers had fewer concerns, but an ongoing problem seemed to relate to how individualized documentation practices functioned with each provider developing his or her own personal system for structuring the visit. While this may partially reflect different learning styles, it may be that this variability emerged due to a lack of suitable visit templates geared towards the ways in which providers actually worked.

In terms of assessment, providers generally felt that they had inadequate tools for assessing patient adherence. This was despite their use of features such as prescription refills in order to identify problems. Essentially, providers were very interested in gathering new and better data from patients in order to gain a more complete picture of their health behaviors. One idea of interest to providers was relying less on technologies such as glucometers to track blood sugar, since patients often forgot to bring them to their appointments. As a result, there was some enthusiasm for applications such as the VA’s new Telebuddy monitoring system, which automatically sent patient data to providers between visits. Another provider said that they would like to track more lifestyle-oriented information: “It would be kind of nice if we could somehow track exercise more and ...a diet diary...”

Providers also indicated that they needed more CPRS-based support for the informing work that they did. One provider said that there was a need for notes templates to track patient education activities. Several also complained about the limited availability of take-home patient education materials, including those that could be integrated with CPRS.

Finally, providers generally found CPRS helpful in their efforts to continue contact with patients over the long term. However, a few providers remarked that they would like to have access to a list of patients that could allow them to identify those with greater needs, based on their level of blood sugar control. Once identified, these patients could then be targeted for more intensive disease management, as this physician said:

“I would love to be able to get a review of all of my patients and see where my outliers are and make sure I’m comfortable with why they’re outliers and if I’m not comfortable, being able to target to getting those people in and target them more effectively.”

5. DISCUSSION AND CONCLUSION

Findings from this exploratory, qualitative study revealed that health care providers had developed a range of technologically oriented practices geared towards the specific demands of diabetes-related clinical consultations. In this paper, we described these uses as priming, structuring, assessing, informing, and continuing. Some of these practices were well supported by the existing technology, but others were less well supported, or not supported at all. At the same time, users developed new, unanticipated uses — such as the practice of sharing visualizations of laboratory results to persuade patients to change their health behavior. This study, therefore, provides a powerful example of the ability of a group of users to appropriate technologies for local use.

While the present study did not set out to assess the relationship between EHR use and the quality of clinician-patient communication, findings did reveal a number of EHR-related practices that may influence participants' perceptions of communication quality. For example, as in previous studies, we observed providers: positioning their computers to engage patients in discussions about their care [49], displaying visualizations of longitudinal data to patients [46], and using medication reconciliations to discuss patients' medication-taking practices [44]. The development of a collaborative follow-up technique using note co-signing also resonates with prior research regarding the importance of mutual awareness to collaborative work [19]. Additionally, while the provision of information in the clinical encounter has been the focus of considerable research (e.g., [8]), it has rarely considered the role of artifacts such as the EHR in the process of informing. Results of this paper, therefore, reinforce this prior work, while documenting new EHR system uses that also have the potential to affect perceptions of clinician-patient communication, such as clinicians' use of EHRs to prepare for, structure and follow-up on consultations. Further research is needed to determine the impact of these varied EHR-related practices on perceived quality of clinician-patient communication.

The presence of unanticipated uses and shortcomings of CPRS points to a complex negotiation between CPRS and the clinicians who use this technology in the context of their work. A useful framework for understanding this negotiation process is the “script” approach to studying technology. A technological “script” becomes embedded in a technology when its design “defines a framework of action together with the actors and the space that in which they are supposed to act” [2, p. 208]. This design framework both enables and constrains human activity and may be accompanied by an adjustment process between the “imagined user,” who was built into the design, and the “actual user.” Akrich and Latour [3] described these processes of negotiation as including “subscription” — acceptance of the script — and “description” — its renegotiation or rejection [p. 261]. In our study, we saw evidence of both processes with many CPRS features used in ways that aligned with intended use — most obviously in the ubiquitous use of CPRS as a resource for patient care. At the same time, many of the technology-oriented practices described in this paper represented extensions and adaptations of CPRS. These adaptations indicated a renegotiation of a general-purpose EHR system's script to the specific demands of diabetes care at each site. Helpfully, many of these renegotiations were not restricted by the design of CPRS, and some were even facilitated by customization capabilities found in CPRS itself,

such as in the ability to create tailored templates. Yet, if uses are not anticipated or understood, there is always a risk that ongoing system improvements could inadvertently disrupt capabilities that users value, as well as the practices that rely upon the system. Accordingly, results of this study suggest the value of further in-depth studies of HIT use in clinical care practices and the ways in which technology use and practices “co-evolve” [45] in clinical settings. Moreover, they suggest that system designers should attempt to identify developing uses and take them into account when changing or upgrading systems that have passed the initial adoption stage. This is an especially critical point if widespread adoption of HIT is indeed accomplished as a result of the extensive federal investments in this area.

While some negotiations between technological scripts and users are relatively smooth, our research also revealed more intractable mismatches between diabetes care and CPRS. For example, findings revealed that the repetitive, ongoing nature of diabetes care made some providers long for more standardized and aggregated displays of diabetic patient information in CPRS. Moreover, because diabetes management takes place primarily outside of health care settings — in the terrain of everyday life — providers needed to devote considerable attention to treatment adherence and day-to-day disease management. Unfortunately, this reality was only awkwardly addressed by the existing system, and providers lamented a lack of better ways of tracking patient progress and documenting their patient education work. Furthermore, some providers identified a need for CPRS to help them systematically identify high-risk patients in need of more intensive health care services. Such data were difficult to extract from CPRS, leading to missed opportunities for the prevention of diabetic complications. A common theme across all of these challenges relates to the difficulty in reconciling chronic disease care models with the more episodic nature of traditional, acute care oriented medical services. Accordingly, this research revealed some problems of workflow integration like those that have been identified in previous health informatics research [e.g., 41]. However, it is notable that in this setting, such mismatches did not stand in the way of extensive and creative use of CPRS for diabetes care. Nevertheless, in order to optimally support care, we recommend that system designers address the CPRS-diabetes care mismatch by making several changes to the system, including:

- creating summary views of diabetic patient information, geared towards their use in clinical consultations.
- developing novel methods for tracking and reporting patient lifestyle data, including diet, exercise and treatment adherence.
- incorporating detailed methods of recording patient education activities in the wider record of care provision.
- extending clinicians’ abilities to identify and follow up on high-risk patients who would benefit from more intensive intervention.

With regard to the last recommended change, CPRS may benefit from incorporation of principles of population management. Population-based management of chronically ill patients uses health information systems to apply public health principles to the management of individual patients [28]. Population management systems have the potential to merge disease registry data, clinical algorithms and reminder systems in an attempt to enhance

clinical outcomes through proactive management of high-risk patient groups [23]. The VA currently uses a number of different regional, local and national databases that draw on data from CPRS to facilitate such activities. These databases include diabetic and pre-diabetic or “at risk” patients and can produce reports that aggregate data — or present data on individual patients — regarding patient demographics, vital statistics, lab results, co-morbidities and medications, both across and within VA medical centers. Our study suggests that giving providers access to these data via CPRS could facilitate the development of local practices surrounding the use of these data, as well as their integration into wider care practices.

This study took an exploratory, qualitative approach to investigating the use of an EHR system in clinical consultations with diabetic patients. We identified several categories of EHR use in this context — priming, structuring, assessing, informing, and continuing. Some of these uses were anticipated and well-supported by the EHR system, and others could be characterized as “local innovations” that emerged in response to providers’ needs. At the same time, there were also desired uses that were not supported at all — most notably in the mismatch between episodic care models that may be “scripted” into EHR systems and the complexities of long-term diabetes care. This research, therefore, reaches beyond the current political focus on stimulating HIT adoption to considering how such technologies may (or may not) be integrated into clinical work in the long-term. Our research suggests that IT adoption should be considered an ongoing and emergent process — one in which the relationship between design and use must be repeatedly examined, and in which systems must continuously evolve alongside the care that they are intended to support.

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7. REFERENCES

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Table 1

Study Participants

	Site 1	Site 2	Total
Physicians	5	4	9
Nurse Practitioners	1	3	4
Registered Nurses	4	4	8
Licensed Practical Nurses	4	3	7
Doctors of Pharmacy	3	4	7
Residents	3	3	6