

A clinical decision support needs assessment of community-based physicians

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ABSTRACT

Objective To conduct a grounded needs assessment to elicit community-based physicians' current views on clinical decision support (CDS) and its desired capabilities that may assist future CDS design and development for community-based practices.

Materials and methods To gain insight into community-based physicians' goals, environments, tasks, and desired support tools, we used a human-computer interaction model that was based in grounded theory. We conducted 30 recorded interviews with, and 25 observations of, primary care providers within 15 urban and rural community-based clinics across Oregon. Participants were members of three healthcare organizations with different commercial electronic health record systems. We used a grounded theory approach to analyze data and develop a user-centered definition of CDS and themes related to desired CDS functionalities.

Results Physicians viewed CDS as a set of software tools that provide alerts, prompts, and reference tools, but not tools to support patient management, clinical operations, or workflow, which they would like. They want CDS to enhance physician-patient relationships, redirect work among staff, and provide time-saving tools. Participants were generally dissatisfied with current CDS capabilities and overall electronic health record usability.

Discussion Physicians identified different aspects of decision-making in need of support: clinical decision-making such as medication administration and treatment, and cognitive decision-making that enhances relationships and interactions with patients and staff.

Conclusion Physicians expressed a need for decision support that extended beyond their own current definitions. To meet this requirement, decision support tools must integrate functions that align time and resources in ways that assist providers in a broad range of decisions.

INTRODUCTION

Clinical decision support (CDS) systems 'provide clinicians, staff, patients, and other individuals with knowledge and person-based information, intelligently filtered and presented at appropriate times, to enhance health and healthcare.'¹ Beginning in 2011, federal financial incentives will encourage community-based physicians to install and 'meaningfully use' electronic health record (EHR) systems that include CDS.² Community-based physicians, however, are a relatively new population in which to study biomedical informatics with general and CDS in particular. We sought to understand what CDS means to these physicians and how it can better meet their needs. Furthermore, we wanted to determine if

community-based physicians faced decisions not addressed by CDS. Our goal was to provide a user-centered perspective that could help developers optimize CDS functions to meet the needs of physicians in community-based settings.

BACKGROUND

The American Reinvestment and Recovery Act directs \$27 billion to hospitals and eligible physicians to encourage adoption of certified EHRs that meet 'meaningful use' standards.¹ Certified EHRs are required to provide specific CDS mechanisms such as automatically identifying and preventing unsafe drug-drug interactions, as well as optionally presenting mechanisms such as drug formulary tools.²⁻³ To date, relatively few community-based physicians use fully functioning EHRs with CDS.⁴

CDS evaluations have historically focused on inpatient settings within a small cohort of academic medical centers.⁵⁻⁷ Few published studies on CDS have been conducted in community settings,⁸⁻¹² even though medical errors commonly occur in these environments.¹³ Those that have been conducted demonstrate inconsistencies in outcomes and processes.^{8-11 14-18} To our knowledge, the only randomized controlled study of CDS in community-based clinics related to an automated dyslipidemia alert prompting higher screening rates compared to as-needed alerts or no alerts at all.¹² However, the authors did not discuss why a large proportion (35%) of physicians in the automated alerts group did not carry out the recommended screening, thereby leaving unanswered questions about how CDS can optimally influence user behavior.

To determine the effects alerts had on primary care providers, Krall conducted focus groups and reported that participants felt workflow was the most pressing concern.¹⁹⁻²⁰ This finding is in line with the first three of the CDS 'ten commandments,' which state that 'speed is everything, anticipate needs and deliver in real time, and fit (CDS) into the user's workflow.'²¹ Weingart *et al* surveyed community-based physicians and found that more than one-third reported changing a 'potentially dangerous prescription' within the previous 30 days due to e-prescribing alerts.⁹ Those physicians also reported ignoring a host of alerts, yet the ignored alerts may still have altered their approaches to care by prompting them to offer patients additional counseling, for example. That finding led the authors to note that rates of 'ignored' alerts alone may not have wholly reflected the impact alerts had on medical practice, thereby raising questions as to how CDS impacts user behavior.

Informatics researchers have begun considering that decision supports may extend beyond the alert-reminder paradigm. Stead *et al* identified a range of types from ‘simple rule-based alerts’ to ‘statistical and heuristic’ logics.²² The authors described ‘patient-centered cognitive support’ as an aspect of CDS that requires particular attention. Examples of cognitive support include holistic patient information developed from ‘fragmented’ patient data as well as tools that simplify data collection. These CDS functions are particularly salient within the context of the patient-centered medical home model that places a premium on clinical decision-making for patients who receive care over time from multiple providers. Bates and Bitton noted a significant knowledge gap in our understanding of CDS functions in these contexts.²³ Armijo *et al* framed CDS as merely one group of information tools that are needed to support clinical decision-making, the others being ‘memory aids, computational aids, and collaboration aids.’²⁴ Our own research described constituencies’ competing and sometimes conflicting understandings of the meanings of CDS, which include ‘alerting, workflow, and cognitive’ supports.²⁵ These studies demonstrate a ‘pressing need’²⁶ to determine how CDS should support clinical decision-making, particularly in community-based practices.

We attempted to understand CDS needs from provider perspectives in community-based practices. Although informatics literature provides multiple needs analyses,^{22 27–42} we were unable to locate any that sought insight from community-based physicians within the US.^{43–46} Outside of informatics literature, Hoff conducted a thorough sociological study of primary care physicians and discussed EHRs in general but did not address CDS.⁴⁷ He reported providers’ general frustration with poor EHR usability and burdensome ‘cognitive work’ for users, such as coordinating care on patients’ behalf.

Given that CDS is a critical component of EHR meaningful use and that much remains to be learned about effective CDS in community-based practices, we sought to understand how physician users view CDS. We believe their perspectives can inform the design of future CDS tools.^{48–53}

METHODS

Our study design was based on aspects of a human–computer interaction framework⁵⁴ in order to understand users and their tasks (see figure 1). We analyzed our data using the grounded theory method, an inductive approach in which transcribed interview and observation data are labeled (‘coded’) and then organized into themes as they ‘emerge.’^{27 55–58} We sought to answer two research questions: (1) How do community-based

physicians conceptualize CDS? and (2) What do community-based physicians need from CDS? We received institutional review board approval for all study sites.

Site selection

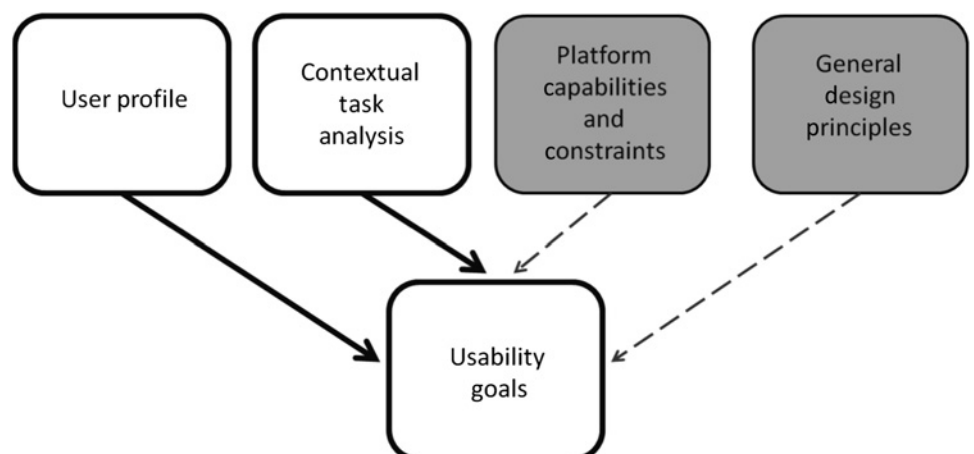
We purposefully recruited community-based physicians from three healthcare organizations across Oregon that each supported a different EHR with CDS. Organization A oversaw the installation and maintenance of NextGen (NextGen Healthcare; Horsham, Pennsylvania, USA) on behalf of its independent practice members. Organization B used eClinicalWorks (eClinicalWorks; Westborough, Massachusetts, USA) that was supported by an EHR service provider. Organization C oversaw the installation and maintenance of Epic Ambulatory (Epic Systems; Verona, Wisconsin, USA). The inclusion of three different healthcare organizations and EHRs provided a sample with maximum variability that enabled an investigation of physicians’ felt needs⁵⁹ that extended beyond any single software platform or organizational boundary and could generate themes based on a wider range of experiences, opinions, and insights. We did not collect clinic-level patient population data.

We received a minimum of 1 hour training on each EHR to become familiar with screen layouts, available CDS, and workflows for documenting a patient encounter. The purpose was to inform our observations so that we would know when a physician was not using available CDS functions. We refrained from extensive system training so as to not become immersed in system functionalities but rather remain focused on users.

Participant recruitment

Recruitment centered on the predominant primary care specialties in the US: (1) family practice, (2) internal medicine, (3) obstetrics-gynecology, and (4) pediatrics.^{60 61} We sought study participants with exposure to CDS within their EHR system (including active and passive alerts and reminders) to ensure that participants were able to discuss CDS-related issues. We also sought 30 subjects (10 from each organization) to achieve thematic saturation so that there would be sufficient data to identify recurring themes. We recruited participants with the assistance of organizational sponsors, participant referrals, and staff from various clinics. Contact with potential participants was made in person, by email, or over the phone. Rural or urban status was not a requirement for inclusion in the study, although we actively sought participants from both settings. Small tokens of appreciation were given to participants and staff for donating their time and effort.

Figure 1 Mayhew’s human–computer interaction model focusing on ‘user profile’ and ‘contextual task analysis.’ Shaded areas were not examined in this study.



Observation and interview strategies

We observed physicians to conduct a ‘contextual task analysis’⁵⁴ of their decision-making in community-based settings. All participants were de-identified and no personally identifiable patient data were collected. Patients were provided with a study handout and agreed to any observations before an observer entered the patient room. The observer (JER) took field notes and noted participants’ decision-making related to goals, tasks, and interactions with their environments. Observations were minimally obtrusive, and the observer only asked questions during opportune moments in clinical workflow.

Interviews probed participants’ views on current CDS tools to gain insight into desired CDS functionalities. Participants provided signed consent prior to any digitally recorded interview and all interviews but one were conducted in private. The questions (see online appendix A) were designed to provide a deep understanding of participants’ goals, motivations, and decision-making needs. We also probed and explored topics that arose during observations. The interview guide evolved as the study progressed and as subjects revealed topics we had not originally considered.

Analysis

We reviewed transcripts of interviews and observations, then coded content deemed significant or noteworthy using NVivo qualitative software version 8.x (QSR International; Doncaster, Australia). We then organized codes into broader themes related to CDS definitions and needs.

We also took three steps to improve the reliability of our results. First, we consulted with two medical anthropologists not associated with the study to compare codes. In these discussions, we addressed questions and competing interpretations of the data until each researcher determined that an appropriately descriptive codebook had been developed. Second, we conferred with health organizations to clarify if observed or discussed system limitations resulted from the EHR/CDS systems, limitations in participants’ knowledge, or both. Third, we sought feedback on preliminary results from all 30 participants via email according to published best practices.⁶² We received feedback from seven respondents, all of whom approved the user-centered CDS definition and affirmed the user-centered distinction between CDS and non-CDS functions.

RESULTS

Participating providers and clinics

We conducted interviews and observations in 15 urban and rural community-based clinics across three healthcare organizations over the course of 2 months in the spring of 2010 (table 1).

We interviewed 30 primary care physicians (table 2). Twenty-four physicians consented to observations in patient rooms, two

Table 1 Clinic characteristics

Clinics	Data
Number of clinics	15
Clinics with Epic Ambulatory	6
Clinics with eClinicalWorks	5
Clinics with NextGen	4
Average number of doctors/clinic	8 (7.333)
Median number of doctors/clinic	7
Range of doctors/clinic	1–21
Rural clinics	5
Urban clinics	10

Table 2 Subject demographics (includes all subjects except one non-respondent)

Participants	Data
Males	17
Females	13
Average age in years (range)	48 (31–63)
Family practitioners	16
General internists	7
Obstetrics/gynecology	3
Pediatricians	4
Years practicing medicine	17
Average years using the current EHR	2.75
Subjects who had used another EHR	7
Level of EHR proficiency, self-assessment (current EHR only)	4 Novice 15 Average 10 Advanced

EHR, electronic health record system.

consented to observations in clinic work areas only (an obstetrics/gynecology clinic), and four declined observations. Semi-structured interviews averaged 26 min in length and ranged from 11 min to 38 min.

Participants’ definition of what is and is not CDS

Participants were familiar with CDS functions and adept at describing its impact based on their experiences. Participants described facets of CDS that informed the following definition: ‘Clinical decision support is made up of tools that are intended to inform clinical decisions by way of electronically delivered medication safety alerts, health maintenance alerts and prompts, best practice prompts, and access to accurate and timely reference materials.’

Participants distinguished clinical decisions directly related to patient care from other types of decisions that were tangential to patient care. For example, a family practitioner (FP) made the following distinction: ‘[Clinical] decision support ... is ... knowing what drug to prescribe ... but I think [ensuring that lab test results are available prior to a patient visit] would just be a DOCTOR support, or care management support’ The distinction is salient because participants expressed a need for ‘clinical decision support’ as well as types of ‘care management support’ that buttressed administrative activities.

Participants saw subtle but clear distinctions between CDS and administrative support. An internist highlighted the distinction: ‘... answering phone calls [or] inputting medication in lists...[That is] just CLINICAL support ... [Clinical] decision support is ... the algorithms ... The patient has a thyroid nodule. What do you do NEXT?’

Physicians from all four specialties described what did not constitute CDS. The need for EHR navigation, a common frustration among study participants, was not considered a form of CDS. A clear distinction was made between navigating the EHR to find information and ultimately deciding what to do. An FP noted, ‘I don’t know [if EHR navigation] affects my CLINICAL decision ... the ultimate outcome is the same. I just take a lot more steps to GET there.’ The quote conveys a sentiment commonly expressed among participants—that poor navigation merely caused ‘more steps’ to get to an inevitable clinical decision. Probing questions, however, revealed examples of when poor navigation impacted medical practice: ‘I have to go in and look at each different [medical] note until I find a foot exam ... And so rather than DO that, I just do another foot exam.’

Community-based physicians' requirements of CDS

We grouped data into three themes: (1) provider characteristics and motivations that inform their goals; (2) system characteristics that support decision-making; and (3) work environment and characteristics of clinical tasks (see box 1 and supplemental table 4 in online appendix C for a detailed summary).

The users

User-centered design encourages developing an understanding of users' goals and motivations, whether professional or personal. Participants stated that they enjoyed the 'variety' and 'spectrum' of patients in primary care and that they would feel 'bored' by the uniformity of cases in specialty care. Participants saw themselves as 'compulsive' and 'a little OCD [obsessive-compulsive disorder]'; some would prepare for patient visits the night before because preparation reduced 'anxiety' when seeing patients. More than one described primary care practitioners as a 'tribe' and some lamented that their specialty is not always professionally and economically valued.

Participants placed a high value on patient relationships and the 'trust' engendered in relationships played a role in their decision-making. Relationships not only created trust but were also a source of providers' job satisfaction.

The system

Participants commented that the EHR systems were built for billing purposes rather than to support clinical decisions, and as such benefitted people other than themselves such as 'lawyers' and 'billers.'

Participants stated that they rejected alerts, and were observed rejecting alerts, for three primary reasons: (1) 'fatigue' from the abundance of alerts; (2) alerts not reflecting perceived clinical importance; and (3) perceived inaccuracies of alerts given a patient's context. Participants reported an overall sense that alerts were not trustworthy, and users reportedly turned off CDS within hours of initial use.

We also observed health maintenance alerts and prompts being ignored. When we asked why, a common reason concerned perceived time shortages. Yet at the same time, physicians expressed a need for systems that prompted best practices such as alerts or flowsheets. One FP recalled not remembering the

procedure for receiving a positive RPR (test for syphilis) and stated she had lacked access to recommended procedures.

Community-based physicians also placed a high premium on timely access to reference material (see online appendix B). Being able to access online material while in the patient room was considered a boon, despite the occasional awkwardness of searching in front of patients. Reference material often informed physicians' decision-making and care plans.

Participants' comments demonstrated that poor CDS usability affected their decision whether or not to take action. First, EHRs separated medications, conditions, diagnoses, and more across display tabs. Physicians reported that these compartmentalized displays slowed the 'flow' of patient visits and diminished patient-provider interactions. Second, slow data collection tools hindered participants' abilities to interact with patients and shortened the time for patient education and counseling (see figure 2). Participants appreciated built-in functions and third-party applications that made data collection quicker. Third, participants often took paper-based notes during patient visits to capture data for eventual entry into the system. Lastly, some participants appreciated improved documentation through templates and flowsheets, while others expressed concern that these tools promoted medicine that was not patient-centered.

Participants expressed a need for tools to help manage patient panels in order to identify groups of patients requiring particular follow-up. One organization's EHR system had an unused panel management capability, yet decision-makers were unaware that there was an expressed need for this function among users.

Participants were well aware of their inability to share data within and across practices, and bemoaned waste and inefficiency due to inconsistencies in medication lists, laboratory data, and patients' health maintenance data. One participant expressed frustration that different values from within a single basic metabolic panel arrived on different days.

The work

Participants idealized CDS tools that would enhance their decision-making and clinical efforts within community-based practice settings. Clinic environments placed physical and cognitive demands on participants who described challenges associated with clinical decision-making.

Participants were exceedingly busy. The pace of work in both urban and rural practices felt rushed. Observation notes indicated that participants frequently ran behind schedule. Lunch times were often abbreviated and food hastily eaten while the participants caught up with paperwork and charting. Within this context, physicians ignored health maintenance flags, reminders, and alerts due to perceived lack of time.

Box 1 Summary of themes

1.0 The users

- 1.1 Personalities and perspectives
- 1.2 Patient relationships

2.0 The system

- 2.1 Medication alerts
- 2.2 Health maintenance alerts and prompts
- 2.3 Best practice alerts and flowsheets
- 2.4 Access to accurate and timely reference materials
- 2.5 Usability barriers and facilitators
- 2.6 Patient panel management tools
- 2.7 Data availability

3.0 The work

- 3.1 The community-based practice environment
- 3.2 Time
- 3.3 Cognitive work
- 3.4 Collaboration
- 3.5 Workflow

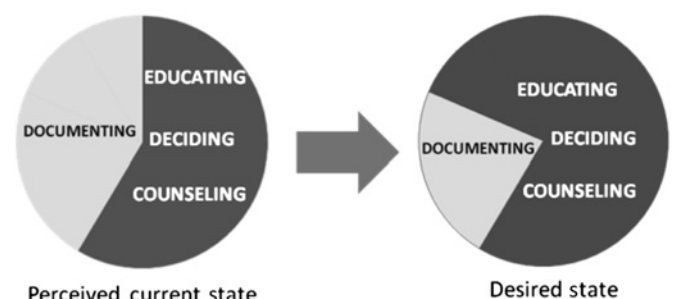


Figure 2 Perceived need for clinical decision support (CDS) to redirect work away from documentation.

Participants reported day-to-day 'cognitive work' for which doctors do not get paid and receive little support. An internist described 'cognitive work' as the effort required to synthesize disparate data both within and outside the EHR. Participants reported needing tools that helped present a overall view of a patient or patients so that decisions about care plans and strategies could be implemented.

The observations identified four groups with whom participants often collaborated: patients, patients' families and friends, clinic staff, and entities within the larger healthcare system. Physicians often used EHR displays to facilitate communication and joint decision-making with patients and patients' families, and one provider envisioned a CDS that could shift 'routine' work to staff and 'doctor stuff,' like patient education, to providers.

Participants noted that the workflow of meeting a patient, making initial notes, and then charting after the visit was time consuming and 'energy draining.' Although participants exhibited idiosyncrasies when charting, a cyclical pattern emerged that appeared to hold true regardless of site, physician role, or EHR system (see figure 3).

DISCUSSION

How participants viewed CDS

Participants distinguished clinical decisions from clinic decisions. Clinical decisions dealt with procedures such as ordering medications and administering evidence-based treatments. Participants wanted improved alerts, reminders, and algorithms to help with clinical decisions. However, participants also described a class of clinic decisions that entailed collaboration, workflow, and time management. Based on participants' perspectives, we distinguish CDS meant to support *clinical* decisions from 'cognitive decision support' meant to support *clinic* decisions (see figure 4). We found this distinction to be noteworthy and it supports the view that a spectrum of decision supports may optimize EHRs intended to support clinical performance.²²⁻²⁴ Further investigation into the nature of clinical decision-making and cognitive decision-making as it relates to CDS design is therefore required.

What participants needed from CDS

We present our proposed model for using a system to connect users with larger goals in figure 4.

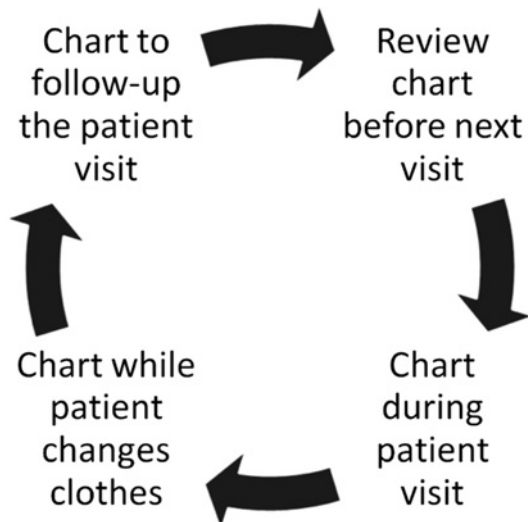


Figure 3 Common instances of charting during patient visits.

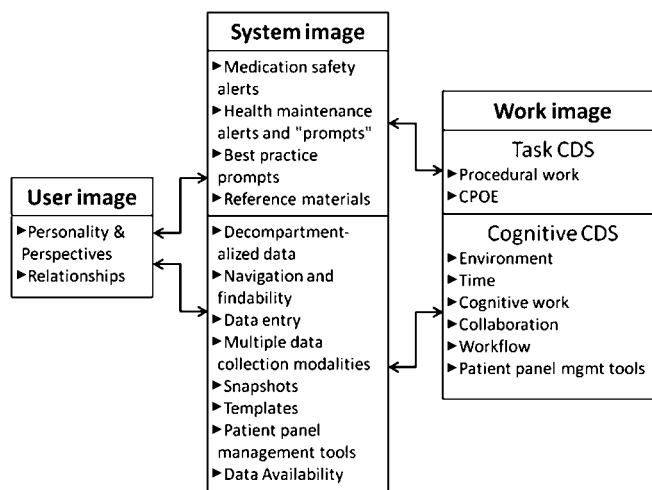


Figure 4 A proposed model for using a system to connect users with larger goals. CDS, clinical decision support; CPOE, computerized provider order entry.

The users

CDS designers could utilize this understanding of participants' personalities and perspectives as well as their desire to maintain bonds with patients. The physicians we studied wanted CDS features that support immediate tasks as well as enhance patient communication, such as informative yet brief patient summaries. This would help to provide physicians with a greater sense of control over an EHR that facilitates information and knowledge exchange with patients, and engender greater trust between patients and physicians, giving physicians another 'tool' with which to foster patient interaction.

The system

The incorporation of snapshots into EHRs could support decision-making by providing a tool that gathers data into high-level patient views. Snapshots would be akin to web-based maps that enable users to zoom in and out of a particular location, genograms that visually display familial relationships (see figure 5), and data maps.⁶³ Snapshots would also address a number of requirements raised in this study: the need to establish or re-establish a patient's identity in a provider's mind, the need to promote relationships with patients, the need to view data within a model of the patient rather than a model of a paper record, and the need to provide patient data pertinent to a physician's role. We encourage further research in this area.

Observations in the field revealed the difficulty participants had in capturing clinical data. Our time spent observing and

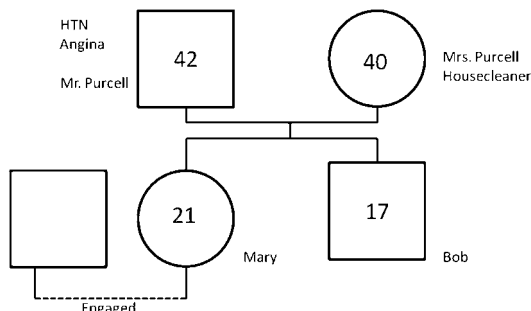


Figure 5 A genogram showing medical conditions, familial relations, and occupational information.⁶⁶ HTN, hypertension.

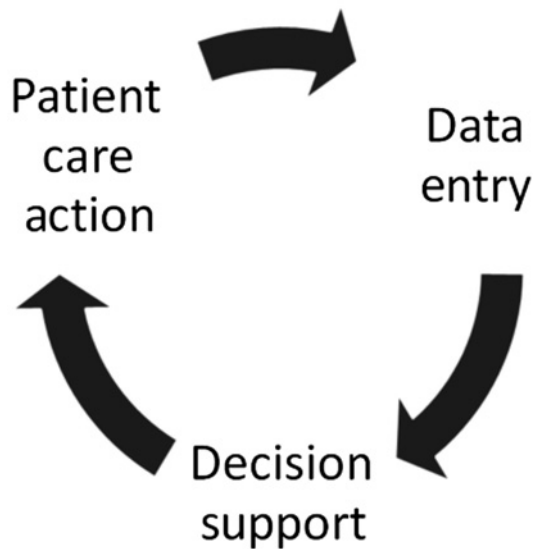


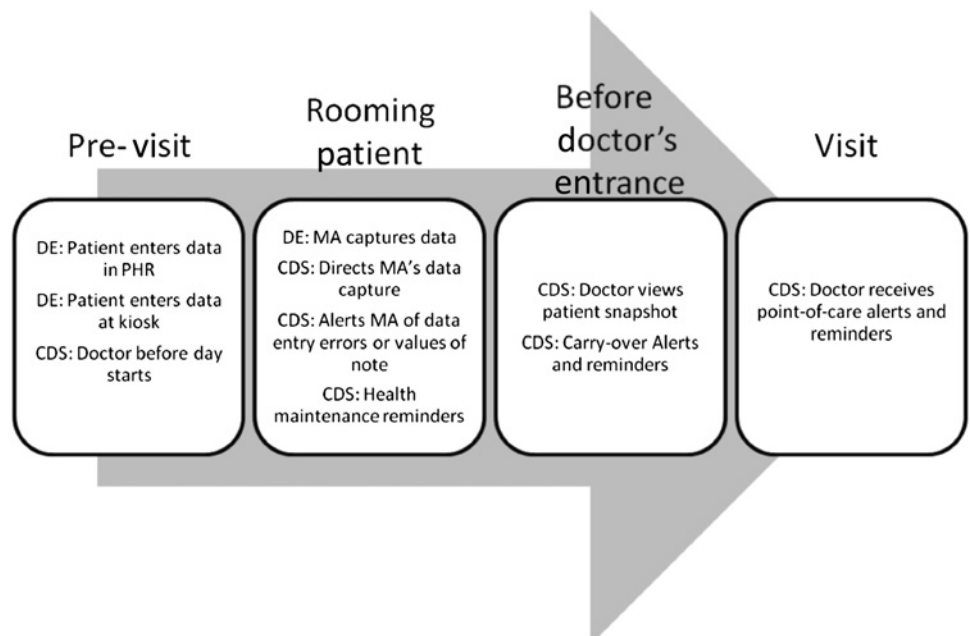
Figure 6 Clinical decision support (CDS) as one stage in a cycle.

interviewing participants highlighted a need for efficient tools that populate data in EHRs. This shortcoming is critical since a CDS system can only be as good as the data entered into it, and if the data are suspect, then so too is the CDS. First, we suggest that patient encounters require minimal typing by the physician. Second, we propose a model that views data entry as one step in a CDS lifecycle whereby clinical data drive CDS, CDS drives actions, and those actions require follow-up data entry (see figure 6).

The work

Decision-making occurred within demanding and tiring work environments where interruptions were frequent. Our findings concerning the work fit into three key categories: (1) the use of CDS to redirect work among clinical staff; (2) cognitive work; and (3) workflow.

Figure 7 Opportunities for CDS display in community-based practices. DE, data entry opportunities; CDS, clinical decision support opportunities.



Redirecting work

CDS could be designed in ways that shift 'data work' tasks to lower level staff members who (guided by flowsheets, reminders, and alerts) could collect data required for routine health maintenance. Shifting these tasks would allow physicians to carry out 'doctor stuff' such as educating, counseling, and motivating patients to meet a variety of individual needs. Doctors often described these activities as the enjoyable aspects of their work, underpinning the reasons why they chose to work in primary care settings. Given this perspective, differently designed CDS would enable physicians to offer more to patients by freeing them from simple but time-consuming tasks that can be done by others.

Cognitive work

Participants used the term 'cognitive work' in support of Hoff's findings.⁴⁷ Cognitive work was described as the unpaid work of communicating and coordinating care as opposed to the procedural work for which providers are paid. Cognitive work consists of myriad tasks such as reviewing laboratory results from disparate sources, communicating with providers in hospitals and other practices, contacting patients, and synthesizing notes. Participants asserted the need for cognitive support to better meet patients' needs because they felt burdened by inefficient methods of documentation, communication, and coordination; physicians feel new forms of 'decision support' (not CDS) may help with their cognitive work. These issues may become more relevant as an increasing number of providers in the US attempt to create practices that are modeled on the patient-centered medical home.^{64 65}

Workflow

Finally, we found that users may respond more positively to CDS that is presented during opportune moments within workflow rather than primarily at the point-of-care (see figure 7).

LIMITATIONS

This study focused more on users and their tasks and less on the systems they used (see figure 1). However, we received training

in each EHR system and consulted participating organizations when we had questions about EHR or CDS functionality and design. Participating organizations were all based in Oregon, but we sought participants from clinics across healthcare organizations who practiced in a range of communities, including urban and rural settings, and who used different EHR systems. Finally, the first author coded the data but did so in consultation with the second author, unaffiliated medical anthropologists, and with feedback from a subset of participants.

CONCLUSION

Our user-centered approach generated an understanding of participants' motivations, goals, and insights into decision-making in community-based practices. Participants delineated between clinical and clinic-related decisions and maintained that the two are quite different, even though the lines sometimes blurred upon further questioning. This finding may inform future discussions as researchers attempt to develop models of different decision support systems.

Participants described the requirements of clinical decision tools such as effective medication alerts and cognitive decision supports that address 'cognitive work' and improve connectedness. First, participants wanted tools that supported their personal satisfaction in developing and promoting relationships with a wide spectrum of patients who present with a variety of conditions. Second, participants wanted CDS that offered patient-specific alerts and reminders as well as decision supports that aggregate data into patient snapshots and data maps. Third, participants needed tools that support collaboration with patients as well as staff. Future research into the various aspects and types of decision-making can broaden discussion to better define decision support and how it can be designed to better meet users' needs.

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