Exploring Barriers and Facilitators to the Use of Computerized Clinical Reminders

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Abstract

Objective: Evidence-based practices in preventive care and chronic disease management are inconsistently implemented. Computerized clinical reminders (CRs) can improve compliance with these practices in outpatient settings. However, since clinician adherence to CR recommendations is quite variable and declines over time, we conducted observations to determine barriers and facilitators to the effective use of CRs.

Design: We conducted an observational study of nurses and providers interacting with CRs in outpatient primary care clinics for two days in each of four geographically distributed Veterans Administration (VA) medical centers.

Measurements: Three observers recorded interactions of 35 nurses and 55 physicians and mid-level practitioners with the CRs, which function as part of an electronic medical record. Field notes were typed, coded in a spreadsheet, and then sorted into logical categories. We then integrated findings across observations into meaningful patterns and abstracted the data into themes, such as recurrent strategies. Several of these themes translated directly to barriers and facilitators to effective CR use.

Results: Optimally using the CR system for its intended purpose was impeded by (1) lack of coordination between nurses and providers; (2) using the reminders while not with the patient, impairing data acquisition and/or implementation of recommended actions; (3) workload; (4) lack of CR flexibility; and (5) poor interface usability. Facilitators included (1) limiting the number of reminders at a site; (2) strategic location of the computer workstations; (3) integration of reminders into workflow; and (4) the ability to document system problems and receive prompt administrator feedback.

Conclusion: We identified barriers that might explain some of the variability in the use of CRs. Although these barriers may be difficult to overcome, some strategies may increase user acceptance and therefore the effectiveness of the CRs. These include explicitly assigning responsibility for each CR to nurses or providers, improving visibility of positive results from CRs in the electronic medical record, creating a feedback mechanism about CR use, and limiting the overall number of CRs.


On average, Americans receive about half of recommended medical care. Computerized clinical reminders (CRs), a form of clinical decision support, could improve quality of care by broadly reducing reliance of providers on their memories and by presenting accepted clinical guidelines at point of care. Computer-based decision support, including CR systems, increase adherence to preventive care guidelines.

A meta-analysis of 16 randomized, controlled clinical trials found computerized CRs increased vaccinations, breast cancer screening, colorectal cancer screening, and cardiovascular risk reduction, but not cervical cancer screening or other specific forms of preventive care. In the Veterans Administration
The VA CR system evaluates available patient data according to a defined logic, based on the clinical topic addressed. If the data indicate that an intervention is potentially appropriate for the patient, the reminder is deemed “applicable”; if the data indicate the intervention has been provided, the reminder is deemed “satisfied” and if not provided, “due.” In the CPRS, each patient’s chart opens to a cover sheet where due CRs are listed (Fig. 1). Some reminders are nationally mandated. Others may be mandated locally or regionally, and a third category includes reminders that are optional. Clinicians have the ability to add or remove optional reminders from the cover sheet display.

The CR system is intended to be used by both nurses and providers at different points in the clinic workflow. During patient intake, nurses complete many of the routine preventive care and screening reminders that appear in the patients’ electronic record such as depression screening. Reminders aimed at providers may require more clinical judgment. We use the term “provider” to include only the physicians, residents, nurse practitioners (NPs), and physician assistants observed. We distinguish “intake nurse” to include those participants who had responsibility for the initial patient check-in, including collection of patient weight and vitals. We use the term “clinician” to include all observed participants.

Each reminder is programmed to appear according to VA evidence-based guidelines. For example, the colorectal cancer screening reminder is triggered for male patients 50 years and older with no history of colectomy, no colonoscopy in the past ten years or no sigmoidoscopy in the past five years, and no record of three fecal occult blood tests (FOBT) results reported within the past year. If the patient has a family history of colorectal cancer, the age criterion is adjusted downward to 40. If the record does include three FOBT card results in the past year, the reminder appears annually. If the record indicates that a colonoscopy was performed, the reminder will appear ten years after the colonoscopy date. Similarly, the reminder will appear five years after a sigmoidoscopy. Rank-order logic is used so that the longest applicable period is chosen for the time to reappearance of this reminder. The system also allows the provider to document reasons for inapplicability, such as a patient refusal of a recommended action. The period of time that the reminder is “satisfied” varies for the different options (Fig. 2).

To satisfy the CRs, the clinician must first create a new progress note, then click on an icon to call up a list of reminders that are due, and then click on individual reminders to invoke a dialogue box to address each one. Once the dialogue is open, the clinician satisfies a reminder by selecting the appropriate dialogue options (Fig. 2). After each CR is processed, text is automatically inserted in the progress note. The reminders are passive in that clinicians have uninterrupted access to the CPRS software regardless of whether they address any reminders. That is, the reminders do not “pop up” and require an acknowledgment. CRs function in essentially the same way at each site, where they run as part of the CPRS. However, the administration at each site may tailor the reminder interfaces and code to add institutional performance goals and/or desired practices, unless it is a mandated national reminder. For example, one of the sites added “Codes for Bilateral Foot and Leg Amputee” as an option to document that the diabetic foot examination reminder

Methods

The Veterans Administration Computerized Patient Record System and Clinical Reminder System

The VA health care system includes 163 medical centers and more than 850 outpatient clinics. VA is a leader in the transition to electronic patient records and clinical decision support, including the design and implementation of CRs. The CRs function as part of the VA’s electronic medical record, the Computerized Patient Record System (CPRS). The CPRS is an integrated program with multiple software packages designed to allow providers to order medications, laboratory tests, consultations, and document actions.
was inapplicable. The total number of available reminders at each site varied (Table 1).

**Setting and Participants**

Three researchers with experience in human-computer interaction and ethnographic observation observed in the primary care outpatient clinics of four geographically distributed VA medical centers, two full clinic days at each site, between January and June 2004. At three of the centers, observations were conducted for two consecutive days. At the fourth site, observations were conducted at both the medical center and an affiliated outpatient facility nearby, one day at each. Aside from this one affiliated outpatient clinic, the primary care clinics were housed in the hospitals, which have full laboratory, pharmacy, and radiology services. These four sites were selected based on willingness to participate and diversity of geographic location. At all sites, each clinic room possessed a computer terminal where the nurse or provider could access the CRs.

Participants, both nurses and providers, were recruited opportunistically after consent per the institutional review board–approved procedure at each site. We observed a total of 35 intake/triage nurses (registered nurses, licensed practical nurses (LPNs), licensed vocational nurses, and health technicians) during patient intake and 55 providers (physicians, residents, NPs, and physician assistants) with their patients. Table 1 shows the distribution of participants by site.

**Data Collection**

Three observers experienced in ethnographic observation separately shadowed the nurses and providers as they interacted with the CRs during patient encounters and conducted opportunistic interviews to better understand the observational data. This technique is minimally intrusive and thus ideal for a busy clinic setting. We employed a maximum sampling strategy in which each observer stayed through an average of two patient encounters (mean = 2.0, standard deviation = 0.69) with any one clinician before observing another. Observations were recorded via handwritten notes during participant interaction with the CRs, capturing observable activities and verbalizations. All notes were deidentified; participant, patient, clinic, and site names were not retained. Notes were recorded continuously and time stamped. Table 2 shows an example of the primary data.

**Analysis**

Data analysis followed an established process of upward abstraction of qualitative field observations, in which details that are specific to the context of a setting are replaced by the underlying strategies and performance criteria that are relevant across settings. In other words, the data are represented at a higher level of abstraction such that observations can be integrated across cases to show patterns of behavior, for example. The handwritten observations were typed within a few days after each site visit, and a coding scheme
was applied to permit tracking of observer, site, and day. In an iterative fashion using a spreadsheet, we sorted the coded observations into 30 emergent categories (Table 3), collapsed similar categories, and split others into logical subcategories. We integrated findings across observations into meaningful patterns and abstracted the data into emerging themes, such as recurrent strategies (e.g., tendency to use the computer while not with the patient). For each theme, we recorded the frequency of occurrence from the sorted data, with the ability to break down the numbers for each site (e.g., 12 of 15 providers at Site 3 did not use the computer while with the patient). Many of these themes translated directly to barriers and facilitators of effective use of CRs. We also sorted individual level data for each observed clinician, including frequency and timing of CR use, knowledge of CRs, and level of computer use during patient encounters.

Table 1 ■ Patient Encounters Observed, Clinicians Observed, Number of CRs, and CPRS Version at each Medical Center

<table>
<thead>
<tr>
<th>Site</th>
<th>Patient Encounters</th>
<th>Nurses</th>
<th>Providers</th>
<th>No. of CRs</th>
<th>CPRS Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41</td>
<td>8</td>
<td>11</td>
<td>65</td>
<td>v1.0.22.16</td>
</tr>
<tr>
<td>2</td>
<td>48</td>
<td>11</td>
<td>15</td>
<td>37</td>
<td>v1.0.22.16</td>
</tr>
<tr>
<td>3</td>
<td>37</td>
<td>9</td>
<td>15</td>
<td>33</td>
<td>v1.0.23.15</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>7</td>
<td>14</td>
<td>30</td>
<td>v1.0.23.15</td>
</tr>
</tbody>
</table>

CRs = Clinical reminders; CPRS = Computerized Patient Record System.

Table 2 ■ Example Field Notes from Site 1

Time | Actors and Content
--- | ---
2:10 PM | Checks into CPRS. Dr. X: Can you walk at all? Pt: No Clicks to progress note before CRs there, clicks to cover sheet [still processing CRs] Left side has been hurting. Nursing home for 20 days. Dr. Are you coming up on your time to go home? Pt: I don’t know. Dr looking through note. Starts new progress note: “see addendum to [date] note” Pt: Swelling on left hand. See how much larger the left is than the right? Dr. X does not see because looking at the computer. Dr. X? Dr. X looks and says: Yes, that is quite a bit more swollen. Turns back to computer.

CPRS = Computerized Patient Record System; CRs = clinical reminders.

Results

We identified five barriers, four of which have related subcategories, and four facilitators, organized by three themes: organizational, workflow, and computer interface (Table 4).

Barrier 1: Coordination between Nurses and Providers

Role Confusion between Nurses and Providers

At each site except Site 3, nurses and providers displayed substantial confusion regarding delegation of responsibility for satisfying CRs (removing them from the due list). In fact, responsibilities for resolving particular reminders varied not only between the four sites, but also in some cases varied between each specific clinic within a site. Even when roles were clarified, the assigned responsibility of individual reminders sometimes changed over time, producing confusion. For example, at Site 3, a CR for colorectal cancer screen was originally assigned to the nurses to perform during intake and then later switched to providers. At Site 4, the opposite role reversal was reported for all diabetes CRs (provider assignments switched to nursing). Finally, three clinicians, all from Site 2, selectively chose which reminders they would satisfy or decided to “help out” and satisfy certain CRs time permitting, when in actuality they were responsible for resolving a predefined list of CRs at all times. Overall, six of 55 observed providers did not use the CRs at all. Unclear responsibilities for the CRs can produce confusion and become a barrier to the effective use of CRs.

Coordination from Intake to Patient Examination

At each site, we observed the use of paper-based workarounds to transmit clinical data from intake nurses to providers. At Site 1, a provider used printed nursing notes that include the nursing CR activity from intake while with patients, despite the availability of the information in the electronic medical record. At Sites 2, 3, and 4, we observed that nurses indicate a positive CR screen result, such as from depression screening, with handwritten notations or paper post-it notes on the patient’s routing form or a special card delivered to the provider by the patient. However, positive screening results do appear in the CPRS for the provider to view after the reminder is processed by the nurse during intake. The use of a paper-based workaround is a barrier to the use of the reminders because it effectively circumvents the intended use of the system and increases the opportunity...
for losing the printed information and resulting gaps in documentation.

**Barrier 2: Satisfying Reminders While Not with the Patient**
Clinical reminders were designed to be used while with the patient. At Site 3 in particular, we observed a strong social norm for providers to complete documentation (e.g., write progress notes, satisfy CRs) after the patient had left (either immediately or later in the day). At Site 3, 12 of 15 providers did not use the computer while with the patient or had minimal computer use (e.g., order a laboratory test). Thus, the providers had a tendency to do CR documentation after the patient left, even when information from the patient was necessary to accurately satisfy the reminders. This trend was observed to a varying degree at the other three sites: nine of 11 providers at Site 1, four of 15 providers at Site 2, and six of 14 providers at Site 4 did begin progress notes while with the patient but did not use the CRs. The social norm for providers to avoid using the computer while with the patient forms a barrier to effective CR use. In contrast, the nurses who performed patient intake were more likely to satisfy CRs while with the patient with the exception of the nurses who performed patient intake were more likely to satisfy CRs while with the patient but did not use the CRs. The social norm for providers to avoid using the computer while with the patient is a barrier to effective use of the reminders because the nurses and providers perceive the CRs to be a noncore activity, the CRs are less likely to be satisfied when they are pressed for time.

- **RN**: “It all comes down to time. If you’re busy and you need to cut time, the reminders are the expendable part.”

**Redundant Documentation**
Completing the CRs creates “double documentation” burdens for some providers, thus adding to their workload, as they generally keep track of this information without the CRs (e.g., in a health maintenance list within the progress note). Nurses often must enter the patient’s vitals information twice during intake, once in the CPRS Vitals Package and then again in the CR system (e.g., Hypertension Screen/Blood Pressure Check reminder). When the CRs require redundant data entry, this is a barrier to effective use of the reminders because the clinicians perceive that there is no benefit to entering data in multiple places in the electronic medical record.

**Paper-based Workarounds**
An elaborate workaround was observed at one of the hospitals at Site 2 to save nurses time during patient intake. At this hospital, a list of the patient’s CRs was automatically generated and printed at check-in with the clerk. The nurses then used this printout to address the CRs during intake and recorded the responses on the printout itself. This printout traveled with the patient to the provider and eventually was returned to the nurse so that she could record the information in the CPRS later in the day and “satisfy” the computerized CRs. The CR system was designed to work without such paper-based support. Additional time for patient intake would be needed if the nurses at this hospital were to use the CR system as it was designed (additional time to enter patient response and data into the interface for the computerized CRs and computer processing time). As noted previously for coordination from intake to patient examination,

### Table 3 - Emergent Categories During Data Reduction

<table>
<thead>
<tr>
<th>Category</th>
<th>CR dialogue options</th>
<th>CR specific praise/criticism</th>
<th>CR general praise/criticism</th>
<th>General CR functioning</th>
<th>Evidence of CRs “reminding”</th>
<th>Inapplicability of CRs</th>
<th>Training</th>
</tr>
</thead>
</table>

**CR** = clinical reminder.

### Table 4 - Barriers and Facilitators by Theme

<table>
<thead>
<tr>
<th>Theme(s)</th>
<th>Barrier/Facilitator</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR-specific praise/criticism</td>
<td>Coordination between nurses and providers</td>
</tr>
<tr>
<td>General praise/criticism</td>
<td>Satisfying reminders while not with the patient</td>
</tr>
<tr>
<td>General CR functioning</td>
<td>Workflow</td>
</tr>
<tr>
<td>Evidence of CRs “reminding”</td>
<td>Lack of flexibility</td>
</tr>
<tr>
<td>Inapplicability of CRs</td>
<td>Poor usability</td>
</tr>
<tr>
<td>Training</td>
<td>Limiting the number of reminders at a site</td>
</tr>
<tr>
<td>Misuse of CRs</td>
<td>Strategic location of the computer workstations</td>
</tr>
<tr>
<td>Integrated CR template</td>
<td>Integration of reminders into workflow</td>
</tr>
<tr>
<td>Use of nondue CRs</td>
<td>Ability to document problems</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>and receive prompt feedback</td>
</tr>
</tbody>
</table>

**Barrier 2:** "It takes away from doing other important activities with the patient.”

### Not Enough Time
Perception that there is insufficient time is closely related to the “core” activity perception. Five providers and one LPN reported the CRs as being “time-consuming,” and a second LPN was directly observed to be frustrated with how long it took to use the depression, tobacco, and alcohol screening reminders. One provider and four LPNs reported that they would not satisfy a patient’s CRs until later in the day because of being busy. Four providers and seven LPNs reported not completing the CRs for a patient at all as a result of being busy, and two LPNs were observed skipping a patient’s CRs. If nurses and providers perceive the CRs to be a noncore activity, the CRs are less likely to be satisfied when they are pressed for time.

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the use of a paper-based workaround is a barrier to the effective use of the reminders as it circumvents the intended use of the system and increases the opportunity for losing clinical information.

**Barrier 4: Lack of Flexibility**

*Inapplicability of the Reminders*

We observed instances in which none of the available options to satisfy the CR applied to the patient or situation. In addition, clinicians reported that they faced situations in which CRs could not be removed and therefore continued to appear. Two providers established during a patient encounter that a reminder was not applicable because of (1) a previous misdiagnosis for diabetes and (2) a case in which the reminder was “reminding” the provider to refill the patient’s angiotensin-converting enzyme (ACE) inhibitor when in fact a refill order was not needed. In this second case, the system looks for the patient filling a prescription, not the provider ordering the medication. This design is intentional and serves as a monitor of patient adherence to prescribed therapy. However, a list of CRs that may or may not be applicable to the patient can impede the clinician’s efficient use of CRs.

**Reminders and Clinical Judgment Conflict**

Two providers were observed to decide that a colorectal cancer screen reminder was not applicable due to patient age and other health factors. Further, one of the two providers decided that a tetanus vaccine reminder was not applicable because there was a shortage and only the patients at highest risk were to receive the vaccine. In these cases, the CRs did appear at the appropriate time and were relevant to the patient. However, they conflicted with the provider’s judgment and thus were not followed. Effective use of the CRs is impaired when providers do not agree with the intervention, and time during the patient encounter has been used to view and consider these CRs that the provider has determined to be inapplicable.

**Dead-end Scenarios**

There were cases in which clinicians reached a dead end within the CR system, with no reasonable option to proceed. When using a “Next” feature to satisfy a sequence of CRs, two nurses and one provider were observed to reach the dialogue box for a CR that they did not wish to satisfy. However, there was no means to cancel the CR without losing the data already inputted for the previous CRs. A workaround is to select each CR individually from the list rather than using the Next button to navigate through a sequence of CRs. In another case, a provider reported wanting to drop specific components of a hypertension lifestyle counseling CR that he thought did not make sense for the current patient. However, this was not possible without losing the data already inputted for the other portions of the CR. The existence of dead-end scenarios is a barrier to the effective use of the reminders since it impedes the ability to satisfy them and introduces the possibility of losing data previously inputted.

**Barrier 5: Poor Usability**

*No Right Answers*

Options within the dialogue box of the CRs do not always match the patient’s response or there is not an appropriate option for indicating why the provider has decided not to order a test, for example. This is a barrier to resolving the reminder. Seven nurses and seven providers reported that there was “no option for…” or “not enough options” in the CRs for specific reminders. Additionally, we observed one nurse and one provider become “stuck” trying to satisfy a CR because the appropriate option was not available to them. Two nurses and two providers reported that they wanted additional options for resolving specific reminders even though there was a legitimate way to satisfy them at the present time. Finally, two providers reported using workarounds to satisfy reminders because of the inflexibility of the dialogue options. For example, the following was reported at Site 2, where the provider arbitrarily selected a date to satisfy the reminder:

- **Provider:** “Sometimes there aren’t any legitimate answers. I just make something up when that happens. For example, a lot of patients have outside [of the VA] care. They don’t know when they had their flu shot. The real question is whether they had the shot this year or not.”

**Finding the Reminders**

When opening a patient’s record in the CPRS, a summary cover sheet displays items such as a problem list, allergies, and appointments (Fig. 1). The CRs appear on this cover sheet but are delayed in loading and displaying (Site 3 reported an average delay of 8 seconds for the CRs to load). During this delay, we observed providers and nurses use strategies such as clicking on the progress notes tab before the reminders have displayed (six providers and two nurses) or reporting a default tab to bypass the cover sheet, thereby lessening the visibility of the reminders. Further, when defaulting past the cover sheet, feedback for the presence of due CRs is signified by a question mark icon in the upper right corner of the display. We observed three providers misinterpret this question mark to indicate that the patient had no CRs due, in actuality it meant the system was still evaluating data to determine which CRs were due.

**Lack of Speed**

In 162 total patient encounters observed, we recorded computer system delays in approximately 10% of the encounters (with 13 nurses and three providers) and computer crashes in approximately 1% of the encounters (with one nurse and one provider). By “delay,” we mean that the clinician was stopped while the CPRS was open and processing. When the computer system crashed, the clinician could do little until it was returned to working order as virtually all nursing and provider functions are performed through the CPRS. In addition to the observed delays and crashes, two nurses and 14 providers reported experiencing them in the past. An example from Site 3:

- **Physician:** “The CPRS is slow today, the hourglass [is an indicator], when it starts slowing down we know that it might crash. We become paralyzed. It shuts everything down.”

Insufficient dialogue options, inadequate visibility, and slow processing speed relate to usability issues that negatively affect the effective use of the CRs. In addition to barriers, four facilitators to the effective use of CRs were identified from our observations and interviews with host investigators at each site.
Facilitator 1: Limiting the Number of Reminders at a Site

Five nurses and two providers were observed to skip all or some of the reminders and explained that this was because they perceived that they did not have enough time to “satisfy” the reminders by entering data. At sites where some clinicians routinely drop satisfying reminders, the number of reminders is greater since these reminders continue to appear along with any new reminders that have been added or become “due” since the last appointment. Therefore, one facilitator is the extensive and consistent use of CRs, particularly in removing inapplicable reminders, by all intake nurses and providers because the “reminder burden” becomes lower over time. This is particularly important for the first visit by a new patient, as that is often when there are the most reminders to address for the patient.

Site 4 had the lowest overall number of reminders (30) at the time of observation. A physician champion for reminders informed us that they had explicitly decided to keep the overall number of reminders down to reduce “reminder fatigue.” They categorized the reminders by (1) performance scores that they needed to work on, (2) efficiency benefits, and (3) clinical guidelines. He said that, generally, only those in Category 1 make it on the list. In the past, anyone at the site could ask to add a reminder at the site, but now they have a committee that must approve them before they are implemented. At Site 3, a similar committee approved reminders before implementation and also assigned “N” and “P” labels to indicate intake nursing and provider responsibility, respectively. Limiting the number of reminders, with use of a committee, for example, can help facilitate the effective use of them by reducing the potential for reminder fatigue.

Facilitator 2: Strategic Location of the Computer Workstations

In all our observations, a computer workstation was placed in each clinic room so that the clinicians could access the CPRS software while with the patient. There was variability in terms of where in the room the computer was located, ranging from the clinician needing to turn his or her back on the patient to use the computer, to where the clinician could maintain eye contact with the patient while using the computer, to where the clinician and the patient could both view the screen simultaneously. At least one provider positioned the screen to maintain eye contact during most of the visit, then explicitly moved the screen and asked the patient to come closer so that the patient could view laboratory test results, then returned the screen to another position for the rest of the time. Further research is needed to determine the optimal location of the computer workstation in the patient’s room and/or clinician strategies to communicate and build rapport effectively and efficiently with the support of a computer.

In addition to the patient rooms, workstations were available in other locations at several of the sites, which apparently facilitated the use of the CRs. At Site 1, a computer workstation was placed in the clinic hallway. To save time, when all the clinic rooms were full, the intake nurse was observed to use the hallway workstation to view a patient’s CRs ahead of time while waiting for a room to become available. This way, she described that she could make physical and “mental” preparations related to the reminders before calling the patient (e.g., the patient needs a flu shot). At Site 3, providers had computers in a dedicated common workspace called a “bullpen.” All the observed providers at that site viewed the patient’s record, including the CRs, immediately before seeing the patient in the clinic room. Also, providers generally satisfied the CRs in this workspace while writing the progress note after the patient encounter. These examples illustrate that strategic placement of the computer workstations may help facilitate the effective use of the CRs.

Facilitator 3: Integration of Reminders into Workflow

The typical intake nurse workflow at all the sites was to obtain vital sign data (i.e., weighing the patient and taking a blood pressure reading), enter the vital sign data into a vital sign package function in CPRS, and then open a progress note and document the patient’s “chief complaint” and responses to preventive care and screening questions. At several of the sites, templates were used for the progress notes to make the information gathering and documentation more efficient and consistent. The use of CRs automatically generates text that is added to the progress note, but that text is not integrated with the template information and is generally added to the bottom of the note. At Site 4, the tobacco screen reminder observed at the other three sites was eliminated because the same information was added to the template for the intake nurse. This facilitated tobacco screening by embedding the task directly into the typical workflow. Although this strategy can currently only be used for reminders that apply to every patient visit, it is possible that these features could be more closely integrated in the future, such as by having templates dynamically include CRs at the appropriate locations of the note or have documentation in a field of a template automatically “satisfy” a reminder. This integration of the clinical topic addressed by the reminder into the template aligns it more directly into the nurse’s workflow, thus facilitating its effective use.

Facilitator 4: Ability to Document System Problems and Receive Prompt Feedback

A facilitator observed at Site 3 involved a feedback mechanism that allowed the clinician to document a problem that he or she was having with a particular CR. In one case, a provider was observed using the feedback tool to document a problem with the reminder “CHF NOT ON ACE” (congestive heart failure not on ACE inhibitor). The reminder referred to an ACE inhibitor medication that needed to be renewed. However, the patient’s dose of lisinopril had previously been reduced and so the patient still had half of the prescription. Based on this, no appropriate option existed to satisfy the reminder, and the provider had to leave the reminder unsatisfied and document the problem with the feedback tool. The provider reported that her past experiences with the feedback tool were positive; the feedback tool was timely. In other words, feedback from the tool was sent to the local Information Resources Management office, and the CR was removed from the patient’s record by a Clinical Applications Coordinator. In addition, an administrative physician stated: “Part of the success of CRs at [Site 3] is attributed to the feedback tool… At times, changes are made to the CRs based on
Table 5 ■ Summary of Findings from Present and Previous Studies on Barriers to the Use of Computerized Clinical Reminders

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Facilitators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Coordination issues between nurses and providers</td>
<td>1. Limiting the overall number of reminders at a site</td>
</tr>
<tr>
<td>2. Satisfying reminders while not with the patient</td>
<td>2. Improving the location of the computer workstations</td>
</tr>
<tr>
<td>3. Workload</td>
<td>3. Improving integration of reminders into workflow</td>
</tr>
<tr>
<td>4. Lack of flexibility, false alarms</td>
<td>4. Ability to document problems and receive prompt feedback</td>
</tr>
<tr>
<td>5. Poor usability</td>
<td></td>
</tr>
<tr>
<td>6. Training</td>
<td></td>
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<td>7. Accessibility issues</td>
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<td>8. A perception that administration benefits more than providers</td>
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</table>

*Not observed in present study.
†Partially supported in present study.

this feedback.” Providing the ability to document such problems and receive prompt feedback facilitates the effective use of the CRs.

Discussion

When health care systems rely on clinician memory, patients do not consistently receive all interventions that might improve their outcome. Computerized CRs are one tool to assist clinician adherence to and sustain evidence-based practices at the point of care. This observational study extends the previous findings that organizational and computer interface characteristics affect compliance in a system with CRs (Table 5). Results from this study were revealed by use of ethnographic methodology and a sociotechnical systems perspective, an advantageous approach to analyzing human factors in complex medical work systems. Coordination issues between nurses and providers, including role confusion and communication of CR results from intake to patient examination, were a barrier to effective CR use found in this study that was not revealed in previous research. Further, several new facilitators to CR use emerged from this study (Table 5). Use of these findings to structure an implementation plan for a CR system may improve the ability to effectively and easily use CRs and would likely increase the quality and consistency of care provided for outpatients.

The list of barriers and facilitators to the effective use of computerized CRs in Table 5 has relevance beyond the CPRS and the computer interface. Indeed, the methods employed allowed the examination of the greater organizational and work process influences on the use of the CRs. As opposed to simply assessing the usability of the CPRS and CRs, methods that employ ethnographic observation allow the researcher to understand the work system as a whole, from the larger sociotechnical components down to the computer interface level. Figure 3 illustrates the differences in scope between usability testing of computer interfaces and other methods. Frameworks such as cognitive engineering and distributed cognition both use an ethnographic observational approach, as both support that the cognitive work cannot be separated from the context of the complex environment within which it exists. That is, both expand the unit of analysis beyond simply a single user and computer interface and instead focus on how the human–computer interaction exists among the many people and technological artifacts in a sociotechnical system. From Table 5, all the barriers, with the exception of poor usability, relate to or are at least influenced by the greater sociotechnical work system.

Previous research identified barriers to the effective use of ten CRs used for HIV care. These barriers included workload, time to remove inapplicable reminders, false alarms, training, reduced eye contact, and the use of paper forms rather than software. A survey of VA providers in 2003 supported these barriers and also found that poor ease of use, accessibility (i.e., slow computer speed, not enough workstations), and a perception that administration benefits more than providers were additional barriers to use. The present study supports many of the previous findings and adds additional insights. Moreover, it is unique in that it focuses on both nurses and providers and covers the full complement of CRs in the VA.

With the exception of training, all the barriers from the HIV CRs study were also supported in the present study. Except for residents, most of the observed clinicians knew how to access and satisfy the CRs. Of the additional barriers to CR use found in the 2003 VA national provider survey not found in the HIV CRs study, poor ease of use, accessibility, and a perception that administration benefits more than providers, are partially supported by the present study. Poor ease of use was a finding in the present study. However, only accessibility in terms of computer speed, not the number of workstations, was found to be a barrier in the present study. Finally, while there may have existed a perception that administration benefits more than providers, a survey method is more likely to reveal this barrier than direct observation.

Aside from the exceptions discussed above, the barriers found in the previous studies in the VA were confirmed in the present study. A new barrier discovered in the present study not found in the previous studies was coordination issues between nurses and providers, including role confusion.
and communication of CR results from intake to patient examination. This barrier was likely not discovered in the previous research since nurses responsible for patient intake were not a primary focus in those studies.

At the site level and, in some cases, the clinic level, some CRs are assigned to either nurses to perform during patient intake or to providers to perform during the patient encounter. Confusion of CR responsibilities was observed where clinicians selectively chose which reminders they would satisfy as well as sometimes “helping out” by doing reminders assigned to others. Further, when certain reminders were not being satisfied, there were cases in which the assignments of the reminders changed over time between nurses and providers. If clinicians are not clearly given responsibilities for specific CRs, the reminders may not be consistently satisfied. A solution that we recommend is to explicitly assign roles and make those roles visible on the computer interface itself. This practice was observed at Site 3 and seemed to reduce potential role confusion as compared to the other three sites. As Site 3, each CR was prefaced with an “N” (for nurse) or a “P” (for provider), making it clear who was responsible for completing the reminder.

Communication of positive screening findings by intake nurses using CRs to providers was problematic through the CPRS as providers generally did not open nursing progress notes before seeing patients. At all four sites, paper-based workarounds were employed to alert providers to positive findings from the screening, including printing the nursing note for the provider (Site 1), placing a post-it note or using handwritten abbreviations on the patient’s routing form (Sites 2 and 4), and marking a check box next to the appropriate item on a “green card” that the patient then gave to the provider (Site 3). These paper-based strategies are not necessarily inefficient. However, we believe that these examples suggest that the design of the computerized CR system is currently insufficient for supporting transmission of reminder results from nursing intake to provider examination. At Site 1, a new CR was triggered if a patient was found to be depressed entitled “Depression Screening Positive.” A variety of approaches could be used to better communicate positive screening results from intake nurses to providers in the CPRS. For example, a pop-up dialogue box could highlight the information when the provider opens the patient record or the information could be prominently displayed on the cover sheet.

The four identified facilitators to effective CR use (Table 5) are unique to the present study and can help to reduce some of the barriers. We believe that two facilitators are especially important and, based on space limitations, we focus on these two facilitators. The first one, reducing the number of CRs, seems like a simple facilitator. Clinicians may experience reminder “overload” and become desensitized to the CRs when faced with a long list of them for each patient. There is a clear trend in the VA to continuously increase the number of CRs, both locally through adoption and sharing of reminders across sites informally as well as nationally. However, some VA sites may already have reached saturation. At Site 1, which has 65 CRs, we observed an average of eight reminders appear per patient. Assuming, for the sake of argument, that each reminder requires approximately 30 seconds to satisfy (open reminder, obtain necessary information from patient, order any necessary consults or tests, and document), then the clinician would spend 4 minutes per a 15- to 30-minute encounter completing the reminders in an already time-pressured appointment. By finding strategies to reduce the number of reminders, we may increase the likelihood of reminders being effectively used.

The second facilitator, the feedback tool observed at Site 3, can facilitate continuous quality improvement efforts by allowing the user to communicate problems to administrators. In addition, when users feel that they are participating in the design or redesign of a system, they are more likely to accept changes to that system. In other words, allowing the user the ability to provide feedback can give the user a sense of ownership in the process. We expect that clinicians will be more likely to use and accept the CR system when provided with the ability to document problems with the reminders and receive prompt feedback.

The primary limitation of this study was convenience sampling of intake nurses, providers, and patients, which is the standard technique when access to busy professionals is limited. Also, we visited only four of 163 VA medical centers. The evidence of the facilitators outlined in this article is not as strong as the evidence of the barriers because they are based more on interview data than the barriers and there is less converging evidence to support the findings. While the results of this study may help explain some of the variation in the effectiveness of computerized CRs, the reasons for the decline of CR effectiveness over time found in previous research remain unclear. It is possible that research targeted specifically at resident physicians might shed light on this question as interview data suggested that resident physicians, who did not receive consistent organizational feedback on reminder use completion rates, reduced usage of CRs over time more than the nurse and housestaff providers. We expect findings from this study to have relevance and provide some guidance to non-VA hospitals that use CRs with an electronic medical record. However, generalizability of our results to non-VA hospitals may be limited due to the unique factors of the VA’s CPRS and CR system. For example, the reminders in the electronic medical record at Brigham and Women’s Hospital in Boston do not have the documentation aspect observed with the VA reminder system.

Conclusion

Previous research shows that the effectiveness of CRs is variable and may decline over time. We employed ethnographic, or “naturalistic,” observation to identify barriers and facilitators that affect the effectiveness of the reminders. Barriers outlined in this study are consistent with those found in previous research, except coordination issues between nurses and physicians, which was a unique finding in this study. Based on these findings, we propose recommendations for CR system design. To reduce role confusion, we recommend prefacing, when appropriate, each CR with a matching assignment for nurse or provider and highlighting positive results in the CPRS to assist the provider in viewing results from patient intake. To engage providers in reminder use and improvement, we recommend that facilities using computerized CRs provide a feedback mechanism for clinicians and limit the overall number of CRs to increase the likelihood of user acceptance.
References


