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Factors associated with improved completion of computerized clinical reminders across a large healthcare system

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ABSTRACT

Objective: To analyze the relationship of completion rates for a standardized set of computerized clinical reminders across a large healthcare system to practice and provider characteristics.
Methods: The relationship between completion rate for 13 standardized reminders at 49 primary care practices in the VA New England Healthcare System for a 30-day period and practice characteristics, provider demographics and, via survey, provider attitudes was analyzed.
Results: There was no difference in clinical reminder completion rate between staff physicians versus nurse practitioners/physician assistants (87.6% versus 88.1%) but both were better than residents (76.6%, $p < 0.0001$). With residents excluded, there were no differences between hospital and community-based clinics or between teaching and non-teaching sites. Clinical reminder completion rate was lower for sites that did not fully utilize support staff in completion process versus sites that did (82.4% versus 88.1%, $p < 0.0001$). Analysis of survey results showed no correlation of completion rate with provider demographics or attitudes towards reminders. However there was significant correlation with frequency of receiving individual feedback on reminder completion ($r = 0.288$, $p = 0.004$).
Conclusion: Completion of computerized clinical reminders was not affected by a variety of provider characteristics, including professional training, demographics and provider attitude, although was lower among residents than staff providers. However incorporation of support staff into clinic processes and individualized feedback to providers were strongly associated with improved completion. These findings demonstrate the importance of considering practice and provider factors and not just technical elements when implementing informatics tools.

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1. Introduction

Clinical reminders (CRs) are a widely used type of clinical decision support and consist of a prompt to the clinician to perform a due health care task. Computer-based clinical reminders have been shown to improve adherence to clinical practice guidelines and specific standards of care [1–5]. However, reported rates of CR completion have generally been low

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Table 1 – Factors identified in the prior publications which may facilitate or inhibit the use of clinical reminders

Reminder characteristics
Possible facilitating factors
Minimization of keystrokes, mouse clicks, scrolling, window changes and complexity [12,14]
Facilitation of alert completion with pre-populated alternatives [14]
Minimization of time required to document why reminder did not apply ("exceptions entry") [9–11,14]
Correct assignment of patient eligibility with updating easy and rapid [9–11,14]
Utilization of stored patient data to more precisely target patients [14]
Selective targeting of users based on department, degree and other user characteristics [14]
Provision of enough information to allow a triage decision at a glance [14]
Presence of links to other information resources [14]
Provision for users to have some control of reminders so that they can avoid unnecessary ones [14]
Presentation of CR in use of electronic medical record at the point of decision and action [14]
Including all clinically appropriate options for action, including patient refusal [7,10]
Ensuring CRs easy to locate in EMR [10]
Practice characteristics
Possible facilitating factors
Easy accessibility to computers [10,14]
Presentation of CRs at the appropriate time within the clinic workflow to the appropriate staff [10,12,14]
Coordination between nurses and providers [10]
Limitation of number of reminders to minimize "reminder fatigue" [10]
Ability for providers to document problems with CRs and receive prompt feedback [10]
Possible inhibiting factors
Provider workload and inadequate time during visit [7–14]
Interference with provider-patient interaction [9,11,12]
Use of paper records or forms in completion process [9,11]
Using reminder while not with patient [10]
Slow computer processing time [10]
CRs that benefit administration more than providers [11]
Lack of reimbursement for reminder completion [7]
User characteristics
Possible facilitating factors
Adequate training on reminder use [9,11]
Staff provider vs. resident physicians [11]

[5–7]. If the full benefit of computerized clinical decision support systems such as CRs is to be realized, factors related to successful use in actual clinical practice must be understood and changes in practice to improve use instituted.

Recently there has been a number of publications identifying factors that may impact the use of CRs. Methodologies used to identify these potential factors included user surveys [7–13], user focus group [14] and a survey of individuals attending a VA informatics conference [10]. Two studies involved detailed observational studies of clinics, the first of 10 clinics using selected HIV related reminders [9] and the other of four VA medical center clinics using a number of preventive and chronic disease management reminders [10,11]. A long list of factors which might affect use of reminders has been identified through these investigations, shown in Table 1. These factors can be characterized into those related to the design of the CR itself, those related to the characteristics and workflow of the clinical setting in which the CR is being used and those related to the staff using the CR. However none of these studies examined the relationship of these factors to actual completion rate in practice.

In 2001, the primary care services in the VA New England Healthcare system agreed to standardize the CRs across the large integrated healthcare network. Use of the VA electronic medical record (EMR) was universal and the EMR included a comprehensive CR capabilities. Effort was undertaken to produce and implement a single set of well designed and accurate CRs. While the literature cited above had not yet been published, many of the recommended design elements listed in Table 1 were in fact incorporated into the reminders. Approximately 2 years after standardized reminders were implemented, we examined the completion rates for a specific set of CRs across the multiple primary care clinics in this network [15]. In that study we found an overall completion rate of 88.3% for the 142,073 reminders due in the 29,515 patients seen in the study period, a rate that was considerably higher than reported in other studies [5–7]. However significant variation in completion rate was also observed. Among the 49 clinics, completion ranged from 66.6% to 97.1% and among the 355 primary care providers completion ranged from 43.8% to 99.4%. Our experience offered an opportunity to correlate specific site and provider characteristics with actual CR usage, something that prior studies had not done. The objective of this study therefore was to evaluate the effect of provider and practice characteristics on CR completion rates.

2. Methods

2.1. *Participants*

The study included all primary care providers in 49 primary care practice sites affiliated with the eight medical centers

Table 2 – Practice site and provider characteristics evaluated in the study

Practice characteristics
Size—number of active primary care patients (range: 320–18,683 patients, mean 9530)
Community-based clinic (88 providers) vs. hospital based clinic (267 providers)
Teaching practice—includes resident continuity clinic (219 providers) vs. non-teaching practice (136 providers)
Immediate "real-time" data entry for CR completion by support staff: yes (122 providers) vs. no (233 providers)
Provider characteristics
Staff physician (144) vs. nurse practitioner or physicians assistant (97) vs. resident (108)
Age (from provider survey with options, age: 25–30, 31–40, 41–50, 51–60, 61–70, >70 years)
Year of graduation from Medical School or from NP or PA program (from provider survey)
Duration of employment at VA (from provider survey): how long have you worked for the VA? <6 months, 6–12 months, 1–2 years, 3–4 years, 5–10 years and >10 years

Sample size for each characteristic is shown in parentheses.

of the VA New England Healthcare System. For the purposes of statistical analysis, nurse practitioners and physician assistants were combined into a "midlevel provider" group. The site and provider characteristics analyzed are shown in Table 2.

2.2. *Clinical reminders*

The function of CRs is to identify patients for whom a specific health care task is applicable, to determine whether the task has been completed within an identified time frame and to remind the clinician to complete the task if it is in fact due. In the VA EMR, once a reminder has been developed and activated in the computer system of a particular medical center, the CR is classified as either "applicable" or "not applicable" for each patient. Each applicable reminder is then classified as either "satisfied" or "due" at any given time. Applicable and due status of CRs for a patient is displayed based on clinical data in real-time and is determined based on patient's diagnoses, laboratory results, and demographic characteristics (such as age, gender). For example, for a patient with a diagnosis of diabetes mellitus, annual hemoglobin A1C (HbA1c) measurement would be an "applicable reminder". The VA EMR automatically evaluates the laboratory profile of this patient to determine whether HbA1c testing was performed within the last year. If a test result is found in the system, the reminder is automatically "satisfied". If no results for HbA1c are found, then the reminders appear as "due". In the case of the HbA1c reminder, appropriate documentation of non-VA lab testing by the clinician can also satisfy the reminder.

Due reminders are displayed on the first screen of a patient record in the VA EMR. When completing a progress note, clinicians can open a "dialog box" for an individual CR. Completing the information in the dialog box allows the clinician to complete the reminder and perform clinical documentation in one seamless step. When indicated, the CR also is linked to specific orders, such as a prescription, lab test or consult, so that during the completion of the CR a specific order is generated.

Although, the VA provides national guidelines regarding the scope of CRs, individual CRs are developed and implemented locally. Since 2001 VA New England Healthcare System developed and implemented a standard set of clinical reminders at all its practice sites. Data for this study included the reminder completion rate for a standard set of 13 reminders (Table 3), derived from standardized reporting of completion rate for a 30-day period in the year 2003 using a report included in VA's reminder software [15]. Completion rate measurement uses a patient's last visit as a reference point and is determined by calculating the total numbers of "applicable reminders" and "due reminders" for a given period where rate (%) = [(applicable CR − due CR)/applicable CR] × 100].

2.3. *Provider survey*

A survey of all staff Primary Care providers regarding their attitudes toward and experience with CRs was administered, using the questions shown in Table 4. A prototype survey was developed by the authors based on their impressions of factors that might affect reminder completion rate and a review of the limited literature that was available at the time. The prototype was refined with input from Primary Care physician and nursing leadership as well as union representatives. It was piloted with a group of target respondents, and finalized. Surveys results included blinded ID to allow linkage to individual provider CR completion rate. As this project was implemented as a quality improvement initiative, with the goal of understanding how the organization could further improve its reminder completion rate, approval by institutional review board and human subjects review committee

Table 3 – Thirteen clinical reminders evaluated in the study

Reminder
Beta blocker after MI
Colorectal cancer screening
Diabetic eye exam
Diabetic foot exam
Hemoglobin A1c in diabetics
Hepatitis C antibody testing
Hepatitis C risk assessment
Influenza vaccination
Mammography
Pap smear
Pneumococcal vaccination
Preventive health education
Tobacco use cessation counseling

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Table 4 – Items of staff provider survey on attitudes on and experiences with clinical reminders

Five-point Likert scale: strongly disagree to strongly agree
1. Clinical reminders improve overall quality of care
2. Clinical reminders improve preventive care
3. Clinical reminders improve quality of medical documentation
4. Clinical reminders save time it takes a provider to complete a visit
5. Clinical reminders save time it takes a provider to document
6. Reminders do not reduce provider autonomy
7. I have received adequate training about reminders
8. There is adequate support staff in clinic for reminder work
9. Compliance with reminders is an important component of my performance evaluation
10. I try to check and complete reminders routinely at every patient visit

Five-point Likert scale: too many to too few
What is your assessment regarding overall number of reminders currently in place?

Five-point Likert scale: very unfavorable to very favorable
What is your overall attitude regarding clinical reminders?

Five frequency choices: never, <every 6 months, every 2–6 months, monthly or weekly
Do you ever receive feedback on your completion of reminders?

Table 5 – Provider characteristics and completion rate

Provider type	Number	Completion rate (%)	Statistical significance
Staff MD	144	87.6	
NP or PA	97	88.1	ns compared to MD
Resident MD	108	76.6	$p < 0.0001$, compared to MD or NP/PA

were not required. Responses from 135 staff providers were obtained, a 53% response rate.

2.4. *Statistical analysis*

Using SAS software, *t*-tests were used to analyze the relationship between completion rate and dichotomous site characteristics. Analysis of variance was used to compare completion rates of provider types and a Ryan–Einot–Gabriel–Welsch multiple range test, which controls the Type 1 experiment error rate, was used to explore differences between the groups. Pearson correlations were use to compare completion rate with clinic size, provider survey responses and provider demographics.

3. Results

Analysis of relationship of completion rate to provider characteristics, shown in Table 5, showed no difference between staff physicians compared to nurse practitioners/physician assistants (87.6% versus 88.1%) but both were better than residents (76.6%, $p < 0.0001$). Among those staff providers who responded to the survey, there was no correlation of completion rates with demographics including age, year of graduation from medical school or NP/PA program or length of time working for VA ($p = 1.0$, 0.13 and 0.77, respectively).

Analysis of site characteristics, shown in Table 6, initially revealed a significant difference between community-based clinics and medical center based clinics (88.2% versus 83.1%, $p = 0.002$) and between sites with resident primary care clinics and non-teaching sites (81.8% versus 88.4%, $p < 0.0001$). However once results for resident physicians were excluded, there were no differences between either category of site, indicating the differences were simply due to the lower completion rates of the resident physicians rather than other characteristics of the practice sites. Comparison of those sites where there was immediate "real time" CR data entry by clinic support staff to those that did not revealed that sites which had this practice had a significantly higher completion rate (88.1% versus 82.4%, $p < 0.0001$).

Analysis of results of staff provider survey revealed that there was no significant correlation with responses on any of the questions regarding attitude towards reminders. There was also no correlation with degree of agreement with statements that they had received adequate training about reminders, that there was adequate support staff in the clinic for CR work, that CR were important in their performance evaluation, that they try to complete reminders at every visit, or their assessment of the number of CRs currently in place. However there was a significant correlation with the perceived

Table 6 – Site characteristics and completion rates

Site characteristic	Completion rate (%)	*p*
Medical Center clinics[a]	87.5	0.55
Community clinics[a]	88.2	
Teaching sites[a]	86.9	0.15
Non-teaching sites	88.4	
Real time data entry by support staff		
Absent	82.4	<0.0001
Present	88.1	

[a] With resident physician results excluded.

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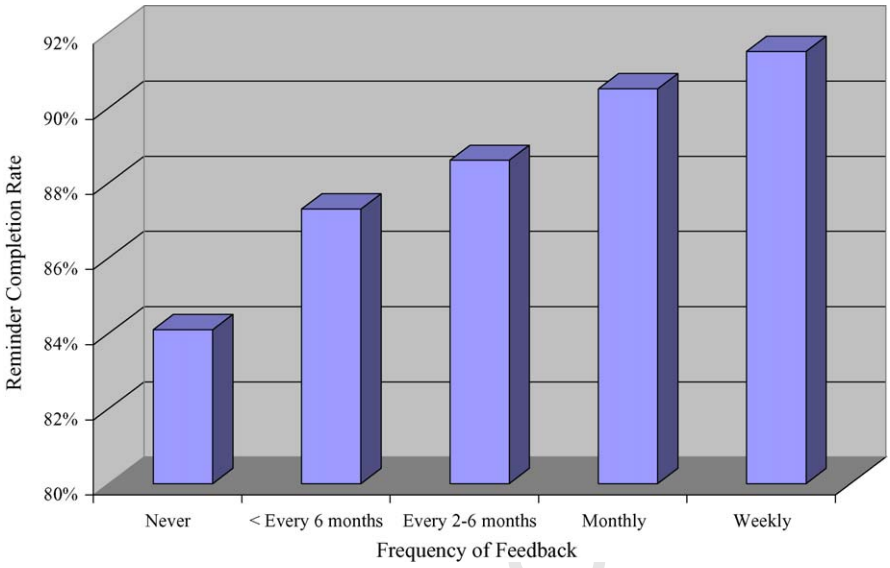

Fig. 1 – Effect of frequency of feedback on reminder completion rate.

frequency of receiving feedback on completion of reminders as shown in Fig. 1 ($r = 0.288$, $p = 0.004$).

4. Discussion

Earlier investigations cited in the introduction provide an important beginning to the effort to improve CR usage. However as they are limited to survey and observational data about possible facilitating and inhibiting factors, the prior publications are best considered preliminary and hypothesis generating. The findings from this study provide important additional insights as they are the first to actually correlate usage in the clinical setting with various factors.

Our first finding was that there was a significantly lower completion rate among residents than staff providers. Patterson et al. had earlier identified this as a potential barrier [10]. In their survey of attendees at a VA informatics meeting, they found that VA sites with residents had installed fewer reminders compared to those that did not have residents. While their observational work included only one teaching practice, they found that the seven residents observed were unable to utilize reminders at all. Our sample is much larger both in number of residents and practice sites, and we certainly saw much usage by resident providers. Nevertheless, we found that this factor did indeed have an effect in practice and resident physicians had a lower completion rate. There may be several reasons for this. As individuals who spend only a small portion of their time in the VA primary care clinic, the residents may be less familiar with the VA EMR than full time providers, and thus not be as aware of this element of the EMR. Second, starting their clinical careers, they may be more focused on the immediate issues of diagnosis and management, and less cognizant of the preventive and chronic care issues that are the subject of reminders. Finally the VA is heavily invested in a performance management system with measurable outcomes, and CRs are generally viewed as an important contributor to organizational performance. Staff physicians may be more attuned to and influenced by the issues of organizational performance and hence pay more attention to reminders on that basis. Residents, spending only limited time in the clinic and based at their academic affiliates rather than full time in the VA, would be less concerned with this issue.

Training on the use of CRs had also been identified by earlier investigators as a possible influence on enhancing usage by earlier investigators [9,11]. Our survey of staff providers asked about their impression on whether they had received adequate training on CR usage. We found that response to this question had no effect on actual usage rate. It is possible that in our settings all providers had received an adequate level of training, given the emphasis the primary care service put on CR use. In other settings training could certainly remain an important influence and should not be overlooked. Improved training may also be an important approach to improving resident utilization.

When considering other provider characteristics, we thought we might find lower rates of completion among physicians than mid level providers. We had sensed a greater resistance to reminders among physicians, some of whom had expressed beliefs that CRs represented “cookbook” medicine and were inconsistent with the role of the physician to practice individualized medicine grounded in the physician’s clinical judgment. However we found no difference between staff physicians and mid level providers. We also thought that completion rates may be associated with attitudes toward a variety of CR related issues, with provider age or with interval from completion of post graduate schooling. In fact none of those factors had any association with completion. These suggest that CRs had become a well established part of the practice whose use was not influenced by individual provider beliefs.

Looking at site characteristics, we found no relationship between the size of the site or whether it was medical center or community based on usage. We had been concerned that larger practices may have lower rates. Once resident performance was excluded, we also found no difference between

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teaching sites and non-teaching sites. This finding provides evidence that high rates of use can be achieved across a wide variety of practices and even in large, busy and complex clinic settings.

Many of the prior publications had noted that elements of the clinic process itself might influence CR completion. Indeed we did find that the process used to complete reminders did have an effect. Those sites that did not fully use support staff to complete reminders and enter the data into the EMR immediately, before the patient saw the primary care provider, had lower completion. Improved performance in the clinics that did use this approach could arise from the elimination of steps in the process, such as creating a handwritten results which then must be passed to the clinician for EMR entry, thereby improving the reliability of the process. Alternatively it may free the provider from the necessity of performing certain steps altogether, and shift the task to a staff with more time and more interest in the particular tasks. This finding supports the observation by Patterson et al. that use of paper forms during the reminder completion process was a possible inhibiting factor in CR use [9,11]. It points out the need to carefully design the clinic process for CR usage. Appropriate use of support staff, minimization of steps involved in CR completion and avoidance of steps involving writing down information prior to input into EMR are steps that could all improve completion [9–12,14]. This finding is consistent with the increasing realization that delivery of quality primary care is a team process, and incorporation of a team approach is required for achieving optimal care [16].

We also found a strong association with improved completion and frequency of feedback on individual provider completion rate, a factor that had not been mentioned in prior publications. This finding is consistent with other studies which have shown that individualized feedback is an effective intervention to change behavior [17–19]. Feedback on clinical performance itself has been shown to be an effective quality improvement approach. However we offer a different twist on that approach, by suggesting that feedback be provided on reminder completion rate itself. Demakis in the randomized trial of CRs in the VA, noted a declining completion over time [5], as did others [4,18], and he prophetically commented, "A lack of feedback concerning residents' performance may have contributed to the observed decline. Perhaps providing performance feedback and/or educational reinforcement to residents would help sustain the positive effects of reminders." Our finding suggests that individualized feedback is a potent mechanism to improve completion, and that organizations considering using CRs to improve clinical performance would do well to incorporate this step into their strategy. Moreover this strategy should be technically feasible as the data on completion should be available from the EMR systems. As discussed in the methods section, the VA CR system includes many options for generating reports on completion rates. It was this capability that allowed us to widely implement the use of feedback.

An important limitation of this study is that these are results from one healthcare system using one type of EMR and one set of CRs. The universal use of an excellent EMR system with robust CR capabilities was a critical factor in achieving our comparatively high rates of completion. A system without these capabilities would face many barriers that we did not. The presence of a formal performance management system in the VA, with explicit targets for clinical performance indicators motivating clinic leadership was also an important factor in our results. Other systems without this may face barriers in engaging and motivating staff to participate. Finally although we did not specifically address the issue, we agree optimum design of CRs is an important issue. Other systems using different EMRs with different CR capabilities, or using CR to address different types of clinical issues, may also face a different set of barriers.

The Primary Care Service Line in VA New England has taken several steps in response to these findings. It has encouraged improved utilization of support staff, and now virtually all sites have adopted the practice of real time completion and data entry by support staff. It has also encouraged the practice of regular individualized feedback to providers on reminder completion, and developed a standardized report for this purpose. Finally the service line developed standardized educational materials on the use of CRs for residents and the various resident teaching programs have implemented increased education of residents on the use of CRs in their resident clinics.

5. Conclusion

We found that care by staff physicians (rather than residents), optimal utilization of clinic support staff and frequent feedback to providers all correlated with improved completion of clinical reminders. These findings demonstrate the importance of practice and provider characteristics in implementation of informatics tools such as CR, and provide guidance to healthcare systems who wish to maximize the effect of computerized clinical reminders as a tool for improved patient care.

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Summary points

What was known before the study?

- Computerized clinical reminders improve adherence to clinical practice guidelines and specific standards of care.
- Use of reminders in actual clinical practice settings is generally low.
- Surveys and observational studies have identified many factors which might be facilitators or inhibitors of reminder use but correlation of possible factors with actual completion rates in clinical practice remains uninvestigated.

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What the study has added to the body of knowledge?

- In a study of an integrated healthcare system examining completion rates of 13 standardized reminders across 49 practice sites, it was found that resident physicians had lower completion rate compared to staff physicians and mid-level providers.
- Provider attitudes toward reminders and provider demographics had no effect on completion rate.
- Optimal use of support staff and avoidance of paper forms in the completion process improve completion rates.
- Frequency of feedback to providers about reminder completion rate correlated strongly with completion rate.

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