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Refereed paper

Creating a diabetes foot reminder-based registry using the electronic medical record

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ABSTRACT

Objective We created a new diabetes foot examination clinical reminder to directly populate a foot risk registry and examined its accuracy versus administrative data.

Methods A pre- and post-test design assessed accuracy of coding foot risk and clinician acceptability. The intervention hospital's reminder was replaced with a dialogue tick box containing the International Diabetic Foot Classification System to populate risk using health factors.

Results There were no hospital agreement differences for each foot condition except diabetes and peripheral neuropathy, demonstrating higher agreement at the intervention hospital. There were no differences in service agreement adherence or consulting rates although both demonstrated significantly lower consulting rates at study end. The intervention hospital had a significantly lower patient cancellation rate (1% v. 5%, p=0.01) and better coding for grade 3 patients. The new reminder demonstrated high acceptability.

Conclusions The registry system resulted in improved discrimination of the highest foot risk. Further testing is recommended.

Keywords: amputation, amputation prevention, diabetes, diabetic foot, electronic medical record, patient care planning, quality improvement, registries, reproducibility of results, validation studies

What is known about the subject
Informatics tools such as diabetes registries and clinical reminder have been shown to improve the process of diabetes care. Some of these approaches have also improved intermediate outcomes in diabetes patients. However, only two approaches have used clinical reminders for comprehensive foot examinations and none have used a risk stratification approach to create a registry for risk based care delivery.

What this study adds
Implementation of a clinical reminder examination based registry system resulted in improved discrimination of the highest risk patients and improved coding for peripheral neuropathy. It was well accepted by clinicians due to the tick box format inserting standardised prose into the record, thus avoiding additional typing. From the informatics perspective, the local implementation approach may avoid the pitfalls of relying on physician report alone[1] and may improve data security by not relying on web-based tools or other data transportation methods with protected health information.[2] Further testing of this approach is recommended.

Introduction

Disease registries and clinical reminders have been promoted as clinical improvement tools. While diabetes registries to improve the process of care have been described, none have utilised foot risk stratification to better guide care delivery levels. This strategy has led to significantly decreased hospitalisations, skilled nursing admissions and amputations.[3]

Many registry approaches use administrative data relying on providers to accurately code the visit. Coding accuracy depends on procedure performance, local healthcare setting and reimbursement structure. Overall, coding of diabetes has been described as accurate. However, coding accuracy for amputation risk factors, such as chronic kidney disease[4] and peripheral neuropathy may be substantially under-coded.[5] Therefore, the purpose of this study was to use the Veterans Health Administration's (VA) Computerized Patient Record System (CPRS) to investigate outpatient coding accuracy for foot risk conditions, and to explore the feasibility of creating a high risk foot registry using the clinical foot examination reminder.

Methods

Design and setting

We used a pre- and post-test design (2007 and 2008) at the outpatient clinics of two VA hospitals having similar bed capacity, visits, employees and service scope. The study received ethical approval from the institutional review board. Participants included those responsible for performing the foot reminder, including podiatrists, podiatry residents, advanced practice nurses, primary care physicians and health technicians. We interviewed the amputation prevention team directors about the value of the tool for improving patient care.

Intervention

The original clinical reminder at the intervention hospital was a free text template note that would appear when the reminder was activated. The clinician would then place an 'X' for positive findings, sign the note and fill out an encounter form. This reminder was replaced by a dialogue tick box with the International Diabetic Foot Risk Classification System.[3] A Class 3 CPRS software patch was written for the ticked box to automatically populate the visit file with a health factor. A different health factor was created for each risk category: 0=no neuropathy; 1=neuropathy without peripheral arterial disease (PAD) or foot deformity; 2=neuropathy with foot deformity with or without PAD; and 3=history of foot ulcer, amputation or end stage renal disease. Prior to activating the new reminder, a primary care training seminar was held.

Chart selection

We examined 50 records at each site before and after reminder implementation. International Classification of Diseases (ICD-9) codes were used to identify diabetes patients. A random number generator was used to randomly order patients. We progressed through the list until we had identified 15 grade 3, 15 grade 2, 10 grade 1 and 10 grade 0 patients. This stratified sampling process helped assure equal representation across risk levels and that higher risk patients were oversampled.

Outcome measures

The main outcome measure was the kappa coefficient of agreement between the risk factor identified in the note and the coded condition(s) (Table 1). Secondary process measures included: changes in rates of podiatry consultations; adherence to service agreements for consultation between primary care and podiatry; patient non-attendances; scheduling errors; clinic cancellations and patient cancellations. Service agreements are made between clinical services to act as guidance for appropriate referrals.

Analysis plan

Kappa coefficients (κ) and 95% confidence intervals were calculated and interpreted according to published criteria: <0 poor agreement; 0–0.2 slight; 0.21–0.4 fair; 0.61–0.8 substantial and 0.81–1.0 almost perfect.[6] Chi-square analysis, Fisher's Exact Test, or one-way ANOVA were used for secondary measures.

Results

At the control hospital, the majority of foot screenings (45/49) took place in primary care. However, the randomisation scheme was exhausted prior to identifying the final grade 3 patient, resulting in 49 observations. At the intervention hospital, podiatrists and residents performed the screening examinations. The control hospital's agreement ranged from poor to moderate (κ=–0.01–0.54), while it ranged from slight to almost perfect (κ=0.00–1.00) at the intervention hospital (Table 2). Significantly higher agreement for diabetes

Table 1 ICD-9-CM and CPT codes

Condition	Codes
Diabetes	250.xx
Foot ulcer	250.8x, 707.12–707.15, 707.9, 440.23, 454.0
Amputation or amputation status	v49.70- v49.76, 84.11–84.18
End stage renal disease	585.6
Neuropathy	250.60, 250.61, 356.9
PAD	250.70, 250.71, 443.9, 459.81
Foot deformity	681.11, 682.7, 711.07, 998.59, 681.10, 682.7, 682.6, 713.5, 736.72, 726.91, 735.0–735.4, 686.9, 681.1, 703.0, 730.27, 730.07, 681.11, 727.1, 735.5, 735.8

Table 2 Criterion validity of visit coding against chart documentation

	Control		Intervention	
Examination type	Baseline (κ 95%CI)	Final (κ 95%CI)	Baseline (κ 95%CI)	Final (κ 95%CI)
Diabetes	0.00 (0.00–1.00)	0.06 (–0.02–0.15)	0.88 (0.64–1.00)	1.00 (1.00–1.00)
Foot ulcer	0.24 (–0.20–0.69)	0.13 (–0.22–0.47)	0.70 (0.46–0.94)	0.68 (0.36–1.00)
Amputation	0.30 (–0.20–0.80)	0.40 (–0.02–0.81)	0.77 (0.52–1.00)	0.77 (0.47–1.00)
ESRD	0.32 (–0.02–0.66)	0.00 (0.00–1.00)	0.00 (0.00–1.00)	0.00 (0.00–1.00)
Neuropathy	0.20 (-0.05–0.46)	0.18 (0.03–0.33)	0.33 (0.08–0.59)	0.61 (0.39–0.83)
PAD	–0.01 (–0.26–0.23)	0.09 (–0.24–0.41)	0.30 (0.06–0.55)	0.33 (0.05–0.61)
Foot deformity	0.54 (0.08–1.00)	0.00 (0.00–1.00)	0.72 (0.52–0.93)	0.79 (0.56–1.00)

and peripheral neuropathy was observed at the intervention hospital's final measurement (Table 1). At the intervention hospital, Kappa coefficients increased for diabetes, PAD and foot deformity, and nearly doubled for neuropathy; however, overlapping 95% confidence intervals suggest lack of statistical significance. We found slight discrimination for cumulative risk for grades 2 and 3 at the control hospital, and fair discrimination for grade 2 with substantial and significant discrimination for grade 3 at the intervention hospital (Table 3).

There were no differences between hospitals for consultations or service agreement adherence, although both hospitals demonstrated significantly lower final consultation rates. There were no hospital differences for baseline patient cancellation and non-attendance rates. The control hospital demonstrated significantly more final patient cancellation and non-attendance rates. The final patient cancellation rate was significantly improved for the intervention hospital (1% v. 5%, p=0.01).

Amputation prevention director interviews suggested high acceptability for the new reminder. The director at the intervention hospital observed that the strength of the new approach was keeping the vital information regarding the foot reminder easily accessible to everyone who could access the note. The director also believed that the new registry approach would help amputation prevention efforts.

Discussion

We describe a novel method for creating a high risk foot registry by populating it directly from the clinical foot examination reminder. The risk factor coding accuracy described in the note may also be considered criterion validity for an administrative data-based registry. Most coding at the intervention hospital exhibited substantial reliability[6], the exception being fair reliability for PAD. Some measures appeared to improve with the new reminder although they were not significant. There were no coding differences between hospitals except for the final peripheral neuropathy measure. The new reminder also demonstrated significantly better discrimination of grade 3 patients. The new reminder approach may improve coding although this did not occur for all examination elements. Our findings are similar to others suggesting that coding for end stage renal disease is not very sensitive.[4] We do not believe a Hawthorne effect was present as residents at the intervention hospital were instructed only that the clinical reminder would change and there was no change in service agreement adherence. However, others have described the importance of a clinical nurse to improve initial registry uptake and sustain its progress when general practitioner use begins to decline.[7]

At the control hospital, most measures demonstrated poor to moderate reliability where reminders were performed in primary care. Primary care providers are responsible for many reminders, and foot screening may not be the primary reason for the visit. Thus, coding may be directed to other competing needs. Newer methods such as using natural language processing to search for free text phrases in records might have improved this reliability if the entire medical record was searched.[8]

We believe the tool facilitates programmatic coordination[9] as it provides a link to the service agreement and prompts a mental health referral if needed. Another advantage is insertion of standardised examination and risk language directly into CPRS, thus limiting typing time demands. Generating a risk based health factor creates a searchable field by the clinic of origin, potentially impacting on better standardisation of risk based care.[3] These features have also been described for developing diabetes practice registries in Scotland.[10]

There are limitations to this pilot study. The small sample size from two centres limits generalisability. Blinding was not entirely possible, although we looked for provider behaviour changes. Finally, there were centre effects, with podiatrists performing the foot examinations at the intervention hospital potentially biasing in favour of the intervention as podiatrists regularly code for these conditions.

Table 3 Discrimination by risk levels

	Control		Intervention	
Examination type	Baseline (κ 95%CI)	Final (κ 95%CI)	Baseline (κ 95%CI)	Final (κ 95%CI)
Grade 2	0.00 (–1.00)	0.00 (–1.00)	0.21 (–0.21–0.63)	0.10 (–0.41–0.61)
Grade 3	–0.02 (–0.52–0.48)	–0.06 (–0.51–0.39)	0.61 (0.24–0.97)	0.74 (0.41–1.00)

Implementation of a clinical reminder examination based registry system resulted in improved discrimination of the highest risk patients and improved coding for peripheral neuropathy. It was well accepted by clinicians due to the tick box format inserting standardised prose into the record, thus avoiding additional typing. Further testing of this approach is recommended to include other registry approach features, such as additional risk based decision support with therapeutic shoes and insoles and performance feedback with access to benchmarks and evidence, as well as patient education materials.[11]

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CONFLICTS OF INTEREST

The manuscript presents the findings and conclusions of the author(s); and it does not necessarily represent the Department of Veteran Affairs (VA) or HSRandD. The authors declare that they have no competing interests.

STATEMENT OF RESPONSIBILITY

JSW was responsible for writing the grant proposal and drafting the protocol and assisted in creating the new reminder, assembling the research team, analysing the results and writing of the manuscript. FW assisted with feedback regarding the proposal, drafting of the protocol, assisting as site PI, method development and writing of the manuscript. WC assisted with feedback regarding the proposal, protocol and manuscript, assembly of the research team and arranging local implementation through primary care. RS contributed feedback regarding the proposal, methods and manuscript. RTC and LR were responsible for developing the chart abstraction tool, chart abstraction and contributions to the methods and manuscript. RP was responsible for the creation, programming and implementation of the new reminder, and offering feedback on the proposal and methods. DGA was responsible for method development, and offering feedback on the grant proposal, protocol and writing of the manuscript.

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