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Patient, Provider, and System Factors Associated With Failure to Follow-Up Elevated Glucose Results in Patients Without Diagnosed Diabetes

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Abstract

Background: Although elevated glucose values are strongly associated with undiagnosed diabetes, they are frequently overlooked. Patient, provider, and system factors associated with failure to follow-up elevated glucose values in electronic medical records (EMRs) are not well described.

Methods: We conducted a chart review in a comprehensive EMR with a patient portal and results management features. Established primary care patients with no known diagnosis of diabetes and $\geq$ 1 glucose value >125 mg/dL were included. Follow-up failure was defined as (1) no documented comment on the glucose value or result communication to the patient within 30 days or (2) no hemoglobin A_{1c} (HbA_{1c}) ordered within 30 days or resulted within 12 months. Associations were examined using Wilcoxon and χ^2 tests.

Results: Of 150 charts reviewed, 97 met inclusion criteria. The median glucose was 133 mg/dL, and 20% of patients had multiple values >125 mg/dL. Only 36% of elevated glucose values were followed up. No associations were observed between patient characteristics, diabetes risk factors, or provider characteristics and follow-up failures. Automated flagging of glucose values $\geq$140 mg/dL by highlighting them red in the EMR was not associated with improved follow-up (46% vs 32%; $P = .19$). Even when follow-up occurred ($n = 35$), only 31% completed gold standard diabetes testing (HbA_{1c}) within 12 months. Of the resulted HbA_{1c} tests ($n = 11$), 55% were in the prediabetes range (5.7%-6.4%).

Conclusions: Two-thirds of elevated glucose values were not followed up, despite EMR features facilitating results management. Greater understanding of the results management process and improved EMR functionalities to support results management are needed.

Keywords

results management, abnormal test results, electronic medical records, random glucose, diabetes

Introduction

Management of laboratory test results in clinical practice is a high volume,[1] complex process with multiple potential error sources.[2,3] Glucose is commonly measured and overlooked because it is frequently included in laboratory panels ordered for other clinical indications.[4] Although random glucose values >200 mg/dL are considered diagnostic of diabetes in the setting of hyperglycemic symptoms, there are limited data to guide the interpretation and use random glucose values <200 mg/dL in clinical practice.[5] Current American Diabetes Association[5] and US Preventive Services Task Force[6] diabetes screening

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guidelines recommend testing based on traditional diabetes risk factors. However, they do not include elevated random glucose as an indication for screening. In spite of this, elevated random glucose values are strongly associated with undiagnosed diabetes and may help identify high-risk individuals in need for diabetes screening.[7,8] Since glucose values are routinely available in clinical practice, improved recognition of abnormal glucose values and follow-up with gold standard diabetes screening tests may improve the detection of undiagnosed diabetes and prediabetes.[7,8]

Although electronic medical records (EMRs) can improve result notification to clinicians,[9] failure to follow-up and communicate abnormal results to patients remain common.[10] Using a comprehensive EMR with a well-established patient portal, we conducted a retrospective chart review to describe patient, provider, and system factors associated with failure to follow-up elevated glucose values in patients without diagnosed diabetes.

Methods

We queried a comprehensive EMR to identify nonpregnant adults age 18 or older who had 1 or more primary care provider (PCP) visits at an academic medical center between January 1, 2011, and December 31, 2013 (N = 19, 763). We excluded patients with diagnosed diabetes using diabetes *International Classification of Diseases, Ninth Revision* codes present on problem lists or encounter billing codes in the past 5 years. We also excluded patients who had a resulted hemoglobin A_{1c} (HbA_{1c}) in the past 2 years (regardless of result) because we considered them up-to-date on diabetes screening. We then identified patients with 1 or more outpatient blood glucose results >125 mg/dL. We selected this threshold because (1) patients do not routinely have their fasting state documented at the time of laboratory testing in our health system, (2) we cannot differentiate between fasting and random glucose values in our EMR, (3) fasting glucose values >125 mg/dL are diagnostic of diabetes if confirmed on repeat testing,[5] and (4) random glucose values >125 mg/dL should prompt ordering of gold standard diabetes screening tests.[11] Of patients meeting study criteria (n = 367), 150 were randomly selected for chart review by 2 trained reviewers. Additional prespecified exclusion criteria that were not easily captured with electronic exclusions were applied following the chart review. These included active cancer treatment, inpatient or emergency department random glucose values, and diagnosed diabetes not identified during the electronic query. We developed a standardized abstract form based on a framework of ambulatory errors.[12] A 10% random sample was double reviewed ($\kappa = .73$).

We defined failure to follow-up as (1) no documented comments on the glucose value or result communication to the patient identified in the EMR within 30 days of the laboratory test result or (2) no HbA_{1c} ordered within 30 days or resulted within 12 months. We conducted a comprehensive EMR review of clinic notes, telephone calls, patient portal messages, laboratory notes, and laboratory orders occurring in the 30 days after the resulted elevated glucose value. An additional 12 months of laboratory test results were reviewed for HbA_{1c} testing. We examined associations between patient, provider, and system factors and follow-up failures using Wilcoxon and χ^2 tests.

The study clinic is a National Committee for Quality Assurance (NCQA)–accredited level 3 patient-centered medical home (PCMH) with over 10 years' experience using the ambulatory Epic EMR. The local EMR includes several features designed to facilitate results management. First, all laboratory results are automatically routed to the ordering clinician's EMR inbox and time stamped when viewed. Second, glucose values ≥140 mg/dL are automatically flagged red to alert clinicians and patients to the elevated value. Third, the EMR automatically releases results to patients via the electronic patient portal after 72 hours, even if not reviewed by the ordering clinician. This study was approved by the institutional review board of University of Texas Southwestern Medical Center.

Results

Of 150 charts reviewed, 97 met the inclusion criteria. Although electronic exclusions were applied prior to review, an additional 53 charts were excluded after chart review for meeting one or more prespecified exclusion criteria (32 patients with active cancer, 18 patients with glucose values from an emergency department or inpatient encounter, 6 patients with known diabetes). The coded indications for laboratory testing included chronic disease management (n = 69; hypertension, hyperlipidemia, coronary artery disease, congestive heart failure, atrial fibrillation, renal diagnoses, and hematology diagnoses), symptom-based testing (n = 21; nausea, abdominal pain, dizziness), and health maintenance (n = 7).

The median (interquartile range [IQR]) glucose was 133 (128-148) mg/dL, and 20% of patients had multiple glucose values >125 mg/dL during the study period. Although all glucose results were electronically viewed by ordering clinicians, only one-third (36%) were followed up. In cases of successful follow-up (n = 35), clinicians frequently documented communication of results to patients (71%), but only 57% specifically commented on the abnormality. Even when follow-up occurred (n = 35), the frequency of gold standard diabetes testing was low, with only 23% having an HbA_{1c} ordered within 30 days and only 31% had a resulted HbA_{1c} in the following 12 months. Of the resulted HbA_{1c} tests (n = 11), 55% had abnormal results in the prediabetes range (5.7%-6.4%).

No association was observed between follow-up failure (versus success) and patient characteristics, diabetes risk factors, or comorbidities (Table 1). Similarly, having higher glucose values or multiple elevated glucose values were not associated with successful follow-up. Among those with glucose values ≥140 mg/dL (n = 36), the median (IQR) glucose value was 153 (147-174) mg/dL. Flagging glucose values ≥140 mg/dL by highlighting them red in the EMR were not associated with improved follow-up (46% vs 32%; $P = .19$). Although automated result release through the patient portal provided the patient with their laboratory test results, it was not associated with successful follow-up according to study definitions.

Table 1. Patient, Provider, and System Factors Associated With Failure to Follow-Up Elevated Glucose Results.

Factors	Follow-Up Success (n = 35)	Follow-Up Failure (n = 62)	*P* Value
Patient factors: Demographics, diabetes risk factors, and comorbidities			
Median (IQR) age, years	68.8 (55.2-73.4)	67.7 (49.8-76.8)	.99
Female, %	60	53	.52
Non-Hispanic white, %	69	77	.34
Medicare insurance, %	63	56	.54
BMI, kg/m^2, median (IQR)	26.2 (21.4-31.4)	26.4 (23.0-29.2)	.97
Family history of diabetes, %	31	27	.68
Diagnosed prediabetes, %	6	2	.30
Hypertension, %	54	60	.61
Hyperlipidemia, %	37	34	.75
Coronary heart disease, %	14	11	.75
Congestive heart failure, %	14	10	.52
Chronic kidney disease, %	8.6	14.5	.53
Depression, %	23	19	.68
History of cancer,[a] %	37	42	.64
Provider factors			
Median (IQR) days until reviewed	3 (0-9)	5 (1-31)	.09
Median (IQR) days to return visit with ordering provider	182 (109-259)	84 (33-152)	<.001
Return visit with ordering provider in 12 months, %	83	82	.94
Ordering provider			.78
Primary care provider, %	46	37	
Specialty care provider, %	54	63	
System factors			
Median (IQR) total visits in 12 months after elevated glucose	6 (3-9)	8 (5-12)	.07
Median (IQR) primary care visits in 12 months after elevated glucose	2 (1-2)	2 (1-3)	.12
Median (IQR) number of providers seen	4 (3-5)	4 (2-6)	.47
Patient use of electronic patient portal, %	80	73	.74
Glucose factors			
Median (IQR) glucose value, mg/dL	138 (128-163)	132 (128-143)	.24
More than 1 glucose value $\geq$125 mg/dL, %	20	19	.94
Flagged glucose value $\geq$140 mg/dL in EMR, %	46	32	.19

Abbreviations: BMI, body mass index; EMR, electronic medical record; IQR, interquartile range.
[a]Cancer diagnosis >3 years ago and no treatment in the past 3 years.

In the year following the abnormal glucose value, the median (IQR) number of clinic visits was 7 (4-11), and over 80% of patients had a follow-up visit with the provider that ordered the glucose test. Patients with earlier return visits with the ordering provider were more likely to have follow-up failures ($P < .001$; Table 1). Follow-up failures were equally common among tests ordered by PCPs and specialists.

Conclusions

Among insured patients with an established PCP in an NCQA-accredited PCMH who had frequent office visits and no diagnosis of diabetes, two-thirds of elevated ambulatory glucose results were not followed up. These follow-up failures occurred in spite of EMR features thought to support results management including automated routing of results to providers, flagging elevated values, and direct result release to patients through an electronic portal. We were surprised that patient characteristics, diabetes risk factors, and having higher glucose values or multiple elevated values were not associated with follow-up. Further study of glucose results management practices is needed to better understand why follow-up was suboptimal and what types of EMR-based decision support might facilitate timely recognition and follow-up of abnormal results.

Appropriate follow-up requires clinicians to review results, recognize abnormalities, communicate results to the patient, and discuss further evaluation and treatment with the patient if indicated.[13] Although EMRs can improve result recognition, documentation, and communication of results compared with paper-based systems,[9] our findings indicate that these features are necessary but not sufficient to facilitate follow-up of abnormal glucose results. Although laboratory test results in our study were automatically released to the patient via the EMR patient portal after 72 hours in our study, over 60% of elevated glucose values were released to patients without documented follow-up recommendations for further evaluation based on the abnormal result. The follow-up failure rate in our study is similar to the 50% to 62% failure rates for abnormal glucose values reported in previous studies with less advanced EMR features.[4,14] Importantly, our findings suggest practice patterns and system-level factors, but not patient characteristics or the degree of glucose elevation, are

key drivers of follow-up failures. These findings may reflect the realities of busy clinical practice where clinicians may prioritize direct patient care over tasks such as documentation and result notification.[15]

In clinical practice, glucose testing is frequently bundled with common laboratory panels obtained for reasons other than diabetes screening. In our study, 93% of glucose tests were ordered for symptom evaluation or chronic disease monitoring. Since glucose measurement is rarely the indication for laboratory testing, this likely contributes to failures to recognize and follow-up elevated glucose values.[4] Although random glucose values between 125 and 140 mg/dL are associated with undiagnosed diabetes,[8] values >140 mg/dL are unambiguously elevated and merit additional testing.[8,11,16] Even though glucose values $\geq$140 mg/dL were "flagged" by highlighting them red in our EMR, we were surprised that these values were not more likely to be followed up. In this case, EMR interfaces that highlight all abnormal laboratory test results red may contribute to "alert fatigue" and make it difficult for clinicians to efficiently and accurately identify actionable laboratory test results. Given that over half of the gold standard diabetes screening tests resulted in patients with abnormal glucose values in this study were abnormal, improved, systems-based approaches to promote follow-up of abnormal laboratory results in EMR-based systems may improve identification of unrecognized diabetes and prediabetes in clinical practice.

Strengths of our study include a well-established, comprehensive EMR with a patient portal to facilitate clinician–patient communication and the use of an error framework for chart abstraction. Additionally, our study was conducted in a well-established PCMH experienced with EMR use in ambulatory care. However, our study is small, from a single, academic institution, and does not have sufficient power to detect modest associations. Importantly, our chart review only captured follow-up plans documented in the EMR. If results communication occurred without documentation, our findings may underestimate true follow-up rates.

Our findings have important implications for practicing clinicians and health systems. Although many EMR features are assumed to support effective management of abnormal results, clinician-initiated result notification and recommendations for additional evaluation of elevated glucose were infrequent in our study. In systems using patient portals for direct patient notification, improved communication about laboratory results and follow-up plans are needed to help patients understand abnormal test results and recommendations for further testing. Greater understanding of how providers think about and manage abnormal glucose results is needed to help inform EMR-enabled decision support and other strategies to improve follow-up of laboratory test abnormalities that require further evaluation.

Authors' Note

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Declaration of Conflicting Interests

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