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# Estimated Risk for Undiagnosed Diabetes in the Emergency Department: A Multicenter Survey

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## Abstract

**Background:** One third of the 21 million Americans with diabetes remain undiagnosed. The emergency department (ED) is a novel setting for diabetes screening.

**Objectives:** To estimate risk factors for undiagnosed diabetes in the ED.

**Methods:** This was a cross sectional survey in five Boston EDs. The authors enrolled consecutive adults without known diabetes over two 24-hour periods at each site. The focus was on diabetes risk factors and estimated risk for diabetes on the basis of American Diabetes Association (ADA) criteria. The authors also examined prior diabetes testing and willingness to participate in ED-based diabetes screening.

**Results:** Six hundred four patients (70% of eligible) were enrolled. On the basis of ADA risk score, 33% (95% confidence interval [CI] = 29% to 37%) were high risk for undiagnosed diabetes, and an additional 42% (95% CI = 38% to 46%) had elevated risk. For example, 58% (95% CI = 54% to 62%) of participants were overweight or obese (body mass index of  $\geq 25$ ). Among these at-risk participants without prior diabetes testing, 73% (95% CI = 66% to 80%) reported amenability to having additional blood drawn for ED diabetes screening, and 98% (95% CI = 96% to 100%) indicated that they would follow up for confirmation of abnormal screening.

**Conclusions:** Many ED patients in the study had risk factors for undiagnosed diabetes. Patient attitudes toward ED-based diabetes screening support further exploration of this important and currently underutilized opportunity for public health intervention.

ACADEMIC EMERGENCY MEDICINE 2007; 14:492-495 © 2007 by the Society for Academic Emergency Medicine

**Keywords:** diabetes mellitus, risk factors, screening, emergency medicine

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The burden of diabetes mellitus and its associated complications is steadily increasing; 20.8 million people in the United States had the disease in 2005.<sup>1</sup> Of these people, 6.2 million (2.1% of the U.S. population) were undiagnosed, a proportion that has not improved in the past decade.<sup>1</sup> A cornerstone of diabetes care emphasizes early intervention, which is not possible if diabetes remains undiagnosed.<sup>2</sup>

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Received November 14, 2006; revisions received December 9, 2006, December 19, 2006, and December 21, 2006; accepted December 22, 2006.

Dr. Ginde is supported by the Emergency Medicine Foundation Research Fellowship Grant.

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Accordingly, the American Diabetes Association (ADA) recommends regular targeted screening for high-risk individuals.<sup>2</sup> However, prior efforts to identify undiagnosed diabetes in community and primary care settings have been low yield.<sup>3,4</sup> Investigation of higher-risk populations in novel settings, such as the emergency department (ED), may demonstrate greater success and cost-effectiveness.

The ED provides an untapped opportunity for identification of undiagnosed diabetes, often serving as the only source of medical care for disenfranchised populations. In addition, the ED offers a high potential of encountering patients with diabetes risk factors, including elders, obese patients, and high-risk racial and ethnic minorities. A few single-center studies preliminarily report that a significant proportion of nondiabetic ED patients have hyperglycemia, suggestive of undiagnosed diabetes.<sup>5-7</sup> In this multicenter survey, we examined the hypothesis that the majority of ED patients meet criteria for recommended diabetes screening.

## METHODS

### Study Design and Population

This study was a multicenter, cross sectional survey of adult ED patients. The institutional review board at all sites approved the protocol, and the written informed consent requirement was waived.

During June and July 2006, we collected data at five Boston EDs (three academic, two community) with a combined annual visit volume of 253,000. All sites are participants in the Emergency Medicine Network (<http://www.emnet-usa.org>), which coordinated the study.

### Survey Content and Administration

In a standardized manner, trained research assistants verbally administered surveys to consecutive patients for two 24-hour periods (one weekday and one weekend) at each site. Research assistants were familiar with the survey but were blinded to the primary objective and hypothesis. We monitored patient enrollment by using standardized tracking forms and recorded the reason for any excluded patients. After data collection, we determined the number of missed patients by comparing our records with the final log of registered ED patients.

All ED patients who were 18 years of age or older during the data collection periods were eligible for enrollment. We excluded patients with high acuity or distress, insurmountable language barrier, altered mentation, or possible sexual assault. In addition, for this study, we only enrolled patients without prior diagnosis of diabetes (except gestational diabetes).

We collected demographic information, height, weight, insurance status, and access to primary care. In addition, we assessed family history of diabetes, physical inactivity, delivery of macrosomic infant ( $\geq 9$  lbs.), gestational diabetes and polycystic ovarian disease, and physician diagnosis of pre-diabetes. We asked about prior testing for diabetes, prior recommendation for diabetes screening, and current interest in ED diabetes screening. Finally, we evaluated patients' interest in receiving information on incidentally elevated ED glucose values and willingness to follow up for outpatient diabetes testing if ED screening or incidental glucose values were abnormal.

We calculated the ADA risk score as an estimate of risk for undiagnosed diabetes. As reported elsewhere, this metric has an estimated 79% sensitivity and 65% specificity for undiagnosed diabetes, incorporating age, body mass index (BMI; weight in kilograms/squared height in meters), physical activity, family history of diabetes, and delivery of macrosomic infant.<sup>8</sup> We did not calculate risk scores for participants who had missing data for one or more relevant variables.

### Data Analysis

We performed statistical analyses by using Stata 9.0 (College Station, TX). We summarized data by using basic descriptive statistics with 95% confidence intervals (CIs). We measured associations between demographic and clinical variables and measured outcomes of interest by using proportions and chi-square tests. All p-values are two-tailed, with  $p < 0.05$  considered statistically significant.

## RESULTS

Of the 1,363 ED patients who presented during the data collection periods, 1,014 met selection criteria for enrollment. We surveyed 713 (70%) of the eligible patients (80 refused, 221 missed). Feeling ill and lack of interest were the most common reasons for refusal. Rapid disposition from the ED and inability to locate the patient accounted for missed patients. Nonenrolled eligible patients did not significantly differ from enrolled patients by age, gender, or race and ethnicity. Of the surveyed patients, 109 (15%) had a prior physician diagnosis of diabetes and were excluded from the present study. Table 1 shows survey results for the remaining 604 participants.

African American patients were more likely to have BMI of  $\geq 25$  than were non-African American patients (75% vs. 55%,  $p < 0.01$ ). We also found differences in prevalence of elevated BMI by age (71% for 45–64 years, 58% for 18–44 years, and 43% for  $\geq 65$  years;  $p < 0.01$ ) and by gender (66% for men, 51% for women;  $p < 0.01$ ), but not by ethnicity (66% for Hispanic, 57% for non-Hispanic;  $p = 0.12$ ).

On the basis of the ADA risk score, 187 (33%; 95% CI = 29% to 37%) of 574 participants were high risk for diabetes, 242 (42%; 95% CI = 38% to 46%) of 574 were at risk, and 145 (25%; 95% CI = 22% to 29%) of 574 were minimal risk. There were no significant differences in these risk assessments between sites (data not shown).

Of the 429 participants with elevated ADA risk scores, 36% (95% CI = 32% to 41%) had never been tested for diabetes. In addition, among these at-risk participants without prior diabetes screening, 73% (95% CI = 66% to 80%) stated willingness to have additional blood drawn for ED diabetes screening, and 98% (95% CI = 96% to 100%) indicated that they would follow up for confirmation of abnormal results.

## DISCUSSION

Prior studies of diabetes screening in community and primary care locations have been low yield, mostly because of lower prevalence of undiagnosed diabetes ( $<1\%$ ) than the general population (2.1%).<sup>1,3,4</sup> Although the rate of high-risk classification of ED patients was similar to that of the general population (33% vs. 31%, respectively),<sup>8</sup> most ED patients in our sample had diabetes risk factors, particularly advanced age, obesity, and sedentary lifestyle. Accordingly, nearly four in every five patients were at risk and met ADA criteria for recommended diabetes screening.<sup>2</sup>

These findings provide additional support for the concept that many ED patients may be at risk for undiagnosed diabetes. In their single-center cohort, Graffeo et al. found that 16% of ED patients had a random blood glucose level of  $>160$ .<sup>5</sup> Silverman et al. reported a significant correlation between elevated glucose and HbA1c among nondiabetic patients in their ED, suggesting that ED hyperglycemia indicates undiagnosed diabetes.<sup>6</sup> Preliminary data from Charfen et al. demonstrated rates of 13% for undiagnosed diabetes in a convenience sample of ED patients.<sup>7</sup>

Our data provide additional evidence from multiple centers that the ED may be a unique and important venue for diabetes screening. In addition, we found remarkable support among ED patients for diabetes screening, with

Table 1  
Demographics, Diabetes Risk Factors, and Diabetes Screening Preferences of Patients from Survey Responses in Five Boston EDs

Parameter	n	% (95% CI)
<b>Demographics</b>		
Age in yr (median [IQR])	601	44 (28, 60)
Female gender	303/592	51 (47, 55)
Hispanic ethnicity	91/601	15 (12, 18)
<b>Race</b>		
White	388/578	67 (63, 71)
African American	71/578	12 (10, 15)
Other or multiracial	119/578	21 (17, 24)
<b>Insurance</b>		
Medicare only	37/593	6 (4, 8)
Medicaid (with or without Medicare)	140/593	24 (20, 27)
Any private insurance	372/593	63 (59, 67)
No insurance	44/593	7 (5, 10)
Access to PCP or clinic	506/604	84 (81, 87)
Income <\$40,000*	181/431	42 (37, 47)
High school graduate	525/601	87 (85, 90)
<b>Diabetes risk factors</b>		
BMI in kg/m <sup>2</sup> (median [IQR])	585	26 (23, 30)
Inactive or minimally active	137/601	23 (19, 26)
Parent or sibling with DM	154/599	26 (22, 29)
Pre-diabetes	14/601	2 (1, 4)
History of gestational DM†	6/302	2 (0, 4)
Delivering an infant ≥9 lb at birth†	37/303	12 (9, 16)
History of PCOS‡	15/289	5 (3, 8)
<b>Diabetes screening preferences</b>		
Ever been screened for diabetes	328/599	55 (51, 59)
Ever told at risk for diabetes	81/600	14 (11, 16)
Willing to have ED diabetes screening‡		
Additional blood draw	404/593	68 (64, 72)
No additional blood draw	530/597	89 (86, 91)
Would follow up with PCP for abnormal ED diabetes screening‡	573/598	96 (94, 97)
ED equal or preferred for DM screening vs. PCP‡	273/593	46 (42, 50)
Interested in knowing results of elevated glucose on ED serum labs‡	569/598	95 (93, 97)
Willing to follow up for incidental ED hyperglycemia if informed‡	572/597	96 (94, 97)

IQR = interquartile range; BMI = body mass index; DM = diabetes mellitus; PCOS = polycystic ovary syndrome; PCP = primary care physician.  
\* 173 declined.  
† Women only.  
‡ Based on self-reported preferences.

two thirds of participants stating that they were willing to have additional blood drawn and nine of ten reporting willingness to have existing blood sample used. Moreover, 95% of all participants reported that they would return for further outpatient testing. Determination of actual follow-up and compliance requires further study, especially for patients without existing primary care.

Active diabetes screening would clearly require additional time and resources. However, serum glucose tests are already ordered for 18% of ED visits in the United States, usually as part of multichannel chemistry panels.<sup>9</sup>

Emergency physicians may ignore these data that may be evidence for undiagnosed diabetes, unless the glucose value is critically high.<sup>5</sup> Nearly all of our participants reported that they would want emergency physicians to inform them of incidental hyperglycemia and that they would follow up for further outpatient testing. Although there are some data on random glucose for diabetes screening,<sup>10</sup> the optimal screening thresholds for ED patients given stress response and variable fasting states need further clarification.

## LIMITATIONS

Our sites are geographically limited, and our sample had relatively high rates of insurance and primary care, which limit the generalizability of the findings. We did not measure interobserver variability and relied on patient self-report, which may vary on the basis of patient and interviewer characteristics. Although these factors may bias the data, we administered surveys in a standardized manner, which limits the potential for such bias. In addition, we utilized ADA risk assessment tools, which were developed in the outpatient setting and thus may not be optimal for the ED. Although elevated risk, as defined by the ADA, may not predict ultimate identification of diabetes, it comprises our best noninvasive risk assessment until we develop ED-specific measures.

Because we did not actually offer diabetes screening, our study is unable to determine how many of these patients would actually consent to blood drawing for diabetes screening, how many of those tested would have abnormal screening tests, and how many of these patients would return for outpatient follow-up. In addition, on the basis of our data, we are unable to determine the rate of new diagnosis of diabetes in these patients and how many of these newly diagnosed patients would then comply with treatment and have an improved outcome. Further, because many patients in urban EDs are uninsured or underinsured and lack primary care, it remains unclear who would pay for ED diabetes screening, where the additional influx of patients with a positive screen would be referred, and how this additional care would be financed.

## CONCLUSIONS

We found that many ED patients in our sample were at risk for undiagnosed diabetes. Patient attitudes toward screening support a significant opportunity for identification of undiagnosed diabetes in the ED. Many additional unanswered questions remain before we can determine whether routine or targeted ED diabetes screening would have a positive impact on patient outcomes or be a cost-effective intervention.

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## Dynamic Emergency Medicine

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Each submission must be accompanied by a brief written description of the video contents. High-quality still images will be published in the paper journal and will link to the video in the electronic journal. Videos should not exceed four minutes in length and will undergo peer review.

Information on preferred formats is listed below; in all cases, the highest possible quality is required.

Preferred format: MPEG -1 or -2 (.mpg extension)

Also acceptable: Apple Quick Time (.mov), and Microsoft Audio/Video interfaced format (.avi)

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