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Assessing the Burden of Diabetes Mellitus in Emergency Departments in the United States: The National Hospital Ambulatory Medical Care Survey (NHAMCS)

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Abstract

Objective—To evaluate the performance of three alternative methods to identify diabetes in patients visiting Emergency Departments (EDs), and to describe the characteristics of patients with diabetes who are not identified when the alternative methods are used.

Research Design and Methods—We used data from the National Hospital Ambulatory Medical Care Survey (NHAMCS) 2009 and 2010. We assessed the sensitivity and specificity of using providers' diagnoses and diabetes medications (both excluding and including biguanides) to identify diabetes compared to using the checkbox for diabetes as the gold standard. We examined the characteristics of patients whose diabetes was missed using multivariate Poisson regression models.

Results—The checkbox identified 5,567 ED visits by adult patients with diabetes. Compared to the checkbox, the sensitivity was 12.5% for providers' diagnoses alone, 20.5% for providers' diagnoses and diabetes medications excluding biguanides, and 21.5% for providers' diagnoses and diabetes medications including biguanides. The specificity of all three of the alternative methods was >99%. Older patients were more likely to have diabetes not identified. Patients with self-

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AUTHOR CONTRIBUTIONS

K.A. researched the data and wrote manuscript. J.K. and X.W. researched the data and reviewed/edited manuscript. L.N.M., J.M.L., and W.H.H. contributed to the discussion and reviewed/edited the manuscript.

payment, those who had glucose measured or received IV fluids in the ED, and those with more diagnosis codes and medications, were more likely to have diabetes identified.

Conclusions—NHAMCS's providers' diagnosis codes and medication lists do not identify the majority of patients with diabetes visiting EDs. The newly introduced checkbox is helpful in measuring ED resource utilization by patients with diabetes.

Keywords

emergency room; diagnosis; the National Hospital Ambulatory Medical Care Survey (NHAMCS); sensitivity; diagnosis code

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In the United States, the number of Emergency Department (ED) visits has increased dramatically since the late 1990s.(1) Excessive non-urgent or preventable ED visits have contributed to crowded EDs(1-3) and higher health care costs. Indeed, preventable ED visits were estimated to cost $18 billion in the United States in 2006.(4) Diabetes mellitus is one of several chronic conditions for which most health care can be delivered in an ambulatory setting. Accurately measuring ED utilization by patients with diabetes can identify opportunities for alternative non-urgent care delivery and potential cost savings.

In the past, the National Health Interview Survey (NHIS) reported the total burden of ED visits by patients with diabetes in the United States.(5) However, the NHIS collected only limited information about medical care in EDs and both the diagnosis of diabetes and history of ED visits were self-reported. Recently, the Nationwide Emergency Department Samples (NEDS) database from the Healthcare Cost and Utilization Project (HCUP) became available for the assessment of ED utilization.(6) The NEDS contains up to 15 diagnosis codes, but does not contain clinical information or medication lists, nor does it specifically ascertain diabetes.(6) Based on NEDS, the total number of ED visits by patients with diabetes was estimated to be 11,492,000 in 2009.(7) Other data from insurance plans,(8) Medicare,(9; 10) and hospital(11) databases have used diagnosis codes(8-11) or self-report(10) to identify the diabetes status of patients.

The National Hospital Ambulatory Medical Care Survey (NHAMCS) is a nationally-representative, hospital-based survey, conducted by the National Center for Health Statistics (NCHS) since 1993. It collects information on the utilization and provision of ambulatory medical care services in hospitals and ambulatory surgery centers.(12) The NHAMCS collects up to three diagnosis codes listed by providers, including the primary diagnosis code and two other diagnosis codes, and up to eight medications for each ED visit. In the past, the NHAMCS was used to estimate ED utilization for diabetes-specific diagnoses such as hypoglycemia(13) and diabetic ketoacidosis(14) based on providers' diagnoses. It was also used to estimate that 2,154,000 diabetes-related ED visits were made in 2007.(15)

In 2009, checkboxes for five chronic medical conditions were added to the NHAMCS Patient Record Form: cerebrovascular disease/history of stroke, congestive heart failure, conditions requiring dialysis, HIV, and diabetes mellitus. The purpose of these checkboxes was to better identify ED visits made by patients with these specific conditions.(12) Prior to the addition of the checkboxes, ascertainment of ED visits made by patients with diabetes in

the NHAMCS was limited to visits by patients with diabetes-specific diagnoses.(13-15) The diagnosis codes and medication lists provided in the NHAMCS Patient Record Form were unlikely to identify all ED visits by patients with diabetes.

As with the well-known problem of the underreporting of diabetes on death certificates,(16; 17) it is likely that diabetes is not always listed when a patient with diabetes makes an ED visit. In some instances, diabetes may not have been the immediate or even a contributing cause for the visit. It is equally likely, however, that diabetes may have indirectly contributed to or complicated the visit even when it was not listed as a diagnosis.

To our knowledge, the diabetes status of patients making ED visits has not been compared using diagnosis codes and/or medication lists and the checkbox for identification of diabetes. The aims of this study were: to estimate the sensitivity and specificity of providers' diagnosis codes and medication lists compared to the checkbox as the gold standard using NHAMCS data in 2009 and 2010; and to describe the characteristics associated with diabetes being not identified when those alternative methods are used.

RESEARCH DESIGN AND METHODS

Study Setting

The NHAMCS(12) includes patient visits from a sample of 600 general and short-stay hospitals in the 50 states and the District of Columbia. Federal, military, and Veterans Administration hospitals are excluded. Each hospital participates in the survey for a 4-week reporting period approximately once every 15 months. Up to 100 patient visits to each of the selected hospitals are randomly sampled. A visit is defined as "a direct, personal exchange between a physician, or a staff member operating under a physician's direction, for the purpose of seeking care and rendering health services."(12) Trained hospital staff surveyors fill out all survey forms, including the NHAMCS Patient Record Form. The Patient Record Form collects the following information: patient demographic information, triage information, previous ED visits, reason for visit, injury/poisoning/adverse effect information, provider's diagnosis for this visit, diagnostic/screening services and procedures provided at ED visits, medications and immunizations given at ED visits or prescribed at discharge, provider information, service level (Current Procedural Terminology [CPT] code), and visit disposition.(12)

We analyzed data from the NHAMCS for years 2009 and 2010. In 2009, 356 EDs participated and submitted 34,942 Patient Record Forms with an unweighted ED response rate of 91.5%.(12) In 2010, 357 EDs participated and submitted 34,936 Patient Record Forms with an unweighted ED response rate of 92.0%.(12)

We limited our analyses to patients 18 years of age or older. We chose to do this because of the small number of ED visits by children with diabetes reported in the NHAMCS (N=69). We also excluded 133 visits with no valid diagnosis codes or valid responses (yes or no) to the question "Were medications prescribed or provided?" A total of 5,567 Patient Record Forms, representing 21,278,280 ED visits, were included in this analysis. Because the

NHAMCS datasets are publicly available and de-identified, this study was exempt from regulation by the Institutional Review Board at the University of Michigan.

Study Definitions

Gold standard—Diabetes was considered to be present when the box on the Patient Record Form for the question "Does the patient have diabetes?" was checked. Diabetes was defined as both insulin dependent diabetes mellitus (IDDM) and noninsulin dependent diabetes mellitus (NIDDM) but not diabetes insipidus.(12)

Provider diagnoses [alternative method #1]—We classified patients as having diabetes if one of the following International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) codes were included in the three providers' diagnosis codes listed on the Patient Record Form: 250 (diabetes mellitus), 357.2 (polyneuropathy in diabetes), 362.0 (eye diseases in diabetes), 366.41 (diabetic cataract), and 648.0 (diabetes mellitus of mother).(18) We did not attempt to distinguish type of diabetes, *e.g.* type 1 or type 2 diabetes.

Providers' diagnoses and diabetes medications excluding biguanides [alternative method #2]—We classified patients as having diabetes if they were identified as having diabetes using alternative method #1 or if they were given in the ED, or prescribed at discharge from the ED, insulin or a glycemic-modifying agent as specified by Health Plan and Employer Data and Information Set (HEDIS) guidelines.(18) HEDIS guidelines include the following glycemic-modifying agents: sulfonylureas, meglitinides, alpha-glucosidase inhibitors, thiazolidinediones, anti-diabetic combinations (including combinations of the medications in the classes mentioned and metformin), amylin analogs, and miscellaneous anti-diabetic agents (saxagliptin, sitagliptin, liraglutide, exenatide).(18; 19) HEDIS guidelines exclude biguanides when listed as single glycemic-modifying agents since they may be prescribed for indications other than diabetes.(18)

In NHAMCS, each medication was classified into three drug level categories, using the Multum Lexicon Plus system (Cerner Multum, Inc.).(12) We used the level 2 category anti-diabetic agents (code 099) to identify insulin and a glycemic-modifying agents, which include the following level 3 categories: sulfonylureas, biguanides, insulin, alpha-glucosidase inhibitors, thiazolidinediones, meglitinides, miscellaneous anti-diabetic agents, anti-diabetic combinations, dipeptidyl peptidase 4 inhibitors, amylin analogs, and incretin mimetics. To exclude biguanides, we used the level 3 category of biguanides (code 214).

Provider diagnoses and diabetes medications including biguanides [alternative method #3]—Finally, we classified patients as having diabetes if they were identified as having diabetes using method #2 or if they were given a biguanide in the ED or prescribed a biguanide at discharge.

Statistical Analysis

All analyses accounted for the complex survey design using the design variables provided in the NHAMCS public datasets.(12) We used Stata 12.0(20) for all analyses, with the "svy"

class of commands to produce robust standard errors using first-order Taylor linearization. A type I error of 0.05 was considered statistically significant. Because we combined two years of data, we generated and used a new patient-visit weight variable, which was half the original patient-visit weight, to obtain the estimate per year from the combined dataset.(21) We suppressed estimates based on fewer than 30 observations or with greater than 30% of the relative standard error as the NCHS considers such estimates to be unreliable.(12) We assumed that each Patient Record Form represented a different patient, although there is a possibility that individual patients can be included in the datasets more than once. Because there were no unique identifiers for patients in the NHAMCS, we were unable to account for the possibility of repeat visits by the same patient.

First, we calculated the sensitivity and specificity with 95% confidence intervals (C.I.) of using each of the three alternative methods. Then, we compared the characteristics of patients who were identified and not identified using alternative method #2 among patients whose diabetes was identified using the checkbox. We described the characteristics according to the following factors: the patient's mid-year age, sex, race/ethnicity, expected source of payment, region, number of diagnoses listed on the survey form, number of medications listed on the survey form, diagnostic services and procedures provided in the ED (a blood test for glucose and IV fluids), whether care was provided by attending physicians, and disposition (transfer or admission, clinic for follow-up, no follow-up/return if needed, or others). We used imputed race and ethnicity variables from the public NHAMCS datasets. We re-classified expected source of payment from the original responses that allowed multiple responses into “Medicaid,” “Medicare,” “private insurance,” “self-pay,” and “others” (including worker's compensation, no charge/charity, and other and unknown) by hierarchy, in this order, to make them mutually exclusive. We reclassified disposition into four mutually exclusive groups: “transfer or admission” (including return/transfer to nursing home [only in the NHAMCS 2010], transfer to psychiatric hospital, transfer to other hospital, admission to this hospital, admit to observation unit then hospital, admit to observation unit then discharge); “clinic for follow-up” (including return/refer to physician/clinic for follow-up); “no follow-up/return if needed” (including no follow-up planned and return if needed); and “others” (including left before triage/medical screening exam, left after triage/medical screening exam, left against medical advice, death on arrival, died in ED, other, and no answer).

We developed univariate and multivariate Poisson regression models to estimate the ratio of prevalence of missing a diagnosis of diabetes if alternative method #2 was used. We developed two multivariate models: model A which included demographic and socioeconomic factors (age, sex, race/ethnicity, expected sources of payment, and region), and model B which included the demographic and socioeconomic factors in model A plus factors representing the medical conditions and care provided at the ED visits (number of diagnoses, number of medications, a blood test for glucose, IV fluids, care provision by attending physicians, and disposition). We estimated prevalence ratios rather than odds ratios because of the high frequency of missing patients’ diabetes.(22) We used Poisson models to avoid the numerical instability of logbinominal models and obtained robust standard errors using first-order Taylor linearization.(23) Analyses were repeated for alternative methods #1 and #3 (data not shown). We show here the results from alternative

method #2 as a prototype because it represents HEDIS guideline for identifying patients with diabetes for quality-of-care evaluations.(19)

Finally, we described the primary diagnoses for ED visits grouped into ICD-9-CM chapters(24) in the patients with and without diabetes-related diagnosis among the patients with diabetes as ascertained by the checkbox.

RESULTS

In the 2009 and 2010 NHAMCS datasets that included patients over 18 years of age with valid diagnostic codes and medication information, we identified 2,729 and 2,838 ED visits (unweighted counts), respectively, that indicated diabetes using the checkbox. After appropriate weighting, the estimated number of ED visits by patients with diabetes in the United States was 10,269,731 (standard error [S.E.]: 833,370) in 2009 and 11,008,549 (S.E.: 771,169) in 2010. These represent 10.5% and 11.4% of all ED visits made in those years. When the 2009 and 2010 datasets were combined, there were an estimated 10,639,140 ED visits (S.E.: 673,461) by patients with diabetes per year, representing 10.9% of all ED visits in the United States.

When we used the checkbox as the gold standard, each of the three alternative methods to identify patients with diabetes showed very low sensitivity but high specificity (**Table 1**). Sensitivity was 12.5% (95% confidence interval [C.I.]: 11.0% to 14.1%), 20.5% (95% C.I.: 18.6% to 22.4%), and 21.5% (95% C.I.: 19.5% to 23.6%) for alternative methods #1, #2, and #3, respectively. The improvement in sensitivity associated with adding diabetes medications excluding biguanides to the diagnosis codes was large (12.5% versus 20.5%), but the improvement associated with adding biguanides to other diabetes medications was small (20.5% versus 21.5%), and some of the newly identified patients might have been prescribed a biguanide for an off-label indication (condition other than diabetes). The specificity was >99% for alternative methods #1, #2, and #3.

The characteristics of patients with diabetes identified using alternative method #2 were different from the characteristics of patients whose diabetes was not identified using alternative method #2 when diabetes was identified by using the checkbox (**Table 2** and **Table 3**). Univariate analysis showed that alternative method #2 was more likely to miss diabetes in older patients. Alternative method #2 was less likely to miss diabetes for patients who were Non-Hispanic Black compared to Non-Hispanic White, with self-payment compared to private insurance, and in the South compared to the Northeast. Also, alternative method #2 was less likely to miss diabetes in ED visits by patients with a greater number of diagnoses/medications listed on the survey form, who received glucose measurement or IV fluids, or whose disposition was transfer or admission.

After adjusting for all potential confounders (multivariate model B), alternative method #2 was more likely miss diabetes in patients ≥65 years of age compared to patients 18 to 44 years of age. The likelihood of missing diabetes was 1.08 times higher (95% C.I.: 1.02, 1.14) for those 65-74 years of age and 1.15 times higher (95% C.I.: 1.09, 1.22) for those age ≥75 years of age compared to those 18 to 44 years of age. Alternative method #2 was also

significantly less likely to miss diabetes in patients with self-payment: the likelihood of missing diabetes was 0.87 [95% C.I.: 0.80, 0.95]) times in patients with self-payment to compared with patients with private insurance. Alternative method #2 was less likely to miss diabetes in patients with a greater number of diagnosis codes or medications listed and for patients who received a glucose measurement or IV fluids.

Alternative methods #1 and #3 yielded similar results (data not shown): The alternative methods were more likely to miss diabetes in older patients and less likely to miss diabetes in patients who received a glucose measurement or IV fluids.

Table 4 shows the primary diagnosis codes among patients with diabetes defined by the checkbox. Among patients with at least one diabetes-related diagnosis code, 32.9% listed a diabetes-related code as the primary diagnosis. For patients with diabetes defined by the checkbox who had no diabetes-related codes listed, the most common primary diagnosis codes were symptoms, signs, and ill-defined conditions (29.5%), others (14.6%), injury and poisoning (14.4%), and respiratory diseases (10.0%).

CONCLUSIONS

Accurate estimates of the numbers of ED visits made by patients with common chronic diseases are essential to develop strategies to allocate resources and to assess whether resources are being used appropriately. Although the inclusion of medication lists increased sensitivity, the overall sensitivity using diagnostic codes and medication lists to identify patients with diabetes visiting EDs was quite low (20.5%). Our results suggest that some previous estimates of ED visits,(11; 15) and possibly hospitalizations, related to diabetes, and the prevalence of diabetes among patients visiting EDs, may be severely underestimated. This is analogous to the case of death certificates.(16) Checkboxes have been added to death certificates in several states, including North Dakota, Kentucky, and New Jersey to facilitate the ascertainment of diabetes among descendants.(25)

Using all of the alternative methods, older age was associated with a higher likelihood of diabetes missed. This could be due to the fact that the elderly have multiple comorbid medical conditions, leading providers to not list diabetes as one of the three diagnoses recorded in the NHAMCS. From a clinical standpoint, failure to recognize diabetes may lead to poor clinical outcomes, especially in elderly patients. For example, having diabetes predicts higher mortality for conditions commonly seen in elderly patients, including pneumonia,(26; 27) myocardial infarction,(28; 29) and ischemic stroke in men.(30) Also, elderly patients with acute illness are at risk for hyperglycemic hyperosmolar syndrome, even without a prior diagnosis of diabetes.(31)

We found that patients with self-pay for their ED visit were more likely to be identified as having diabetes. We speculate that patients with diabetes without public or private insurance are less likely to have access to primary care(32) and more likely to require ED care for their diabetes, thus, accounting for their greater likelihood of being identified as having diabetes during their ED visits. The issue has been discussed for Medicaid patients.(33) A significant increase in ED utilization for adults with Medicaid was observed between 1999 and 2007,

while utilization for adults with private insurance, Medicare, and without insurance, did not increase during this period.(34) Further studies are needed to evaluate whether insufficient access to primary care contributes to excessive ED visits in uninsured patients.

Measuring glucose and receiving IV fluids in the ED visit associated with a higher likelihood of identifying patients' diabetes. These factors may indicate that providers have addressed the patient's diabetes during the visit. The fact that they are performed also done suggests that diabetes may have contributed to the need for the visit.

Three limitations of this study should be mentioned. First, the NHAMCS does not have identifiers for individual patients; therefore, some patients who visited the ED more than once were counted independently, yielding inaccurate estimates for the variance of our estimates. However, using the 2009 and 2010 NHAMCS datasets, only 4.4% (S.E.: 0.3%) of ED visits represented repeat ED visits within 72 hours, which would impact the findings of this study only to a small degree.

Second, the NHAMCS included at most only three diagnosis codes and eight medications. A greater number of diagnoses and medications was associated with a higher likelihood of identifying diabetes. Thus, adding more diagnosis codes and medications to the NHAMCS Patient Record Form might yield a higher sensitivity.

Third, implementing checkboxes does not guarantee complete ascertainment of a condition. In the example of death certificates, there is evidence that certifiers mark the checkboxes instead of listing conditions as contributing causes of death(25) even though the certifiers should mark the checkboxes independently from the listed causes of death. For the NHAMCS, we believe that this is less likely, as trained hospital staff surveyors, rather than diverse physicians, fill out the Patient Record Form. In addition, in 2007 and 2008, when the NHAMCS Patient Record Form did not have checkboxes, the prevalence of diabetes, based on alternative method #2, was 2.7% (S.E.: 0.2%) among ED visits by adult patients. The prevalence based on the same alternative method #2 was 2.5% (S.E.: 0.1%) in 2009 and 2010, when the checkboxes were first included in the NHAMCS Patient Record Form. This suggests that there was no substantial change in the proportion of ED visits by patients with diabetes from 2007 and 2008 to 2009 and 2010 (P=0.40). Therefore, it is unlikely that surveyors failed to record diabetes-related diagnosis codes because they recorded diabetes using the checkbox.

In conclusion, the alternative methods using providers' diagnoses and medication lists are at best only approximately 20% sensitive in identifying diabetes of the patients visiting EDs in the NHAMCS survey. Nearly 80% of visits by adults with diabetes are missed. The newly introduced checkbox is helpful in estimating the ED utilization by patients with diabetes assuming that the checkbox is the gold standard. Once we learn more about the nature of ED visits by patients with diabetes and assess the needs for emergent care for patients with diabetes, we may be able to divert care currently being made in EDs to alternative more appropriate and/or less expensive care sites(35) including urgent care centers, outpatient clinics, or offices.

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Table 1

The estimated number of emergency department (ED) visits and sensitivities and specificities of identifying diabetes using diagnosis codes and medication lists (alternative methods#1–#3), the National Hospital Ambulatory Medical Care Survey (NHAMCS), 2009–2010

	No. (S.E.), in 1,000					
	Patients WITH diabetes according to checkbox		Patients WITHOUT diabetes according to the checkbox			
Alternative method	**Diabetes identified using alternative methods**	**Diabetes not identified using alternative methods**	**Diabetes identified using alternative methods**	**Diabetes not identified using alternative methods**	**% Sensitivity (95% C.I.)**	**% Specificity (95% C.I.)**
Alternative method #1: Diagnosis codes[a]	1,335 (112)	9,304 (602)	112 (24)	86,542 (4,692)	12.5 (11.0, 14.1)	99.9 (99.8, 99.9)
Alternative method #2: Diagnosis codes and medication lists[b] excluding biguanides	2,182 (177)	8,458 (540)	323 (42)	86,331 (4,681)	20.5 (18.6, 22.4)	99.6 (99.5, 99.7)
Alternative method #3: Diagnosis codes and medication lists[b] including biguanides	2,291 (191)	8,348 (531)	365 (43)	86,289 (4,681)	21.5 (19.5, 23.6)	99.6 (99.5, 99.7)

[a]The following ICD-9-CM diagnosis codes were included: 250 (diabetes mellitus), 357.2 (polyneuropathy in diabetes), 362.0 (eye diseases in diabetes), 366.41 (diabetic cataract), and 648.0 (diabetes mellitus of mother).

[b]The following glycemic-modifying agents were included: insulin, sulfonylureas, biguanides, alpha-glucosidase inhibitors, thiazolidinediones, meglitinides, miscellaneous anti-diabetic agents, anti-diabetic combinations, dipeptidyl peptidase 4 inhibitors, amylin analogs, and incretin mimetics. S.E.: standard error; C.I. confidence interval.

Table 2

Characteristic of patients with diabetes identified by the checkbox, who were identified and not identified using diagnosis codes and medication lists (excluding biguanides) (alternative method #2), the National Hospital Ambulatory Medical Care Survey (NHAMCS), 2009–2010

	Overall	Alternative method #2		
	No. (S.E.), in 1,000	Diabetes identified, No. (S.E.), in 1,000	Diabetes not identified, No. (S.E.), in 1,000	% Proportion of ED visits by patients who were not identified as having diabetes
N	10,639 (617)	2,182 (177)	8,458 (298)	79.5
Age, year				
18–44	2,297 (178)	576 (56)	1,721 (145)	74.9
45–64	4,160 (296)	920 (100)	3,240 (228)	77.9
65–74	1,892 (133)	373 (43)	1,519 (110)	80.3
≥75	2,290 (141)	313 (35)	1,977 (128)	86.3
Sex				
Female	6,048 (418)	1,222 (112)	4,826 (336)	79.8
Male	4,591 (277)	960 (85)	3,631 (222)	79.1
Race/ethnicity				
Non-Hispanic White	6,234 (395)	1,122 (109)	5,112 (331)	82.0
Non-Hispanic Black	2,888 (353)	711 (91)	2,177 (275)	75.4
Hispanic	1,134 (133)	268 (41)	866 (110)	76.4
Others	383 (103)	80 (20)	302 (90)	79.0
Sources of payment				
Private	2,387 (207)	449 (53)	1,937 (175)	81.2
Medicaid	2,974 (222)	633 (66)	2,341 (177)	78.7
Medicare	3,560 (221)	644 (68)	2,916 (183)	81.9
Self-pay	941 (101)	285 (36)	656 (86)	69.7
Others	348 (53)	83 (23)	265 (45)	76.1
Unknown	429 (62)	87 (19)	342 (54)	79.7
Region				
Northeast	1,870 (142)	322 (30)	1,548 (126)	82.8
Midwest	2,560 (331)	435 (70)	2,126 (270)	83.0
South	4,412 (524)	1,001 (132)	3,411 (425)	77.3
West	1,797 (215)	424 (89)	1,373 (147)	76.4
Number of diagnosis codes				
1	4,341 (320)	419 (53)	3,923 (284)	90.4
2	3,014 (201)	602 (54)	2,412 (171)	80.0
3	3,284 (295)	1,161 (116)	2,123 (194)	64.7
Number of medications				
0–2	6,032 (360)	875 (64)	5,157 (323)	85.5
3–5	3,423 (285)	761 (86)	2,662 (219)	77.8

	Overall	Alternative method #2		
	No. (S.E.), in 1,000	Diabetes identified, No. (S.E.), in 1,000	Diabetes not identified, No. (S.E.), in 1,000	% Proportion of ED visits by patients who were not identified as having diabetes
6–8	1,185 (135)	546 (77)	639 (72)	53.9
Blood test for glucose				
No	5,134 (349)	746 (78)	4,387 (306)	85.5
Yes	5,506 (404)	1,435 (131)	4,070 (298)	73.9
IV fluids				
No	5,468 (362)	775 (67)	4,693 (322)	85.8
Yes	5,171 (371)	1,407 (135)	3,764 (267)	72.8
Seen by attending physicians				
No	865 (127)	149 (31)	716 (103)	82.8
Yes	9,725 (640)	2,028 (173)	7,697 (511)	79.1
Disposition				
Clinic for follow-up	5,241 (352)	906 (91)	4,335 (294)	82.7
No follow-up/as needed	1,124 (122)	172 (26)	951 (110)	84.7
Transfer or admission	4,067 (306)	1,066 (105)	3,001 (225)	73.8
Others	207 (29)	_ [a]	170 (26)	81.9

S.E.: standard error.

[a] Fewer than 30 observations or greater than 30% of relative standard error. The NCHS considers such estimates to be unreliable.

Table 3

Likelihood of not identifying diabetes using diagnosis codes and medication lists (excluding biguanides) (alternative identification method #2) among emergency department (ED) visits by patients whose diabetes was identified by the checkbox, the National Hospital Ambulatory Medical Care Survey (NHAMCS), 2009–2010

	Univariate		Multivariate model A		Multivariate model B	
	Prevalence ratio (95% C.I.)	***P*-value**	**Prevalence ratio (95% C.I.)**	***P*-value**	**Prevalence ratio (95% C.I.)**	***P*-value**
Age, year		0.00		0.00		0.00
18–44	Reference		Reference		Reference	
45–64	1.04 [0.98,1.10]		1.03 [0.98,1.09]		1.05 [1.00,1.11]	
65–74	1.07 [1.01,1.13]		1.06 [1.00,1.12]		1.08 [1.02,1.14]	
≥75	1.15 [1.09,1.22]		1.13 [1.07,1.19]		1.15 [1.09,1.22]	
Sex		0.60		0.50		0.51
Female	Reference		Reference		Reference	
Male	0.99 [0.96,1.03]		0.99 [0.96,1.02]		0.99 [0.96,1.02]	
Race/ethnicity		0.00		0.05		0.09
Non-Hispanic White	Reference		Reference		Reference	
Non-Hispanic Black	0.92 [0.88,0.96]		0.93 [0.89,0.98]		0.95 [0.90,0.99]	
Hispanic	0.93 [0.87,1.00]		0.97 [0.90,1.04]		1.00 [0.93,1.06]	
Others	0.96 [0.86,1.07]		0.99 [0.86,1.15]		1.02 [0.89,1.16]	
Expected sources of payment		0.02		0.13		0.04
Private	Reference		Reference		Reference	
Medicaid	0.97 [0.92,1.02]		0.98 [0.93,1.03]		0.98 [0.94,1.03]	
Medicare	1.01 [0.96,1.06]		0.96 [0.91,1.02]		0.98 [0.93,1.03]	
Self-pay	0.86 [0.78,0.94]		0.88 [0.81,0.97]		0.87 [0.80,0.95]	
Others	0.94 [0.81,1.08]		0.95 [0.83,1.09]		0.94 [0.84,1.05]	
Unknown	0.98 [0.89,1.09]		0.99 [0.90,1.09]		0.99 [0.90,1.09]	
Region		0.02		0.04		0.13
Northeast	Reference		Reference		Reference	
Midwest	1.00 [0.96,1.05]		1.01 [0.97,1.05]		1.01 [0.97,1.05]	
South	0.93 [0.88,0.99]		0.95 [0.90,1.01]		0.98 [0.93,1.02]	
West	0.92 [0.85,1.00]		0.93 [0.84,1.02]		0.96 [0.89,1.03]	
Number of diagnoses		0.00				0.00
1	Reference				Reference	
2	0.89 [0.85,0.92]				0.91 [0.88,0.94]	
3	0.72 [0.69,0.75]				0.77 [0.74,0.80]	
Number of medications		0.00				0.00
0–2	Reference				Reference	
3–5	0.91 [0.88,0.95]				0.97 [0.94,1.01]	
7–8	0.63 [0.57,0.70]				0.71 [0.64,0.79]	
Blood test for glucose		0.00				0.00

	Univariate		Multivariate model A		Multivariate model B	
	Prevalence ratio (95% C.I.)	***P*-value**	**Prevalence ratio (95% C.I.)**	***P*-value**	**Prevalence ratio (95% C.I.)**	***P*-value**
No	Reference				Reference	
Yes	0.87 [0.84,0.90]				0.93 [0.90,0.97]	
IV fluids		0.00				0.00
No	Reference					
Yes	0.85 [0.81,0.88]				0.94 [0.90,0.98]	
Seen by attending physicians		0.13				0.98
No	Reference					
Yes	0.96 [0.90,1.01]				1.00 [0.95,1.05]	
Disposition		0.00				0.32
Clinic for follow-up	Reference				Reference	
No follow-up/as needed	1.02 [0.97,1.08]				0.99 [0.94,1.03]	
Transfer or admission	0.89 [0.86,0.93]				0.97 [0.93,1.00]	
Others	0.99 [0.88,1.11]				1.00 [0.88,1.13]	

All analyses were based on 5,567 ED visits except for multivariate model B, which was based on 5,546 visits. C.I.: confidence interval.

Table 4

Primary diagnosis codes in the patients with diabetes identified by checkbox, the National Hospital Ambulatory Medical Care Survey (NHAMCS), 2009–2010

Primary diagnosis codes (ICD-9-CM)	Patients with at least one diabetes-related diagnosis code			Patients without any diabetes-related diagnosis codes		
	No. (S.E.), in 1,000	%		No. (S.E.), in 1,000	%	
Total	1,335 (112)	100.0%		9,304 (601)	100.0%	
Diabetes-related codes [250 (diabetes mellitus), 357.2 (polyneuropathy in diabetes), 362.0 (eye diseases in diabetes), 366.41 (diabetic cataract), or 648.0 (diabetes mellitus of mother)]	440 (70)	32.9%		0	0.0%	
Other than diabetes-related codes	895 (77)	67.1%		9,304 (601)	100.0%	
Endocrine, nutritional, and metabolic diseases, and immunity disorders (240–279)	_ [a]	_ [a]	100% [b]	437 (49)	4.7%	100% [b]
Mental disorders (290–319)	_ [a]	_ [a]		248 (28)	2.7%	
Diseases of the circulatory system (390–459)	96 (21)	10.7%		874 (74)	9.4%	
Diseases of the respiratory system (460–519)	60 (14)	6.7%		926 (87)	10.0%	
Diseases of the digestive system (520–579)	_ [a]	_ [a]		491 (44)	5.3%	
Diseases of the genitourinary system (580–629)	_ [a]	_ [a]		541 (57)	5.8%	
Diseases of the skin and subcutaneous tissue (680–709)	80 (16)	9.0%		348 (43)	3.7%	
Symptoms, signs, and ill-defined conditions (780–799)	302 (33)	33.8%		2,747 (207)	29.5%	
Injury and poisoning (800–999)	105 (21)	11.7%		1,338 (85)	14.4%	
Others	93 (21)	10.4%		1,354 (110)	14.6%	

S.E.: standard error.

[a] Fewer than 30 observations or greater than 30% of relative standard error. The NCHS considers such estimates to be unreliable.

[b] Proportion of diagnoses within “other than diabetes-related codes.”