Published in final edited form as:

Med Care. 2006 March ; 44(3): 292–296.

Diagnosing Diabetes and Preventing Rehospitalizations:

The Urban Diabetes Study

Jessica M. Robbins, PhD and David A. Webb, PhD

From the Philadelphia Department of Public Health, Ambulatory Health Services, Philadelphia, Pennsylvania.

Abstract

Background—Patients with diabetes frequently are hospitalized, and quality of inpatient care for diabetes is of great concern. Rehospitalization after hospital discharge is a frequent adverse outcome experienced by patients with diabetes.

Objectives—We assessed the frequency of and risk factors for rehospitalization among all Philadelphia residents with diabetes.

Methods—Individual histories of hospitalization were ascertained from hospital discharge summaries for Philadelphia residents ages 25–84 who had at least 1 diabetes hospitalization from 1994 through 2001. Logistic regression was used to assess predictors of nonelective rehospitalization within 30 days of discharge, including recording of diabetes diagnosis.

Results—Nonelective rehospitalizations within 30 days of hospital discharge were ascertained for 58,308 (20.0%) of 291,752 discharges. The proportion rehospitalized was 9.4% after a patient's first diabetes diagnosis hospitalization; after later discharges for which a diabetes diagnosis was not recorded, rehospitalizations occurred in 30.6% of all cases. The absence of a diabetes diagnosis was a highly significant predictor of rehospitalization after adjustment for age, year, gender, race/ethnicity, insurance status, admission type, severity code, length of stay, discharge status, and number of previous hospitalizations.

Conclusion—Failure to record a diabetes diagnoses in administrative hospital discharge data may reflect lack of attention to the critical needs of patients with diabetes who are being treated for other conditions, whereas the attention to patient education and follow-up planning for patients with incident diabetes diagnoses may reduce the risk of rehospitalization.

Keywords

administrative data; diabetes; diagnosis; readmissions

Diabetes is associated with a wide array of acute and chronic complications and comorbid conditions, and patients with diabetes frequently are hospitalized.^{1,2} There were 4.9 million hospital discharges with diabetes as a listed diagnosis in the United States in 2002,³ and this rate probably underestimates the true prevalence of diabetes in hospitalized patients.⁴ Inpatient management of patients with diabetes often is less than optimal, and suboptimal management is associated with excess mortality and increased length of stay.⁴ Diabetes has been cited as one of the diagnoses for which readmissions are likely to be a valid measure of quality of care.^{5,6} We therefore examined hospital discharge data for all Philadelphia residents who were

Reprints: Jessica M. Robbins, Philadelphia Department of Public Health, Ambulatory Health Services, 500 South Broad Street, Philadelphia, PA 19146. E-mail: jessica.robbs@phila.gov..

Supported by grant #R21DK064201-01 from the National Institute of Diabetes, Digestive, and Kidney Diseases.

hospitalized in Pennsylvania with a diabetes diagnosis at any time between 1994 and 2001, inclusive, and assessed risk factors for rehospitalization within 30 days of discharge.

Using variables available in the discharge records, we assessed factors that have been associated with diabetes complications, hospitalizations, or both, including demographic factors, insurance status, calendar year, measures of clinical severity, and previous hospital use.^{7–10} On the basis of observation that in many cases patients with previously diagnosed diabetes were not coded for diabetes in subsequent hospitalizations, we also examined risk of rehospitalization in relation to whether diabetes was coded and to whether the patient had had a previous hospitalization coded for diabetes. Rehospitalizations that were coded as “elective,” indicating that the patient was hospitalized for a planned procedure, were excluded to focus on unplanned, undesirable readmissions.

Methods

Hospital discharge data were obtained from the Pennsylvania Health Care Cost Containment Council, a state agency mandated to collect data on all admissions to all hospitals in Pennsylvania. All residents of Philadelphia ages 25–84 who were hospitalized in Pennsylvania with a diagnosis of diabetes (ICD 9 code 250) at any time between January 1, 1994, and December 31, 2001, were included. All Pennsylvania hospitalizations for these individuals during this period were ascertained, including those for which a diabetes diagnosis was not recorded. Additional details on data collection have been published previously.¹¹ The data collected included demographic information, dates of admission and discharge, admission type, up to 10 diagnostic codes, severity code, and discharge type. Race and ethnicity were recorded in these administrative records and may have been classified either by the patient or by hospital admissions staff.

For this study, hospitalizations during which the patient died and discharges to another hospital were excluded because these patients were not at risk for rehospitalization after discharge. Discharges less than 30 days before the end of the study period (ie, discharges after December 1, 2001) were excluded because rehospitalization could not be ascertained. The outcome of interest was nonelective rehospitalization because these admissions are clearly unplanned and undesirable, whereas elective admissions may reflect aggressive management of potential complications.

Age, gender, race/ethnicity, insurance status, and year were tested as possible risk factors for rehospitalization. Variables that reflect the severity of the patient’s condition (number of previous hospitalizations, admission type, severity code, length of stay, and discharge status) were included as control variables. We also examined whether or not a diabetes diagnosis was recorded and whether or not the patient had had an earlier diabetes-diagnosis hospitalization during the study period. Logistic regression was used to assess multiple risk factors. Secondary analyses tested the effects of using the principal diagnosis and the specific facility as control variables, or using only a single randomly selected hospitalization for each individual patient. All analyses were carried out using SAS version 9.1.¹² The study was approved by the Philadelphia Department of Public Health Institutional Review Board.

Results

There were 291,752 hospital discharges recorded for 88,776 individual patients. Of these discharges, 58,308 (20%) were followed by nonelective rehospitalizations within 30 days. Demographics of the study sample and unadjusted rehospitalization percentages are shown in Table 1.

Overall, diabetes was recorded as a diagnosis in 234,488 (80%) of these hospitalizations, of which 86,043 were the first recorded diabetes diagnosis for that patient in our data (Table 2). Hospitalizations for which a diabetes diagnosis was not recorded were followed by rehospitalization within 30 days 27% of the time, a proportion 49% higher than for hospitalizations in which a diabetes diagnosis was recorded. Among the 57,264 hospitalizations for which diabetes was not coded, 34,457 preceded the first diabetes-diagnosed hospitalization in our data. Some of these probably represent hospitalizations preceding development of the disease. The remaining 22,807 represent hospitalizations in which a previously diagnosed diabetic inpatient was not coded for diabetes, and 31% of these were followed by rehospitalization.

Table 3 presents odds ratios for rehospitalization, controlling for all other variables included in the model. Each of the variables included was statistically significant at $P < 0.01$. Female gender and increasing age were associated with 5.0% and 3.9% reduction in odds of rehospitalization, respectively, whereas odds of rehospitalization increased 8.6% per calendar year. There was a strong dose-response relationship between severity code and rehospitalization; other variables associated with severity of disease, including number of previous hospitalizations, discharge to other institutions or home health care, and (marginally) length of stay also were positively associated with rehospitalization. Relative to non-Hispanic whites, black, Asian, "other," and unknown race/ethnicity had higher odds of rehospitalization whereas Hispanic patients had 16.8% lower odds. By insurance status, the odds of rehospitalization for private fee-for-service and uninsured patients odds were 34.5% and 32.2% lower, respectively, than those for Medicare patients.

After controlling for all other variables in the model, the patient's first hospitalization in which a diabetes diagnosis was recorded (ie, admissions in which diabetes was coded, and the patient had no prior diabetes-diagnosed hospitalizations) was 54.4% less likely to be followed by a nonelective readmission than subsequent hospitalizations. Among hospitalizations after the patient's first diabetes diagnosis, there was a 32.8% excess odds of rehospitalization (95% confidence interval 28.6–37.3%) when a diabetes diagnosis was not recorded.

Additional controls for the specific principal diagnosis and for the facility did not alter these findings, except that after controlling for facility the excess risks of rehospitalization associated with black, Asian, and "other" race/ethnicity were not statistically significant, whereas the risk associated with urgent as opposed to emergency admissions was further diminished (details available from corresponding author). Restricting the analyses to 1 hospitalization per unique patient identifier did not alter the results.

Discussion

We examined all hospitalizations during an 8-year period for all residents of Philadelphia ages 25–84 who were hospitalized with a diagnosis of diabetes at any time between 1994 and 2001. Readmission (to the same or another hospital) within 30 days of discharge followed 20% of these hospitalizations, far more than the 5–14% estimated for all hospital discharges,⁵ representing a substantial burden on both patients and the health care system. The strongest determinants of rehospitalization, other than the high risks for the small number of patients discharged to a home IV provider and the diminished risks for patients with elective admissions, were insurance status and diabetes diagnosis status.

The finding that rehospitalizations were less frequent among patients without insurance has not, to our knowledge, been reported previously and deserves further investigation. The extreme disparity between Medicaid and uninsured patients in our data is a novel finding. Investigators have sometimes combined these 2 generally low-income patient populations into

a single category for analysis.^{9,13} Our results suggest that this practice should be avoided unless the 2 groups are found to have similar risks in the data under consideration. The higher proportions rehospitalized for Medicare and Medicaid relative to those with private insurance probably reflect, at least in part, the socioeconomic factors that are associated with patients' insurance status (poverty in the case of Medicaid and relatively high economic resources in the case of private insurance). Finally, in contrast to analyses of readmissions among newborns,¹⁰ the higher proportions rehospitalized among patients with private managed care coverage relative to those with private fee-for-service insurance may reflect the limitations on care imposed by these organizations, and further investigation of this possibility is warranted.

Our findings that patients with diabetes frequently were not coded for diabetes in discharge summaries are consistent with reports from England, Australia, Spain, Scotland, and Canada.^{14–18} Our study is the first to our knowledge to demonstrate adverse outcomes associated with failure to record a diabetes diagnosis. This is true despite the possibility that diabetes diagnoses not recorded in administrative data were nonetheless available in the hospital chart.¹⁵ Although our secondary analyses showed that the effect of having a diabetes diagnosis recorded was independent of other facility-level factors, there was wide variation among hospitals in consistency of diabetes coding (ranging from 33.4% to 97.5% among hospitals with 100 or more discharges), and at the hospital level there was a strong inverse correlation between the proportion with diabetes coded and the proportion followed by nonelective rehospitalization ($r = -0.53$, data not shown). It is possible that in some cases diabetes was not recorded because it was overshadowed in importance by multiple other morbidities. However, in more than 80% of the discharge records for previously diagnosed patients with diabetes that did not record diabetes, there were unused fields available to record additional diagnoses, and records without a diabetes diagnosis had fewer diagnoses recorded overall than those in which diabetes was recorded (data not shown). Future research should clarify whether rehospitalization is associated with shortcomings in administrative record-keeping and other functions, failure to note diabetes in the inpatient chart, failure to attach patients to followup diabetes care, or some combination of these factors.

In addition, we were able to demonstrate a very substantial decrease in risk of rehospitalization after the first hospitalization during which a patient was coded for diabetes. The results suggest that some actions taken as a result of this event—whether by the hospital staff, the patient, or the providers of follow-up care—may be effective in improving postdischarge outcomes. Although one study¹⁹ found no relationship between the probability of receiving postdischarge follow-up care and whether or not the patient had been newly diagnosed in hospital, that study was limited to patients who had been seen by a certified diabetes educator during the hospital stay. Most hospitalized patients with diabetes do not receive such specialized diabetes care.⁵ Additional research is required to confirm our findings and determine what factors, either during or after the first diabetes hospitalization, might account for the decreased risk of rehospitalization.

There are important limitations inherent in the use of administrative data. We do not know whether diabetes diagnoses were recorded in medical charts even when they were not present in the discharge record. Some patients in the study may have received a diabetes diagnosis, either in outpatient care or during a hospitalization before 1994, prior to the first hospitalization we ascertained with such a diagnosis recorded. However, these limitations would be expected to reduce the associations we found between administrative diagnoses and rehospitalization. Although correlation of outcomes within patients could bias the results of logistic regression using hospitalization as the unit of analysis, secondary analyses including only one, randomly-selected hospital discharge per patient yielded essentially identical results. Observed associations may not be causal, and this study does not provide direct evidence that improving recording of diabetes diagnoses would improve postdischarge outcomes.

Other investigators have shown that intensive discharge planning can prevent rehospitalizations.²⁰ This study suggests that even the apparently minor administrative detail of appropriately coding patients with diabetes is associated with decreased risk for rehospitalization. Efforts to ensure that diabetes is consistently recorded for hospitalized patients may help to reduce the high frequency of nonelective readmissions following discharge for patients with diabetes.

References

1. Anonymous. Major cardiovascular disease (CVD) during 1997–1999 and major CVD hospital discharge rates in 1997 among women with diabetes–United States. *MMWR* 2001;50:948–954. [PubMed: 11708592]
2. Natarajan S, Nietert PJ. Hypertension, diabetes, hypercholesterolemia, and their combinations increased health care utilization and decreased health status. *J Clin Epidemiol* 2004;57:954–961. [PubMed: 15504638]
3. Hospitalizations for Diabetes as Any-Listed Diagnosis. [Division of Diabetes Translation, National Center for Chronic Disease Prevention and Health Promotion, CDC website]. [Accessed on April 7, 2005.]. <http://www.cdc.gov/diabetes/statistics/dmany/table1.htm>
4. Clement S, Braithwaite SS, Magee MF, et al. Management of diabetes and hyperglycemia in hospitals. *Diabetes Care* 2004;27:553–591. [PubMed: 14747243]
5. Benbassat J, Taragin M. Hospital readmissions as a measure of quality of health care: advantages and limitations. *Arch Intern Med* 2000;160:1074–1081. [PubMed: 10789599]
6. Ashton CM, Kuykendall DH, Johnson ML, et al. The association between the quality of inpatient care and early readmission. *Ann Intern Med* 1995;122:415–421. [PubMed: 7856989]
7. Smith DM, Giobbie-Hurder A, Weinberger M, et al. Predicting non-elective hospital readmissions: A multi-site study. *J Clin Epidemiol* 2000;53:1113–1118. [PubMed: 11106884]
8. Krumholz HM, Parent EM, Tu N, et al. Readmission after hospitalization for congestive heart failure among Medicare beneficiaries. *Arch Intern Med* 1997;157:99–104. [PubMed: 8996046]
9. Bloomberg GR, Trinka KM, Fisher EB, et al. Hospital readmissions for childhood asthma: a 10-year metropolitan study. *Am J Respir Crit Care Med* 2003;167:1068–1076. [PubMed: 12684246]
10. Gazmararian JA, Koplan JP. Length-of-stay after delivery: managed care versus fee-for-service. *Health Affairs* 1996;15:74–80. [PubMed: 8991256]
11. Robbins JM, Webb DA. Cardiovascular comorbidities among patients with diabetes: the Urban Diabetics Study. *BMC Public Health* 2005;5:15. [PubMed: 15701166]
12. SAS/STAT 9.1 User's Guide. Cary, NC: SAS Institute, Inc;
13. Lipton RB, Zierold KM, Drum ML, et al. Re-hospitalization after diagnosis of diabetes varies by gender and socioeconomic status in urban African-American and Latino young people. *Pediatr Diabetes* 2002;3:16–22. [PubMed: 15016170]
14. Wallymahmed ME, Dawes S, Clarke G, et al. Hospital in-patients with diabetes: increasing prevalence and management problems. *Diabet Med* 2005;22:107–109. [PubMed: 15606701]
15. Preen DB, Holman CDJ, Lawrence DM, et al. Hospital chart review provided more accurate comorbidity information than data from a general practitioner survey or an administrative database. *J Clin Epidemiol* 2004;57:1295–1304. [PubMed: 15617956]
16. Carral F, Oliveira G, Aguilar M, et al. Hospital discharge records under-report the prevalence of diabetes in inpatients. *Diabetes Res Clin Pract* 2003;59:145–151. [PubMed: 12560164]
17. Leslie PJ, Patrick AW, Hepburn DA, et al. Hospital in-patient statistics underestimate the morbidity associated with diabetes mellitus. *Diabetes Med* 1992;9:379–385.
18. Lee DS, Donovan L, Austin PC, et al. Comparison of coding of heart failure and comorbidities in administrative and clinical data for use in outcomes research. *Med Care* 2005;43:182–188. [PubMed: 15655432]
19. Wheeler K, Crawford R, McAdams D, et al. Inpatient to outpatient transfer of care in urban patients with diabetes: patterns and determinants of immediate postdischarge follow-up. *Arch Intern Med* 2004;164:447–453. [PubMed: 14980997]

20. Naylor M, Brooten D, Jones R, et al. Comprehensive discharge planning for the hospitalized elderly: a randomized clinical trial. *Ann Intern Med* 1994;120:999–1006. [PubMed: 8185149]

TABLE 1

Hospitalizations and Nonelective Rehospitalizations

	No. Hospitalizations	Percent of Total	No. Rehospitalized	Percent Rehospitalized
Total	291,752	100.00	58,308	19.99
Gender				
Female	161,734	55.44	31,295	19.35
Male	130,018	44.56	27,013	20.78
Age, years				
25–34	11,412	3.91	2965	25.98
35–44	27,772	9.52	6238	22.46
45–54	45,879	15.73	9088	19.81
55–64	60,814	20.84	11,726	19.28
65–74	81,940	28.09	15,943	19.46
75–84	63,935	21.91	12,348	19.31
Race/ethnicity:				
Non-Hispanic white	102,885	35.26	18,792	18.27
Black	146,432	50.19	31,009	21.18
Hispanic	1399	0.48	185	13.22
Asian	18,385	6.30	3789	20.61
Other	2791	0.96	553	19.81
Unknown	19,860	6.81	3980	20.04
Year (per year)				
1994	32,017	10.97	4885	15.26
1995	37,247	12.77	7141	19.17
1996	38,534	13.21	7950	20.63
1997	38,293	13.13	8308	21.70
1998	37,872	12.98	8398	22.17
1999	43,050	14.76	9511	22.09
2000	34,016	11.66	6056	17.80
2001	30,524	10.46	5957	19.52
Insurance				
Medicare	122,938	42.14	26,097	21.23
Medicaid	45,539	15.61	10,630	23.34
Private fee-for-service	2395	0.82	280	11.69
Private managed care	69,583	23.85	11,376	16.35
Uninsured/selfpay	2743	0.94	390	14.22
Other/unknown	48,554	16.64	9535	19.64

TABLE 2

Coding of Diabetes and Previous Diabetes-Diagnosed Hospitalization

Previous Diabetes-Diagnosis Hospitalization	Diabetes Coded					
	Yes			No		
	No. Hospitalizations	Percent Rehospitalized		No. Hospitalizations	Percent Rehospitalized	Total
Yes	148,445	23.33		22,807	30.56	171,252
No	86,043	9.45		34,457	24.92	120,500
Total	234,488	18.23		57,264	27.16	291,752
						24.29
						13.87
						19.99

TABLE 3

Risk Factors for Nonelective Rehospitalization

	Odds Ratio	95% CI
Diabetes diagnosis		
Coded, had previous diagnosis	1.000	(Reference)
Coded, no previous diagnosis	0.456	(0.444–0.468)
Not coded, had previous diagnosis	1.328	(1.286–1.373)
Not coded, no previous diagnosis	0.994	(0.965–1.024)
Female gender	0.950	(0.932–0.968)
Age (per 10 years)	0.961	(0.953–0.970)
Race/ethnicity:		
Non-Hispanic white	1.000	(Reference)
Black	1.075	(1.052–1.099)
Hispanic	0.832	(0.709–0.977)
Asian	1.080	(1.036–1.126)
Other	1.155	(1.046–1.274)
Unknown	1.079	(1.036–1.124)
Year (per year)	1.086	(1.080–1.092)
Insurance		
Medicare	1.000	(Reference)
Medicaid	0.972	(0.942–1.003)
Private fee-for-service	0.655	(0.575–0.746)
Private managed care	0.838	(0.815–0.862)
Uninsured/selfpay	0.678	(0.604–0.762)
Other/unknown	0.931	(0.904–0.959)
No. previous hospitalizations	1.068	(1.067–1.070)
Admission type		
Emergency	1.000	(Reference)
Urgent	0.976	(0.946–1.008)
Elective	0.653	(0.634–0.672)
Missing	1.056	(0.889–1.255)
Severity class		
0	1.000	(Reference)
1	1.220	(1.161–1.282)
2	1.687	(1.604–1.774)
3	2.408	(2.279–2.544)
4	2.704	(2.393–3.056)
Missing	1.559	(1.482–1.639)
Length of stay (per day)	1.006	(1.006–1.007)
Discharge status		
Self-care	1.000	(Reference)
Other institution	1.327	(1.293–1.362)
Home health care	1.187	(1.149–1.225)
Home IV	6.262	(4.550–8.616)
Against medical advice	1.633	(1.534–1.739)
Missing	0.949	(0.656–1.373)

Results shown are adjusted for all variables shown in the table.