Inpatient to Outpatient Transfer of Care in Urban Patients With Diabetes

Patterns and Determinants of Immediate Postdischarge Follow-up

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Background: A key opportunity for continuing diabetes care is to assure outpatient follow-up after hospitalization. To delineate patterns and factors associated with having an ambulatory care visit, we examined immediate postdischarge follow-up among a cohort of urban, hospitalized patients with diabetes mellitus.

Methods: Retrospective study of 658 inpatients of a municipal hospital. Primary data sources were inpatient surveys and electronic records.

Results: Patients were stratified into outpatient follow-up (69%), acute care follow-up (15%), and those with no follow-up (16%); differences between groups were detected for age ($P=.02$), percentage discharged with insulin ($P=.03$), and percentage receiving a full discount for care ($P<.001$). Among patients with a postdischarge visit, 43% were seen in our specialty diabetes clinic, and 26% in a primary care site. Adjusted analyses showed any follow-up visit significantly decreased with having to pay for care. The odds of coming to the Diabetes Clinic increased if patients were discharged with insulin, had new-onset diabetes, or had a direct referral.

Conclusions: In this patient cohort, most individuals accomplished a postdischarge visit, but a substantial percentage had an acute care visit or no documented follow-up. New efforts need to be devised to track patients after discharge to assure care is achieved, especially in this patient population particularly vulnerable to diabetes.

Arch Intern Med. 2004;164:447-453

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DIABETES MELLITUS HAS emerged as a significant public health problem in the United States. Rising prevalence of the disease,[1] extensive potential morbidity,[2,3] and excess health care costs compared with the patient population without diabetes[4] have created an increasing burden on patients, society, and the health care system. Recent clinical trials, however, have shown that good glycemic control, along with other interventions, can delay or prevent complications.[5-12]

Figure 1 depicts a model for the continuum of diabetes care. Hospitalizations are a common occurrence for individuals with diabetes, with nearly one quarter of affected individuals reporting such an event[13]; the importance of effective inpatient care to improve hospital outcomes in diabetes (Figure 1, arrow A) has become increasingly evident.[14-18] Despite the large economic burden attributable to hospital admissions,[4,13,19,20] ambulatory settings are the most common sites of diabetes care, with outpatient visits accounting for the majority of physician contacts.[21] Patients who receive structured and integrated outpatient diabetes care (Figure 1, arrow B) achieve good glycemic control and improved outcomes, including decreased health services utilization, and possibly fewer hospitalizations (Figure 1, arrow C).[22-27] Conversely, defaulters from outpatient follow-up have more severe hyperglycemia and are therefore at a greater risk of complications (Figure 1, arrow D).[28-30] Establishing contact with an outpatient care team, therefore, is a critical step in assuring health the of patients with diabetes.

Despite the importance of outpatient diabetes management, little is known about the transfer of care between the inpatient and outpatient settings following discharge from the hospital (Figure 1, dashed line), which represents an important gap in our understanding of the continuum of diabetes care. Understanding the patterns of postdischarge follow-up and identifying patient characteristics that are associated with returning for an ambulatory visit after hospitalization may allow development of interventions that increase the likelihood of individuals receiving recommended long-term diabetes care.

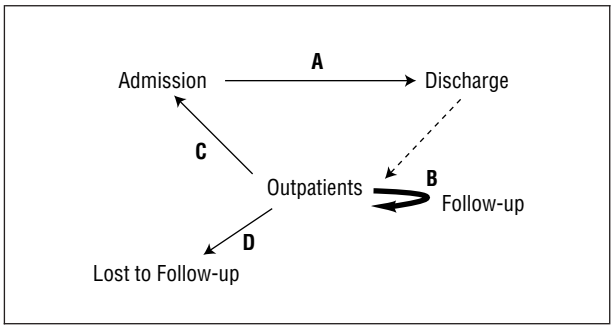

Figure 1. Model of continuum of diabetes care. Both inpatient (A) and outpatient (B) care are well described, and the effect of outpatient care on hospitalizations has been studied (C). Although limited, data are available for patients who were lost to outpatient follow-up (D). Little information is available on patterns and predictors of inpatient to outpatient transfer of diabetes care (represented by dashed line).

Table 1. General Characteristics of All 658 Patients*

Age, y	49 (14.1)
Male	52
Black	88
Discharged with insulin	65
Admission glucose level, mg/dL	426 (301)
Discharge glucose level, mg/dL	199 (114)
Hemoglobin A_{1c}, %	10.5 (3.3)
No health insurance	52
Full discount for care	42

SI conversion factor: To convert glucose to millimoles per liter, multiply by 0.0555.
*Data are given as mean (SD) or percentage of patients.

The issue of postdischarge follow-up is particularly relevant in minority patient populations with diabetes, who have a higher prevalence of the disease,[3,31] worse glycemic control,[32] a disproportionately high rate of diabetes-related complications,[33] and a tendency to have greater socioeconomic barriers that potentially impede obtaining continuing care.[34-36] To gain more insight into how follow-up is occurring in our urban diabetes patients after hospitalization, we conducted a retrospective analysis to examine the pattern of immediate postdischarge visits, and to study patient characteristics associated with follow-up.

METHODS

DESCRIPTION OF FACILITY

Located in downtown Atlanta, the hospital belongs to a larger public health system that includes outpatient specialty clinics, hospital-based and neighborhood primary care sites, and an emergency department/urgent care center. A specialty Diabetes Clinic is located in a separate facility adjacent to the hospital; this clinic, previously described elsewhere,[37-41] is the only formal structured diabetes care program within our health system.

Certified diabetes nurse educators (CDEs) are available to provide one-to-one instruction in diabetes self-management to hospitalized individuals; the patient's primary care team makes the referral to the inpatient CDE. The CDE completes a brief questionnaire on each patient that includes demographics (age, sex, race), date of admission, date of diabetes diagnosis, admission and discharge glucose values, and admission and discharge medications used to treat hyperglycemia. Body mass index values, due to inconsistent availability of inpatient heights and weights, were lacking. In addition, classification of diabetes, which is often difficult to determine in our inpatient setting because of the frequency of diabetic ketoacidosis, frequently was not established; however, most patients, even those who present with ketoacidosis, have type 2 diabetes.[42-44]

DATA RETRIEVAL

Information on patient characteristics and outpatient follow-up were derived from 2 sources: questionnaires completed by the inpatient CDEs and institutional electronic records. Data on all patients seen by the inpatient CDEs during calendar year 2001 were abstracted from their questionnaires and entered into a database for analysis. This file was then linked to the health system's computerized records to determine if outpatient follow-up had occurred, and to retrieve information on health insurance status and patient financial class.

VARIABLE DEFINITIONS

We defined immediate postdischarge follow-up as the location of the first visit after hospital discharge. A search for outpatient visits was conducted through the end of June 2002 to ensure an adequate amount of time for follow-up to occur. Follow-up in the emergency department or urgent care center was designated as an "acute care" setting. Follow-up in the locations that typically schedule appointments (eg, primary care, medical subspecialty, gynecology, or surgery clinics) was designated as an "outpatient clinic." Finally, if no follow-up within the health care system could be identified, it was designated as "no follow-up."

We obtained financial class and health insurance status data from institutional electronic records. Financial class describes the categories used to determine the proportion of inpatient, outpatient, and medication charges to be paid by the patient. Financial class is determined by patient income, household size, and county of residence matched against the federal poverty line; thus, financial class represents a composite measure of socioeconomic status. Using financial class data, we grouped patients into those who received a full discount for medical charges and those who were expected to pay some or all of the charges (partial or no discount). Individuals with insufficient documentation to determine eligibility for a discount or those who reside outside of the 2-county referral area typically receive no discount. Health insurance status was classified as insured or uninsured.

STATISTICAL ANALYSES

Comparisons of continuous variables were done using nonparametric tests and the χ^2 test was used to evaluate differences between proportions. To determine which variables were associated with returning for follow-up, a series of logistic regression models, comparing characteristics of patients with follow-up or with no follow-up, were constructed adjusting for age, sex, race, admission glucose value, insulin use at discharge, duration of diabetes, insurance status, and discount type. A similar analysis compared individuals who presented to the Diabetes Clinic for postdischarge follow-up.

RESULTS

GENERAL CHARACTERISTICS

Records on 658 unique patients were reviewed (**Table 1**). Mean age at the time of admission was 49 years; 52% of

the patients were male, 88% were black, and 65% were discharged with insulin. Mean admission glucose level was 426 mg/dL (23.6 mmol/L) and discharge glucose level was 199 mg/dL (11.0 mmol/L). Hemoglobin A_{1c} values were documented for 74% of patients, with a mean value of 10.5%. Fifty-two percent of patients had no health insurance; 42% had been assigned to a full discount category. Among individuals with health insurance, 78% belonged to government-sponsored plans (eg, Medicare, Medicaid, not shown).

Patients with new-onset diabetes (diabetes as a cause of the admission or diagnosed during the hospital stay) accounted for 34% of cases reviewed. Compared with individuals with established diabetes (**Figure 2**), persons admitted for new-onset diabetes were slightly younger (46 vs 49 years, $P=.008$), and had a higher average admission blood glucose level (533 vs 372 mg/dL [29.6 vs 20.6 mmol/L], $P<.001$). In addition, patients with new-onset diabetes had a slight predominance of males (59% vs 50%, $P=.04$), and more new-onset patients were uninsured (63% vs 49%, $P=.002$). The average duration of disease in persons with established diabetes was 11 years, and 49% of these had visits documented in the Diabetes Clinic prior to admission.

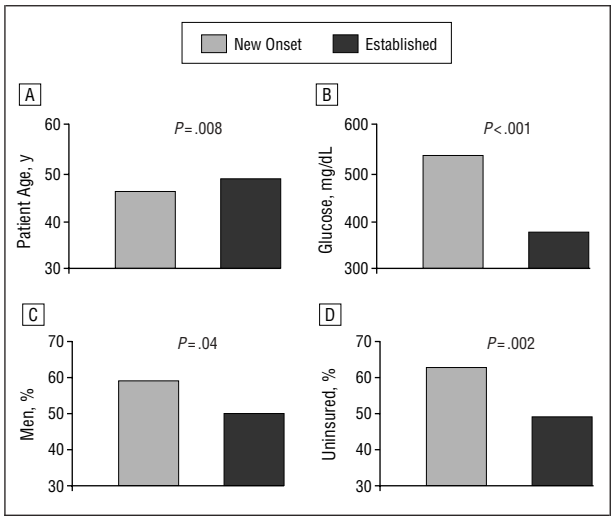

Figure 2. Comparison of hospitalized patients with new-onset and established diabetes. A, Mean patient age; B, mean admission blood glucose level (to convert glucose to millimoles per liter, multiply by 0.0555); C, percentage who were men; and D, proportion who were uninsured.

PATTERNS OF POSTDISCHARGE FOLLOW-UP

Sixty-nine percent of patients had their first postdischarge visit at one of the outpatient clinics, 15% returned for evaluation in the acute care site, and 16% had no evidence of follow-up; only 1% of patients who returned to the acute care facility required readmission. The average time between discharge and any follow-up was 7 weeks, with an average of 6 weeks elapsing for an outpatient visit and 12 weeks for an acute care visit ($P<.001$).

Among persons who had any follow-up, 43% were seen in the Diabetes Clinic for their first postdischarge visit, and 26% were seen in one of the health system's primary care sites (**Figure 3**). An additional 18% had their first follow-up in the hospital's acute care facility, 8% in a surgical clinic, 3% in another medical specialty clinic, and 2% in another type (eg, dermatology) of clinic (Figure 3).

Of all 658 patients, 10% had a noncounty resident designation. Significantly more residents (86%) than nonresidents (71%) had a recorded follow-up visit within our health system ($P=.002$); because the majority of nonresidents did return for follow-up, they were included and adjusted for in subsequent analyses.

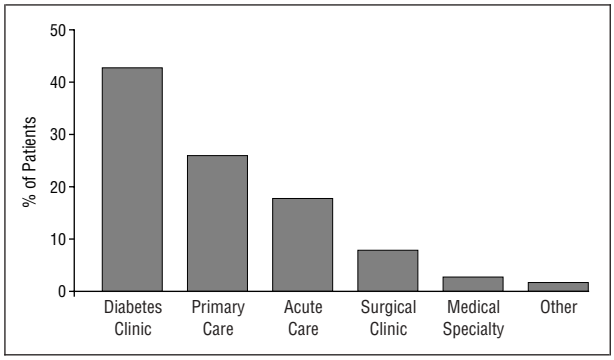

Figure 3. Location of postdischarge follow-up.

CHARACTERISTICS OF OUTPATIENT, ACUTE CARE, AND NO FOLLOW-UP PATIENTS

Sex, admission glucose values, and hemoglobin A_{1c} levels were not significantly different between follow-up groups (**Table 2**). Patient age ($P=.02$) and the percentage who were discharged with insulin ($P=.03$) differed significantly across follow-up categories; patients who returned for an outpatient visit were the oldest and had the highest proportion discharged with insulin. The proportion of individuals who qualified for a full discount of care also was different across follow-up categories ($P<.001$). The percentage of patients who qualified for a full discount of medical services was lowest among the no follow-up patients; thus, a substantial proportion of no follow-up patients would have been required to pay all or part of the charges related to their health care. A substantial number of patients in all 3 follow-up groups were uninsured, but the percentage was comparable among groups. There were also trends for differences among groups for race and in the percentage who had new-onset diabetes (Table 2).

VARIABLES ASSOCIATED WITH PROBABILITY OF FOLLOW-UP

A series of logistic regression models (**Table 3**) was constructed to determine which variables in Table 2 were associated with the probability of returning for a postdischarge visit within our health care system. In these models, we compared persons with an outpatient clinic follow-up with those who had no follow-up (Table 3, model 1), patients with acute care follow-up with individuals who had no follow-up (Table 3, model 2), and all patients who had any follow-up (either outpatient or

Table 2. Comparison of 3 Follow-up Groups*

Variable	Outpatient Follow-up (n = 455)	Acute Care Follow-up (n = 100)	No Follow-up (n = 103)	*P* Value†
Male	51	53	57	.48
Black	89	87	82	.10
Age, y	50 (14)	46 (13)	47 (16)	.02
Admission glucose level, mg/dL	429 (303)	429 (342)	412 (255)	.82
Hemoglobin A_{1c}, %	10.4 (3.2)	11.0 (3.4)	10.6 (3.5)	.48
Full discount for care	44	51	21	<.001
No health insurance	46	54	55	.37
Discharged with insulin	68	54	60	.03
New-onset diabetes	36	27	27	.10

SI conversion factor: To convert glucose to millimoles per liter, multiply by 0.0555.
*Data are given as mean (SD) or percentage of patients.
†Statistics by Kruskal Wallis for continuous variables or χ^2 for proportions.

Table 3. Variables Associated With Postdischarge Follow-up*

	Odds Ratio (95% Confidence Interval)	*P* Value
Model 1: outpatient clinic vs no follow-up		
Discharged with insulin	1.67 (0.96-2.93)	.07
Uninsured	1.94 (1.03-3.64)	.04
Partial discount	0.36 (0.14-0.90)	.03
No discount	0.19 (0.09-0.40)	<.001
Model 2: acute care vs no follow-up		
Age at admission	0.97 (0.94-0.99)	.04
Partial discount	0.15 (0.04-0.55)	.005
No discount	0.12 (0.05-0.33)	<.001
Model 3: any follow-up vs no follow-up		
Uninsured	1.78 (0.97-3.28)	.06
Partial discount	0.34 (0.14-0.83)	.02
No discount	0.18 (0.09-0.38)	<.001
Model 4: outpatient vs acute care follow-up		
Age at admission	1.04 (1.02-1.06)	<.001
Discharged with insulin	2.20 (1.25-3.87)	.006

*Analysis adjusted for other variables in the table plus race, sex, admission glucose level, new onset vs established diabetes, and county residency status. Patients discharged with insulin are compared with those discharged without insulin, uninsured are compared with insured, and discount categories are compared with individuals with a full discount for medical services.

acute care) with individuals who had no documented follow-up (Table 3, model 3). Finally, we compared persons returning for an outpatient clinic visit with those whose first postdischarge visit was to the acute care setting (Table 3, model 4).

Compared with patients who had no follow-up (Table 3, model 1), there was a strong trend indicating that the odds of returning to an outpatient clinic were increased among patients discharged with insulin therapy (odds ratio [OR], 1.67; 95% confidence interval [CI], 0.96-2.93; *P*=.07). Relative to individuals who had no follow-up, the probability of returning to the outpatient clinic was increased for persons without health insurance (OR, 1.94; 95% CI, 1.03-3.64; *P*=.04). However, the probability of having a first postdischarge visit in one of the outpatient sites was markedly reduced among patients who received only a partial discount for medical services (OR, 0.36; 95% CI, 0.14-0.90; *P*=.03), and it was even lower if no discount was received (OR, 0.19; 95% CI, 0.09-0.40; *P*<.001 [Table 3, model 1]).

Relative to patients who had no evidence of follow-up, the probability of returning to the acute care facility was slightly but significantly lower with increasing age (OR, 0.97; 95% CI, 0.94-0.99; *P*=.04), and it was also lower among patients with either a partial (OR, 0.15; 95% CI, 0.04-0.55; *P*=.005) or no discount (OR, 0.12; 95% CI, 0.05-0.33; *P*<.001 [Table 3, model 2]) for medical services. When individuals who had any postdischarge visit were compared with persons who had no follow-up (Table 3, model 3), we found that a partial or no discount status significantly lowered the probability of returning after hospitalization; there was a trend for follow-up patients to be uninsured compared with persons with no follow-up.

Lastly, patients who had their first postdischarge follow-up in one of the outpatient clinics had a higher probability of being older (OR, 1.04; 95% CI, 1.02-1.06; *P*<.001) and taking insulin (OR, 2.20; 95% CI, 1.25-3.85; *P*=.006) compared with acute care patients (Table 3, model 4). Being a resident of the 2-county referral area was not a significant factor in any of the models, nor was race, sex, admission blood glucose level, or diabetes onset.

CHARACTERISTICS ASSOCIATED WITH A DIABETES CLINIC VISIT

Because the Diabetes Clinic represents the only formal structured diabetes education and care program in our health system, we constructed logistic regression models to search for patient characteristics that were associated with the clinic being the location of the first postdischarge visit. This analysis compared persons presenting to the Diabetes Clinic with patients having any other type of follow-up, including acute and other outpatient care. Two separate models (**Table 4**) were constructed according to whether a specific referral to the Diabetes Clinic had been made by the inpatient CDEs. A diagnosis of new-onset diabetes increased the odds of the Diabetes Clinic being the site of the first postdischarge follow-up visit (OR, 1.58; 95% CI, 1.05-2.39; *P*=.03 [Table 4, model 1]). In addition, having been discharged with insulin was sig-

nificantly associated with follow-up in the Diabetes Clinic (OR, 1.73; 95% CI, 1.13-2.65; $P=.01$). Finally, the probability of visiting the Diabetes Clinic significantly increased if patients were referred to the program by the inpatient CDEs (OR, 8.52; 95% CI, 3.72-19.50; $P<.001$ [Table 4, model 2]). After adjusting for individuals who were referred, the variable of being discharged with insulin remained significantly associated with a Diabetes Clinic visit, with new-onset diabetes becoming a strong trend.

Table 4. Variables Associated With Postdischarge Follow-up in Diabetes Clinic vs Follow-up in Non–Diabetes Clinic Sites*

	Odds Ratio (95% Confidence Interval)	*P* Value
Model 1		
New-onset diabetes	1.58 (1.05-2.39)	.03
Discharged with insulin	1.73 (1.13-2.65)	.01
Model 2		
New-onset diabetes	1.50 (0.97-2.32)	.07
Discharged with insulin	1.67 (1.06-2.61)	.03
Referred to diabetes clinic	8.52 (3.72-19.50)	<.001

*Analyses adjusted for other elements in the table plus age, sex, race, admission glucose level, health insurance status, and financial discount type. Models 1 and 2 differ by inclusion of referral to the Diabetes Clinic. New-onset diabetes patients are compared with patients with established diabetes, persons discharged with insulin are compared with those discharged without insulin, and individuals referred to the Diabetes Clinic are compared with nonreferrals.

COMMENT

Extensive data exist on the importance of structured outpatient care on diabetes outcomes,[5-12,23-25] and there have been studies examining the consequence of being lost to outpatient follow-up.[28-30] In addition, the impact of specific outpatient diabetes care on health care utilization and hospitalizations has been described,[26,27] as have the outcomes of intensive inpatient management.[14-18] However, in this continuum of diabetes care, information on what happens to patients after hospital discharge is scant. Establishing a level of long-term outpatient diabetes care after hospitalization is crucial if recommended preventive services are to be obtained, treatment is to be accomplished, and the benefits of management are to be realized.

In this sample of inpatients, we elected to examine the location of immediate postdischarge follow-up, defined as the first visit in the health system after hospitalization. This first visit should represent an opportunity, regardless of the type of clinic where the follow-up occurred, to begin the outpatient diabetes care and referral process. It was encouraging to note that the majority of individuals analyzed here did present for an outpatient visit after release from the hospital. Moreover, most had their first visit either in the Diabetes Clinic or in one of the primary care sites—areas where coordination of diabetes care could occur.

Even a postdischarge visit to an acute care site still represents an opportunity for referral to an appropriate clinical setting. The observation that the average time between discharge and an acute care visit was significantly greater than the time between discharge and an outpatient follow-up, and the low percentage requiring readmission from the acute care site, suggests that an acute illness may not have intervened to prevent an outpatient visit. Factors that distinguished between acute vs outpatient follow-up were age and especially whether the patient was discharged with insulin. Being discharged with insulin also distinguished people who followed up in the Diabetes Clinic from patients who followed up elsewhere in the health system. Individuals who were discharged with insulin may have been more interested in seeking outpatient care because they perceived their illness to be worse or wanted to participate in an educational program with the goal of being able to eventually discontinue insulin therapy. Finally, having new-onset diabetes was an important determinant of having a visit to the Diabetes Clinic, and likely represents a patient group motivated to learn about their disease.

A minority of patients did not have any evidence of follow-up within the health system. Those who had no follow-up were of comparable sex and race as patients who did have a postdischarge visit, and a similar proportion of no follow-up patients were uninsured. After adjusting for other factors, the variables of insulin use, diabetes onset, and age were not significantly associated with the probability of having a postdischarge visit. It is possible that patients who did not have any evidence of follow-up in our system sought care elsewhere, such as private clinics and county health departments, migrated out of the geographic area, or had out-of-hospital mortality. The outcomes of patients who did not return to our health system after hospital discharge are not available. Our no follow-up patients were metabolically as severe (as measured by admission glucose level) as persons who did have follow-up, which underscores the need for the health system to devise a formal system for tracking patients after discharge to ascertain whether ambulatory contact has been established somewhere.

Lacking health insurance increased the odds of having an outpatient visit, and is consistent with our health system's mission to provide care to uninsured patients. An important characteristic that distinguished follow-up from no follow-up patients was the type of discount allowed for medical services. Whether considering patients who returned to an outpatient clinic, or individuals who presented to the acute care setting, needing to pay for medical charges was associated with a lower probability of follow-up and suggests that economic factors were influencing decisions about seeking follow-up. It is possible that individuals who had to pay opted to go elsewhere for their care. Nonetheless, economic factors are increasingly recognized as serious impediments to health care access,[45] and even though the majority of uninsured patients in our area are cared for in publicly owned facilities,[46] the safety net represented by our public institution may not necessarily ensure medical care.[47,48] Although our facility is designed to care for individuals without health insurance, patients with a combination of no insurance and a discount class that requires payment for care may have difficulty following up, even in our municipal hospital system.

There are several limitations to this analysis. There is a selection bias introduced by the study design, as the patients evaluated were only those who were referred to and seen by the inpatient diabetes educators. These patients represented a cohort for whom there was easily accessible and complete information. Nonetheless, the patients analyzed here may not be comparable to all the patients with diabetes hospitalized and subsequently discharged in our health system. The number of diabetic inpatients not evaluated by our CDEs is likely considerably larger than the sample analyzed here. Currently, there is no available mechanism to identify and track hospitalized diabetic patients in our health system beyond those seen by the inpatient CDEs.

It is also not clear what impact the inpatient diabetes education program had on postdischarge follow-up. Persons who received inpatient diabetes education were frequently referred for follow-up to the Diabetes Clinic. Referral to the Diabetes Clinic increased the probability of follow-up in the program, and suggests that establishing improved lines of referral throughout the health system could be one way of increasing the chances of an ambulatory visit. On the other hand, there also is a possibility that individuals who obtained instruction from the inpatient CDEs may be less likely to follow up because they perceived they had obtained the required diabetes education.

Another limitation of the study is an incomplete database. As the analyses were retrospective, many patient variables could not be included, such as sociodemographic (eg, employment status, educational level) variables or self-perceived barriers to postdischarge care that may influence the ability or desire to obtain follow-up. An expanded study that captures this information is needed to develop a more complete profile of factors affecting posthospital care. Finally, we only investigated the first location where patients returned after discharge; follow-up beyond this was not explored.

Despite the limitations, the analysis gave insight into the patterns and some of the determinants of immediate follow-up after discharge from our public hospital. Enhanced ways of identifying inpatients with diabetes should be developed, and improved posthospital tracking is needed to ensure efficient transfer of diabetes care to the outpatient setting. These needs are particularly critical in patient populations such as ours, which have a high prevalence of diabetes and its complications.

Accepted for publication March 28, 2003.

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