Primary Care Physicians and Avoidable Hospitalizations

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Background. The rate of admission for avoidable hospital conditions (AHCs) has been proposed as a measure of the ability of a population to access health care. The purpose of this study was to determine the relationship between the availability of primary care physicians and the rate of avoidable hospitalizations.

Methods. Statewide hospital discharge data for general acute care hospitals in Pennsylvania were used to determine age- and sex-adjusted AHC rates in the 26 health service areas (HSAs) in Pennsylvania. The number and type of primary care physician as well as the per capita income for each HSA were obtained from the Area Resource File. Correlations of number and type of physician with AHC rates were obtained.

Results. Only the number of family and general practice physicians (FPs/GPs) per population was significantly correlated with adult and pediatric AHC rates. As the number of FPs/GPs in each HSA increased, the AHC rate decreased. The significant relationship between FPs/GPs and the AHC rate remained after controlling for the effect of per capita income. No significant correlation was found between either the number of general internists and the adult AHC rate or the number of general pediatricians and the pediatric AHC rate.

Conclusions. The availability of FPs/GPs is related to lower rates of hospitalization for certain conditions. Family physicians may provide more effective first-contact access to health care than is provided by either general internists or pediatricians in Pennsylvania. Future studies should address whether care by family physicians is more cost-effective as a result of this reduction in avoidable hospitalizations.

Key words. Primary health care; health services accessibility; hospitalization; family practice; physicians, family.
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Accessibility is a key characteristic of primary care. This concept may best be defined as the ability of patients to access health care services in a timely manner in response to their needs.[1–3] Many factors influence access to health care in the United States, including number of health care providers,[4,5] availability or transportation to those providers,[6,7] other health care resources (eg, diagnostic and laboratory services), the patient's financial and insurance status,[8–11] and the patient's propensity for using health services.[12]

Several recent studies have suggested that the avoidable hospital condition (AHC) rate can be used as a measure of access to primary care.[13–18] This measure is defined as the hospital admission rate for conditions for which hospitalization might have been avoided if effective and timely ambulatory care had been delivered (eg, early ambulatory care for a person with insulin-dependent diabetes mellitus who has acute gastroenteritis may prevent the development of diabetic ketoacidosis requiring hospitalization).

Weissman and colleagues[13] cite four criteria for selecting avoidable hospital conditions: (1) consensus: have previously published studies used similar indicators? (2) importance: do the conditions represent important health problems? (3) clinical face validity: do the conditions make clinical sense? and (4) data clarity: are the conditions clearly coded in an available data source covering large populations? Using these criteria, they identified 12 potential avoidable hospital conditions.

Several recent studies have suggested that AHC rates are sensitive to alternative measures of a patient's ability to

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access the health care delivery system. Weissman and colleagues[13] found that rates of admission for nine of these conditions were sensitive to insurance status; ie, uninsured and Medicaid patients were more likely to be hospitalized for AHCs than were patients with private insurance. Billings and co-workers[15,17] found a significant relationship between poverty and rate of hospitalization for AHCs. In a recent report from the Institute of Medicine in Washington, DC, AHC rates for seven of the nine conditions identified by Weissman et al were three to seven times higher among patients living in low-income zip code areas than the AHC rates among those in high-income zip code areas in 11 states.[18] A shortcoming of these studies is that they included no attempt to measure the availability of primary care providers.

The purpose of this study was to examine the relationship between the availability of primary care physicians and access to health care as measured by the AHC rate. Specifically, we wanted to test the hypothesis that there is an association between the number and type of primary care physicians and a given population's AHC rate. We hypothesized that as the number of primary care providers increased, the AHC rate would decrease. In addition, we examined whether this relationship would remain after controlling for per capita income, a proxy measure of the ability to purchase health care.

Methods

Definition of Health Service Areas

Counties represent arbitrary political boundaries that have little association with how populations seek health care, especially the delivery of hospital care. Health service areas are defined as one or more counties that are relatively self-contained with respect to the provision of routine hospital care based on travel between the counties for such care. The National Center for Health Statistics combined all 67 counties in Pennsylvania into 26 health service areas (HSAs).[19] Because potentially avoidable hospitalizations are the outcome of interest, we believe that the use of HSAs constructed around hospitalizations provides a valid unit of analysis.

Since the focus of this study was to investigate the relationship between the availability of primary care providers in the HSA where patients live and the rate of hospitalizations for an AHC, the HSA of residence was used to calculate AHC rates rather than the HSA of hospitalization.

Selection of Avoidable Hospital Conditions

Only the conditions found to be significantly related to financial or insurance status in prior studies were selected for this study.[13,15,17,18] Six adult conditions (angina, congestive heart failure, hypertension, pneumonia, asthma, and diabetes mellitus) and two pediatric conditions (diabetes mellitus and pneumonia) were selected.

Calculation of AHC Rates

Hospital discharge data for Pennsylvania were made available by the Pennsylvania Health Care Cost Containment Council for the year 1989.[20] This database consists of individual patient discharge data, which are derived from the Uniform Claims and Billing Form and reported to the Council by all Pennsylvania hospitals, with the exception of Shriner and Veterans Administration hospitals. A subset of these data from short-term inpatient hospitalizations at general acute care hospitals was derived for the purpose of this analysis. Diagnoses were coded by diagnosis-related groups (DRGs).

Since differences in admission rates among HSAs may result from differences in age and sex characteristics of each HSA population, the statistical technique of indirect age and sex adjustment was used to provide a standardized AHC rate for each diagnosis and HSA. A standard rate for the entire state was determined by counting the actual number of admissions per diagnosis in each age and sex category (age was divided into 5-year intervals). This standard admission rate for the entire state was then applied to the age and sex distribution within each small area to yield an expected number of admissions per diagnosis for each age and sex category. These values were then summed to provide the total number of expected admissions for each diagnosis by HSA. The actual observed number of admissions per diagnosis in each HSA was divided by the expected number of admissions, and the ratio was multiplied by the standard rate of admission for the state to yield an adjusted rate for each HSA by diagnosis.

Availability of Primary Care Physicians

The number of licensed, nonfederal, patient-care, office-based general internists, general pediatricians, family and general practice physicians, and the total number of physicians involved in direct patient care for each county in 1989 were obtained from the Area Resource File system,[21] a national, county-level database of health-related and population data. The number of physicians per 10,000 population for each HSA was obtained by dividing the total number of physicians in each physician cat-

Table 1. Avoidable Hospitalization Condition (AHC) Rates in 26 Health Service Areas in Pennsylvania

Medical Condition	Rate*			
	Minimum	Maximum	Mean	Median
Adult AHCs				
Angina pectoris	0.99	6.87	3.72	3.51
Congestive heart failure	2.06	4.96	3.83	4.03
Hypertension	0.14	1.05	0.43	0.39
Pneumonia	1.64	4.65	3.14	3.15
Asthma/bronchitis	0.50	5.09	2.76	2.66
Diabetes	0.61	2.24	1.37	1.40
Pediatric AHCs				
Pneumonia	0.28	2.63	0.97	0.73
Asthma/bronchitis	0.40	2.42	1.31	1.27
Total adult AHC	7.37	24.37	15.24	15.73
Total pediatric AHC	0.68	4.56	2.27	1.99
Total overall AHC	8.93	28.63	17.52	17.47

**Admission per 100,000 population, adjusted for age and sex.*

egory in each HSA by the combined population of the HSA, and multiplying this ratio by 10,000. Additional data abstracted from the Area Resource File included the mean per capita income in each county and the population for each county in 1989.

Data Analysis

A descriptive analysis of the variation in AHC rates and number of physicians in each HSA was accomplished by reporting minimum, maximum, mean, and median values for each variable. Pearson correlation coefficients were used to examine the relationship between AHC rates and the number of each type of primary care physician, the per capita income, and the population of each HSA. A multivariate regression equation was used to determine whether controlling for the effect of per capita income influenced the relationship between physician availability and the AHC rate. All the statistical analyses were conducted on the Statistical Analysis System for the personal computer (SAS Institute Inc, Cary, NC).

Results

Descriptive Analysis

The rates for individual and total AHCs for the 26 HSAs in Pennsylvania are found in Table 1. Total AHC rates varied by a factor of 3.1 across HSAs, from 8.93 to 28.63 per 100,000. The rates for individual conditions varied across HSAs by a factor of 2.4 for congestive heart failure to 10.2 for adult asthma or bronchitis.

Table 2 reports the minimum, maximum, mean, and median number of physicians per 10,000 population for each physician category by HSA in Pennsylvania. Family and general practice physicians (FPs/GPs) comprise approximately 20% of all physicians, with general internists accounting for less than 9% of all physicians involved in direct patient care. The number of general internists demonstrates the largest variation, with five times as many general internists in one HSA as in the HSA with the fewest general internists. The number of FPs/GPs varied by a factor of less than 2.5 across HSAs.

Table 2. Number of Physicians per 10,000 Population in 26 Health Service Areas in Pennsylvania

Specialty	Minimum	Maximum	Mean	Median
General internists	0.52	2.62	1.23	1.15
General pediatricians	0.0	1.29	0.50	0.45
Family and general practice physicians	1.86	4.61	2.99	2.74
Total physicians	4.10	28.58	13.81	12.41

Correlation Analysis

Only the number of FPs/GPs per population was significantly associated with the rate of admission for adult AHCs ($r=-.53$, $P=.005$) or pediatric AHCs ($r=-.41$, $P=.03$). This relationship is inverse; ie, as the number of FPs/GPs in each HSA increased, the combined or total AHC rate decreased (Figures 1 and 2). While the Pearson correlation coefficient was negative, no significant correlation was found between number of general internists and the adult AHC rate ($r=-.01$, $P>.05$) and the number of general pediatricians and the pediatric AHC rate ($r=-.20$, $P>.05$).

The mean per capita income was also significantly related to both the adult ($r=-.68$, $P<.001$) and the pediatric ($r=-.39$, $P=.05$) AHC rates. This relationship is also inverse: the higher the income level in the HSA, the lower the AHC rate. Of equal importance, perhaps, is the finding that a significant association exists between the population in each HSA and the number of general internists ($r=.72$, $P<.001$) and pediatricians ($r=.79$, $P<.001$). A similar relationship exists between per capita income and general internists ($r=.46$, $P=.02$) and general pediatricians ($r=.46$, $P=.02$). Higher mean per capita income and larger population are both associated with greater numbers of general internists and pediatricians per 10,000 population. The number of FPs/GPs per 10,000 population was not significantly correlated with population ($r=-.11$, $P>.05$) or income ($r=.23$, $P>.05$).

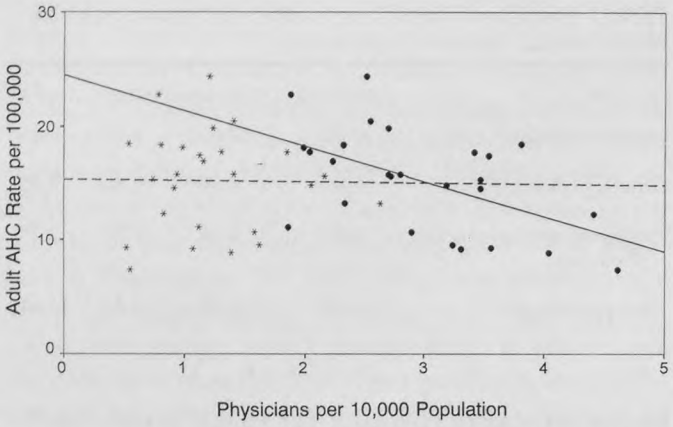

Figure 1. Relationship between rates of avoidable hospitalizations for six adult conditions (angina, congestive heart failure, hypertension, pneumonia, asthma, and diabetes mellitus) and the number of family physicians/general practitioners (FPs/GPs) and general internists per population in Pennsylvania health service areas (HSAs). Note that in areas where the availability of family physicians is greatest the rate of avoidable hospitalizations is lowest. No similar relationship is seen for general internists. AHC denotes avoidable hospitalization condition.
– – – –General internists per 10,000 population
———FPs/GPs per 10,000 population
*Represents general internists per HSA
•Represents FPs/GPs per HSA

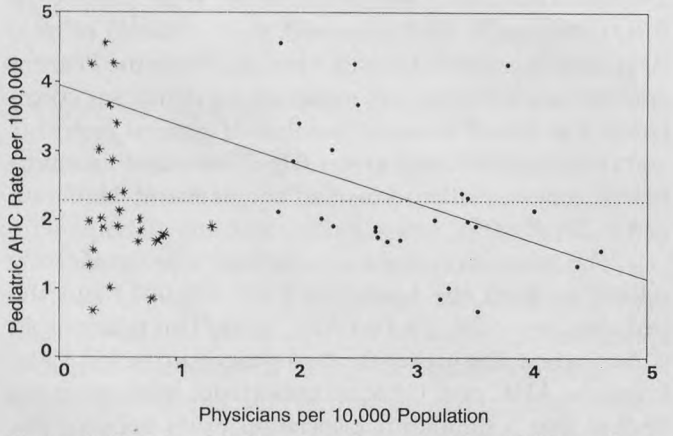

Figure 2. Relationship between the rates of avoidable pediatric hospitalizations for two conditions (diabetes mellitus and pneumonia) and the number of family physicians/general practitioners (FPs/GPs) and pediatricians per population in Pennsylvania health service areas (HSAs). As the concentration of FPs/GPs increases, the rate of avoidable hospitalizations declines. No such relationship is seen for pediatricians. AHC denotes avoidable hospitalization condition.
– – – –Pediatricians per 10,000 population
———FPs/GPs per 10,000 population
*Represents pediatricians per HSA
•Represents FPs/GPs per HSA

Table 3. Regression Analysis of the Relation Between Family Physician/General Practitioner (FP/GP) Availability and Avoidable Hospitalization Condition (AHC) Rates, Controlling for Income, in 26 Health Service Areas in Pennsylvania

Variable	Degree of Freedom	Coefficient	Standard Error	*P* Value	Partial R^{2}*
Intercept	1	47.49	5.71	<.001	
FP/GP	1	−2.75	0.99	.0108	0.1460
Income†	1	−1.52	0.39	<.001	0.4176

NOTE: Dependent variable: total adult and pediatric AHC rate.
**Adjusted model R^{2}=.5257.*
†Per capita income reported in $1000s.

Regression Analysis

A regression equation was used to determine whether the relationship between family physicians and AHC rates remained significant after controlling for the effect of income (Table 3). Even after controlling for income, the variation in the number of FPs/GPs explains a significant amount of the variation in AHC rates. The coefficient on the FP/GP variable suggests that an increase of one FP/GP per 10,000 population in an HSA results in a reduction of 2.75 (95% confidence interval [CI] = −4.79 to −0.69) AHC admissions per 100,000 population. The variation in the number of FPs/GPs per 10,000 population and per capita income together explain over 50% of the variation in AHC rates among HSAs in Pennsylvania.

Discussion

A central component of many current health care reform proposals is the use of primary care physicians as gatekeepers to the delivery system in an attempt to control costs. This study presents evidence that access to family and general practice physicians is associated with lower rates of hospitalizations for certain conditions. This relationship remains even when controlling for the effect of income.

Our results are consistent with those of other studies that suggest a relationship between the availability of primary care providers and health care outcomes. Farmer and colleagues[22] found a relationship between primary care availability and mortality in county groups within the contiguous United States. Shi[23] found a relationship between the availability of primary care physicians and other measures of health status as measured by overall and disease-specific mortality rates and life expectancy. Our findings also support earlier research that found a significant relationship between level of income and rate of hospitalizations for AHCs.[17,18]

Two methods of calculating AHC rates are described in the literature. Weissman and colleagues[13] defined an

adjusted relative rate by dividing the age- and sex-standardized AHC rate by the rate of hospitalizations for all other conditions. They considered all other admissions to represent conditions that were not sensitive to ambulatory care. The second approach, used by Billings and colleagues[17] and the Institute of Medicine,[18] calculated the rate of admissions for AHCs by dividing the number of AHC admissions for a given small area by the population of that area after adjusting for age and sex. We prefer the second approach because the AHC rate does not depend on variations in hospital utilization for unavoidable hospital conditions among the health service areas. For example, it is possible that the observed variation in an adjusted relative rate such as that used by Weissman et al[13] might be related to variation in admissions for unavoidable elective hospitalizations. By using only the conditions that were first subjected to a rigorous medical review and then found to be sensitive to financial or insurance status, we believe that we have identified a core group of diagnoses for which timely and effective ambulatory care may to some degree alter the disease course and thereby avoid hospitalization. Even so, it should be noted that only some undefined portion of these admissions were truly "avoidable"; some might have resulted in an admission even if optimal ambulatory care had been administered.

Several possible explanations exist for the lack of significant correlations between the numbers of internists and pediatricians and AHC rates. First, the physician specialty data in the Area Resource File are based on physician self-report from the Physician Masterfile database of the American Medical Association. Physicians are allowed to report up to three specialties. It is possible that a general internist reported a specialty of cardiology, resulting in a measurement bias.

Second, although the type of care delivered by general internists and general pediatricians is considered primary care, it is possible that these physicians may not be sufficiently distributed outside large population centers to have a significant impact on AHC rates across all HSAs in the state.[24] Other studies have found that only family physicians and general practice physicians are distributed in both rural and urban areas in proportions similar to those of the overall population.[25] Our study showed that the number of family physicians was not significantly correlated with population or income, whereas general internists and pediatricians resided in areas with greater population and higher income.

Apart from the issue of distribution according to population, previous research indicates that, compared with board-certified pediatricians, internists, and physicians of other specialties, family physicians are less likely to require appointments for visits; more likely to have office hours during weekends; more likely to report that they make house calls, emergency department visits, and nursing home visits; and more likely to have offices that are more geographically accessible to patients.[26–28]

Although these data support the conclusion that the availability of FPs/GPs is related to lower AHC rates, other factors might affect the AHC rate. These include quality of patient care delivered in the ambulatory setting, availability of nonphysician providers, prevalence of a given avoidable hospital condition in each HSA, and the number of admissions that were truly "avoidable."[29] The quality-of-care concept may also include variation in physician practice patterns in admitting for these conditions. It has been suggested that variation in physician practice patterns may contribute heavily to small-area variation in health care utilization, such as admissions to the hospital.[30] It is also possible that other health care providers, such as nurse practitioners and physician assistants, deliver primary care services that lower the AHC rate. Our data did not allow for evaluating the effect of these factors.

Billings and co-workers[17] used the National Health Interview Study for two high-volume AHCs, asthma and diabetes mellitus, to explore the issue of disease prevalence, or "burden of illness," within a population and its relationship to variation of AHC rates. They found that disease prevalence was very similar in low- and high-income groups, and therefore concluded that it accounts for only a small proportion of the difference in hospitalization rates between low- and high-income populations. We believe this conclusion is applicable to Pennsylvania.

As we contemplate the structure of a new health care delivery system, these issues deserve to be addressed. Several questions remain that can be answered only by additional research. First, are our findings in Pennsylvania representative of other areas of the country? Second, what proportion of the persons admitted for AHCs were under the care of a physician and thus represent unavoidable hospitalizations or poor-quality outpatient care? Finally, what is the cost of providing additional primary care services to an area, and would that cost offset the benefit of reducing avoidable hospitalizations?

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JFP Journal Club

AVOIDABLE HOSPITALIZATIONS

TITLE: Primary care physicians and avoidable hospitalizations
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Background. Access to health care and its relationship to variations in health care utilization are two of the most important forces driving health care reform efforts. Inadequate access to health care is linked to a variety of poor health outcomes, including delays in seeking care, poorer quality of life indicators, and higher morbidity and mortality.[1–3] The role of primary care physicians in improving patients' access to health care is a key component underlying virtually all health care reform measures. Health services research that examines such issues will inform these reform efforts.

Clinical question. Do more primary care physicians in a population lead to improved access to health care as measured by the avoidable hospital condition (AHC) rate of the population? (AHC is defined as the admission rate [number of admissions per 100,000 population] for diagnoses for which hospitalization could have been prevented with appropriate ambulatory care.)

Population studied. The population studied included all short-term, hospitalized patients discharged from general, acute care hospitals in Pennsylvania in 1989. The physician population included all nonfederal primary care physicians (general internists, pediatricians, and family practice physicians) practicing in Pennsylvania in 1989.

Study design and validity. This study was a cross-sectional, correlational study. The units of analysis were health service areas, defined as one or two counties that are relatively self-contained with regard to where most hospital care is provided. The 67 counties of Pennsylvania were divided into 26 health service areas, and AHC rates were calculated for each area along with the number of primary care physicians/10,000 population. There are many potential biases that could influence the outcomes of this study, including (1) a selection bias in choosing which AHCs to include for study; and (2) critical measurement issues regarding the quality of the Pennsylvania hospitalized patient database, the coding accuracy of the diagnosis-related groups (DRGs), and the accuracy of the county-level health and physician data. The authors did a nice job of distinguishing between a patient's county of residence and county of hospitalization; they applied the AHC rate to the patient's county of residence, a more appropriate measure of access to care and its relationship to the presence or absence of primary care physicians in that county.

Outcomes measured. The avoidable hospital conditions calculated for each health service area examined included: angina pectoris, congestive heart failure, hypertension, pneumonia, asthma, and diabetes mellitus. For pneumonia and asthma, both an adult and a pediatric AHC rate were calculated.

Results. There was substantial variation in the AHC rates for each of the index conditions as well as the total AHC rate across all 26 health service areas. The total AHC rates ranged from 8.9/100,000 to 28.6/100,000. The AHC rate was highest for congestive heart failure (mean 3.8/100,000) and lowest for hypertension (mean 0.4/100,000). The authors also noted that there was substantial variation in the total number of physicians within each health service area, with a range of 4.1/10,000 to 28.6/10,000. A lower AHC rate was significantly correlated with higher per capita income and a higher number of family physicians and general practitioners in a health service area, but not with the number of general pediatricians or internists. Other potential factors relating to the AHC rate, such as the number of nurse practitioners in each health service area, were not measured.

Recommendations. Because of the cross-sectional nature of this study, it is impossible to say that simply having more family physicians in a health service area will result in fewer hospitalizations; nor does the study compare alternative ways of lowering unnecessary hospitalization related to inadequate access to health care. For instance, this study suggests that improved overall population income and less poverty would lead to much greater access to health care than would an increase in the number of family physicians in a community. Also, despite the variation in AHC rates, this study cannot assess the optimal AHC rate for a given condition, suggesting that at some time in the future (perhaps in a future managed care scenario), too low an AHC rate might reflect lower qual-

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ity care. Despite these comments, this research is critically important to family medicine educators, leaders, and other policymakers who are making decisions about allocation of limited health care resources.

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BLOOD GLUCOSE MONITORING

TITLE: Home blood glucose monitoring: effectiveness in a general population of patients who have non–insulin-dependent diabetes mellitus
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Background. Significant controversy exists over how intensively to monitor blood glucose in patients with diabetes mellitus. A recent publication by the Diabetes Control and Complications Trial Research Group on the effects of intensive insulin treatment on outcomes in patients with insulin-dependent diabetes has led many physicians to recommend more intensive blood glucose monitoring for all diabetic patients.[1,2] Unfortunately, the benefits of intensive insulin regimens may come at an unacceptable price, including the cost of treatment, an increase in hypoglycemic episodes, potential negative changes in quality of life, and the lack of feasibility of implementing such regimens in standard clinical practice. More important, it is unknown to what extent the results from studies of insulin-dependent diabetic patients should be used as a basis for therapeutic decisions about patients with non–insulin-dependent diabetes, who comprise by far the largest group of diabetic patients. Some research suggests that home glucose monitoring in patients with non–insulin-dependent diabetes as compared with other modalities, such as urine monitoring, does not result in improved outcomes.[3]

Clinical question. Does home blood glucose monitoring used by non–insulin-dependent diabetic patients improve diabetes control?

Population studied. The population studied included 229 non–insulin-dependent diabetic patients who were followed in the outpatient clinics of the Denver Veterans Affairs Medical Center. Patients were predominantly male (97%), white (68%), and under the care of primary care clinicians (43% staff internists, 40% nurse practitioners, and 15% residents).

Study design and validity. The study was a retrospective chart review. Patients were identified from computerized pharmacy profiles, and a random selection of patients for whom glucose-monitoring supplies were prescribed were selected for review. Inclusion and exclusion criteria were adequately defined, as were case definitions and outcomes. Chart reviewers were not blinded to the purpose of the study, nor was there any attempt to measure the thoroughness or accuracy of chart abstractions.

Outcomes measured. Demographic information collected included age, type of diabetes, and diabetic complications, such as neuropathy, retinopathy, nephropathy, and peripheral vascular disease. Outcome measures included the mean HbA_{1c}, the frequency of laboratory utilization, and the frequency with which home blood glucose monitoring supplies were dispensed. Data were collected for 1 year.

Results. Diabetic complications were relatively frequent in the group, with 51% of the patients having at least one complication. Seventy-nine percent of the patients used home blood glucose monitoring, and the remaining 21% used urine glucose monitoring instead. Patients with diabetic complications were more likely to be using home glucose monitoring (85% vs 74%). There was no difference in glycemic control as assessed by the HbA_{1c} between the groups (11.4% vs 11.3%), regardless of when HbA_{1c} monitoring was begun. There was also no difference in the HbA_{1c} between those who monitored their blood glucose once a day and those who monitored it two or more times a day (11.6% vs 11.1%). Patients taking insulin who had their doses changed in response to home blood glucose monitoring also did not have improved glycemic control. There was also no decrease in laboratory utilization among those using home blood glucose monitoring.

Recommendations for clinical practice. Despite controlled trials of intensive insulin treatment in patients with insulin-dependent diabetes, clinicians can remain justifiably ambivalent about applying such results universally to their

non–insulin-dependent diabetic patients. In the absence of good data demonstrating a reduction in complications and improvement in glycemic control and quality-of-life indicators, or a reduction in health care utilization with the use of home blood glucose monitoring, a variety of treatment and monitoring regimens remain appropriate.

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