Association Between Number of Physician Visits and Influenza Vaccination Coverage Among Diabetic Adults With Access to Care

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OBJECTIVE — The proportion of diabetic adults that receives the influenza vaccine is less than ideal. This study determined the relationship between the number of physician visits in the previous 12 months and the likelihood of influenza vaccination among diabetic adults with access to care.

RESEARCH DESIGN AND METHODS — Data on 1,807 diabetic adults with access to care in the 1999 National Health Interview Survey (NHIS) were analyzed. Prevalence of influenza vaccination was determined by number of physician visits. Logistic regression was used to determine the independent association between number of physician visits and influenza vaccination coverage, controlling for age, sex, race/ethnicity, education, income, employment census region, and comorbidity. STATA was used for analyses to account for the complex sampling design of NHIS.

RESULTS — Overall, 56% of subjects received the influenza vaccine. Proportions vaccinated by number of physician visits were as follows: 35% (no visit), 47% (1–3 visits), 58% (4–9 visits), and 61% (≥10 visits). Compared with people with no physician visit, people with 4–9 visits (odds ratio [OR] 2.61) and ≥10 visits (2.96) were significantly more likely to be vaccinated. However, after controlling for covariates, only people with ≥10 visits (2.34) were significantly more likely to be vaccinated.

CONCLUSIONS — In this nationally representative sample, repeated physician visits by diabetic adults with access to care were associated with only modest increases in influenza vaccination coverage. In adjusted analysis, odds of influenza vaccination were not significantly associated with number of physician visits, except in people with ≥10 visits.

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Diabetes is a chronic debilitating illness that affects ~17 million people in the U.S. Diabetes is the seventh leading cause of death in the U.S., and it is associated with considerable morbidity, mortality, and health care cost (1). Like diabetes, influenza is one of the top 10 leading causes of death and the leading cause of vaccine-preventable deaths in the U.S. (2). Aside from causing 20,000 deaths annually, influenza is responsible for nearly 114,000 hospitalizations each year, and it is a significant contributor to lost productivity and increased health care costs (3,4).

Individuals with diabetes are particularly susceptible to influenza (4), and studies show that people with diabetes have higher hospitalization rates, higher morbidity, and higher mortality from influenza and its complications compared with people without diabetes (5–8). The influenza vaccine is safe and cost-effective for preventing influenza and its associated complications (6,9,10). Consequently, the Advisory Committee on Immunization Practices (ACIP) (4) and the American Diabetes Association (ADA) (11) both recommend that beginning at 6 months of age, individuals with diabetes should receive the influenza vaccine each year during the influenza season (September to March). In addition, the Healthy People 2010 initiative (12) set minimum standards for influenza vaccination coverage for high-risk individuals, such as people with diabetes, to insure adequate coverage. The goal is to routinely administer the influenza vaccine to 90% of diabetic adults aged ≥65 years and 60% of diabetic adults aged ≤64 years by the year 2010.

Primary care physicians (internal medicine, general medicine, and family care) play a crucial role in attaining the immunization objectives of Healthy People 2010 for adults with diabetes for various reasons. First, primary care physicians treat most adults with diabetes (13). Second, data suggest that individuals with access to a regular primary care provider are more likely to receive essential components of diabetes care, including preventive care services (14). Third, there is evidence that primary care physicians exert a strong influence on a patient's decision to accept immunization and that a primary care visit within the past year significantly increases the odds of vaccination (15–18).

Because the ADA recommends that

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Abbreviations: ACIP, Advisory Committee on Immunization Practices; ADA, American Diabetes Association; NHIS, National Health Interview Survey.

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A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

glycemic control monitored by the HbA_{1c} test should be done approximately twice a year for patients with good glycemic control and approximately four times a year for those with poor glycemic control (11), most patients with diabetes are typically evaluated two to four times a year by primary care physicians. Administration of the influenza vaccine is typically incorporated into those primary care visits. However, several studies have shown that a significant proportion of adults with diabetes do not receive the influenza vaccine despite having primary care visits in the previous 12 months (19–21).

Thus, it is unclear how well administration of the influenza vaccine is incorporated into routine physician visits and whether the number of visits to a physician is significantly associated with the likelihood of influenza vaccination in adults with diabetes. For instance, it is unclear how influenza vaccination coverage for patients with potentially good glycemic control who may be seen only twice a year compares with those of patients with potentially poor glycemic control who may be seen four or more times a year.

Therefore, the purpose of this study was to determine the extent to which the number of physician visits in the previous 12 months was independently associated with the odds of influenza vaccination among diabetic adults with access to care. This study used nationally representative data to provide answers to two important questions: *1*) Among individuals with diabetes who had access to care, did influenza vaccination coverage differ significantly by the number of physician visits? and 2) Controlling for demographic and socioeconomic characteristics and comorbidity, was the number of physician visits independently associated with influenza vaccination among diabetic adults with access to care?

It was hypothesized that after controlling for demographic and socioeconomic factors, as well as comorbidity, having multiple physician visits would not be significantly associated with influenza vaccination among diabetic adults with access to care.

RESEARCH DESIGN AND METHODS

— This cross-sectional study comprised 1,807 civilian noninstitutionalized diabetic adults with access to care in the U.S. in 1999. The analyses were performed on data from the sample adult core of the 1999 National Health Interview Survey (NHIS) (22). The NHIS is a national household survey of nonmilitary and noninstitutionalized individuals in the U.S. The sample adult core consists of a random sample of adults aged ≥18 years. The sample is selected by a complex sampling design that involves stratification, clustering, and multistage sampling with a nonzero probability of selection for each person. Final weights are constructed to reflect the unequal probability of selection, adjust for nonresponse, and adjust for poststratification. In addition, the final weights are constructed to reflect the adult civilian population of the U.S. in 1999. Details about the methodology of the 1999 NHIS are described elsewhere (22,23).

Access to care

The NHIS used a series of questions to identify individuals with access to care. These included questions such as "Is there a place you usually go to when you are sick or need advice about your health?", "What kind of place is it—a clinic, doctor's office, emergency room, or some other place?", "What kind of place do you usually go to when you need routine or preventive care such as a physical examination or check up?", and "What kind of health professional do you usually see—a doctor or nurse or some other health professional?" In addition, respondents were asked, "During the past 12 months, have you seen or talked to any of the following health care providers about your own health?. . . A general doctor who treats a variety of illnesses (a doctor in general practice, family medicine, or internal medicine)." The NHIS created a summary access-to-care variable with three catagories: *1*) adults with a single usual source of medical care, *2*) adults with no known single usual source of medical care, and *3*) undefined. For this study, access to care was defined as having a single usual source of medical care. Additional access-to-care variables included seeing a particular health professional for care (yes versus no), type of health professional usually seen for care in the past 12 months (physician versus nonphysician), and type of physician seen in the previous 12 months (primary care, yes versus no).

Demographic characteristics

Age was categorized as 18–64 years and ≥65 years. Four racial/ethnic groups (non-Hispanic white, non-Hispanic black, Hispanic, and non-Hispanic other) defined by the NHIS were included. Education was categorized as less than high school graduate and high school graduate or higher. Household income was defined as a percentage of the federal poverty level and categorized as <200, 200–399, and ≥400%. Adults who reported having a job or business in the past 12 months were considered employed. Census region as defined by the NHIS (northeast, midwest, south, and west) was used for this analysis.

Diabetes status

An individual was assumed to have diabetes if they reported that a doctor or health professional told them that they had diabetes (excluding gestational diabetes).

Comorbidity

Respondents were classified as having an additional comorbid condition if they reported being diagnosed with any of the following chronic medical conditions: coronary heart disease, heart failure, chronic obstructive pulmonary disease, stroke, end-stage renal failure, chronic liver disease, or cancer. These comorbid conditions were selected because of the likely effect of increasing the number of visits to physicians and likelihood of influenza vaccination.

Influenza vaccination

An individual was deemed to have received the influenza vaccine if they reported that they received the flu shot in the past 12 months.

Number of physician visits

Respondents were asked, "During the past 12 months, how many times have you seen a doctor or other health professional about your own health at a doctor's office, a clinic, or some other place? Do not include times you were hospitalized overnight, visits to hospital emergency rooms, home visits, or telephone calls." Four categories of total number of physician visits were created and used for the analysis: none (0 visits), low (1–3 visits), medium (4–9 visits), and high (≥10 visits). Within each category of physician visits, the proportion of respondents that

Table 1—*Characteristics of diabetic adults with access to care in the United States, 1999 (n = 1,807, N = 10,428,650)*

	Percent	SE
Age ≥65 years	40.5	0.013
Sex (women)	52.7	0.014
Race/ethnicity		
White	68.7	0.013
Black	16.3	0.010
Hispanic	11.4	0.008
Other	3.6	0.006
Education		
Less than high school graduate	29.2	0.012
Household income (% federal poverty level)		
≥400%	29.2	0.014
200–399%	34.1	0.014
<200%	36.7	0.015
Employed in the past 12 months	43.5	0.013
Census region		
Northeast	21.1	0.012
Midwest	24.3	0.014
South	38.2	0.014
West	16.4	0.009
≥1 comorbid condition	75.5	0.012
Sees a particular health professional for care	91.6	0.007
Type of health professional seen (physician)	98.6	0.003
Number of physician visits		
0	3.1	0.005
1–3	20.4	0.011
4–9	40.5	0.014
≥10	36.0	0.013
Proportion of physician visits that included primary care visits		
All visits (≥1)	87.8	0.910
1–3	82.8	2.260
4–9	88.1	1.460
≥10	90.1	1.280

Comorbid conditions include coronary heart disease, heart failure, chronic obstructive pulmonary disease, stroke, end-stage renal failure, chronic liver disease, or cancer. Primary care physician includes general practitioner, family physician, or internist. *n*, unweighted sample; *N*, weighted sample to reflect the U.S. population in 1999; percent, weighted sample percent.

reported seeing a primary care physician in the previous 12 months was identified, which made it possible to determine the proportion of physician visits that included visits to primary care physicians.

Statistical analyses

STATA (24) was used for hypothesis testing and to generate population estimates that were weighted for the U.S. population in 1999 while accounting for the complex sampling design of NHIS. Three levels of analysis were performed. First, the characteristics of the study population and the proportion that received the influenza vaccine were defined. Second, among diabetic individuals with access to care, the prevalence of influenza vaccination was determined across physician visit categories and other individual characteristics using χ^2 statistics. Statistical significance was set at two-tailed $\alpha < 0.05$. Third, the association between number of physician visits and influenza vaccination coverage was determined using logistic regression. In the unadjusted logistic regression model, receipt of the influenza vaccine (yes versus no) was entered as the dependent variable and number of physician visits was entered as the independent variable. For the adjusted logistic model, receipt of the influenza vaccine (yes versus no) was entered as the dependent variable and number of physician visits was entered as the independent variable while controlling for known confounders, including age, sex, race/ethnicity, education, income, employment, census region, and comorbidity. ORs and 95% CIs were determined for each model.

RESULTS — In 1999, 30,801 adults were interviewed as part of the NHIS, which represented a final response rate of 70%. Of this number, 1,870 had diabetes. Among adults with diabetes, 1,807 had access to care (96.6%), of whom 56.4% reported receiving the influenza vaccine in the prior 12 months. Extrapolating to the 1999 population, there were ~10.4 million diabetic adults in the U.S. in 1999, of whom only ~5.8 million received the influenza vaccine.

Population characteristics

Table 1 shows the characteristics of diabetic adults with access to care in the U.S. in 1999. Of these participants, ~41% were ≥65 years of age, 53% were women, 69% were white, 29% had less than a high school education, and 37% had household incomes <200% of the federal poverty level. Approximately 44% of subjects were employed, 76% had at least one additional chronic medical condition, and ~41% had between four and nine physician visits in the previous year. About 92% reported seeing a particular health professional for usual care, 98% of whom were physicians. In addition, for each category of physician visit, ~82–90% of the visits included visits to primary care physicians.

Bivariate analyses

Table 2 shows the prevalence of influenza vaccination by individual characteristics among diabetic adults with access to care. The elderly, whites, the unemployed, people who lived in the western U.S., and those with comorbid conditions had higher prevalence of influenza vaccination. Among diabetic adults with access to care, those with one or more physician visits had higher prevalence of influenza vaccination than those with no physician visit. Figure 1 shows the relationship between number of physician visits and influenza vaccination coverage among diabetic adults with access to care.

Multivariate analyses

Table 3 shows unadjusted and adjusted odds of influenza vaccination by number

Table 2—*Prevalence of influenza vaccination by individual characteristics among diabetic adults with access to care*

	Percent vaccinated	SE	*P*
Age			<0.0001
≥65 years	73.4	1.62	
18–64 years	44.9	1.79	
Sex			0.3511
Women	55.2	1.79	
Men	57.9	2.00	
Race/ethnicity			<0.0001
White	60.6	1.54	
Black	42.0	2.84	
Hispanic	51.8	3.54	
Other	55.4	7.46	
Education			0.5974
Less than high school graduate	57.4	2.12	
High school graduate or more	55.9	1.61	
Household income (% federal poverty level)			0.0745
≥400%	60.9	2.99	
200–399%	53.7	2.52	
<200%	53.3	2.10	
Employed in the past 12 months			<0.0001
Yes	45.7	2.10	
No	64.7	1.71	
Census region			0.0199
Northeast	55.1	2.93	
Midwest	59.2	2.78	
South	52.5	1.71	
West	63.3	2.91	
≥1 comorbid condition			<0.0001
Yes	60.8	1.48	
No	42.9	2.69	
Number of physician visits			0.0001
0	34.9	7.80	
1–3	47.2	2.92	
4–9	58.3	2.18	
≥10	61.3	2.15	

Comorbid conditions include coronary heart disease, heart failure, chronic obstructive pulmonary disease, stroke, end-stage renal failure, chronic liver disease, or cancer. Percent, weighted sample percent.

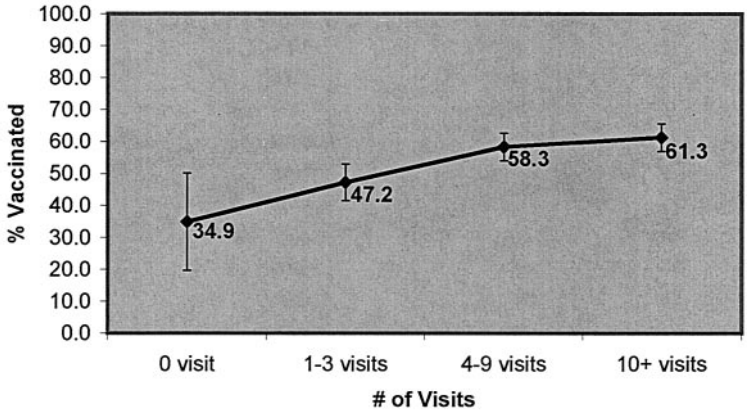

Figure 1—*Proportion of diabetic adults vaccinated by number of physician visits.*

of physician visits among diabetic adults with access to care. In the unadjusted model with no physician visit as reference, those with four or more visits were 2.6–3.0 times more likely to receive the influenza vaccine. After controlling for known confounders, only those with ≥10 physician visits were significantly more likely to receive the influenza vaccine compared with those with no physician visits.

CONCLUSIONS — The major findings of this study were that repeated physician visits were associated with only modest increases in influenza vaccination coverage among diabetic adults with access to care and that the likelihood of influenza vaccination was not significantly associated with the number of physician visits, except among diabetic adults with ≥10 physician visits.

In this study, the proportion of diabetic adults with access to care who received the influenza vaccine ranged from ~35% for people with no physician visit in the prior 12 months to 61% for those with ≥10 visits. Approximately one-third of diabetic adults that did not visit a physician in the previous 12 months still received the influenza vaccine, suggesting that campaigns to increase influenza vaccine administration in nontraditional health care settings may be effective and need to continue (19,25). On the contrary, less than two-thirds of diabetic patients who had an encounter with a physician received the influenza vaccine. This is a significant deviation from the ACIP recommendation (4) that physician-patient encounters should be seen as opportunities for influenza vaccination.

Specifically, it appears that there are several missed opportunities for administering the influenza vaccine in primary care settings because across the categories of physician visits, 82–90% of the visits included visits to primary care physicians. This means that even if most diabetic adults visited a physician up to 10 times in a given 12-month period, a substantial number of them (~39%) would still not receive the influenza vaccine. In addition, this challenges the validity of two commonly cited reasons for nonvaccination, including patient visits outside the influenza season and vaccine scarcity. It seems unlikely that diabetic adults who had ≥10 physician visits made all of those visits outside the influenza season or during

Table 3—*Unadjusted and adjusted odds of influenza vaccination by number of physician visits among diabetic adults with access to care*

Number of physician visits	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
0 (Reference)	1.00	1.00
1–3	1.67 (0.81–3.45)	1.44 (0.61–3.41)
4–9	2.61 (1.29–5.28)*	1.98 (0.83–4.71)
≥10	2.96 (1.45–6.03)*	2.34 (1.00–5.49)*

Unadjusted model: influenza vaccination by number of physician visits. Adjusted model: influenza vaccination by number of physician visits controlling for age, sex, race/ethnicity, education, income, employment, census region and comorbidity. Comorbid conditions include coronary heart disease, heart failure, chronic obstructive pulmonary disease, stroke, end-stage renal failure, chronic liver disease, or cancer. *Statistically significant OR at $P < 0.05$.

periods of vaccine scarcity. Therefore, it is most likely that those visits represent missed opportunities to administer the influenza vaccine.

Another reason typically given for nonvaccination is patient refusal. However, studies (15,16) have shown that primary care physicians play a critical role in influencing a patient's decision to receive the influenza vaccine. In addition, studies that have examined the rates of patient refusal of the influenza vaccine (18,26,27) show that only a small proportion of patients (15–25%) for whom a physician recommended the influenza vaccine refused it. Therefore, it seems unlikely that the 35–53% nonvaccination rates seen in this study were solely due to patient refusal.

An additional finding of importance was the significant regional variation in influenza vaccination coverage in this population. A significantly higher proportion of diabetic adults that resided in the western U.S. received the influenza vaccine compared with those that resided in other regions of the country. Similar regional differences in influenza vaccination coverage have been previously reported in the general population (28) and among adults with diabetes (19). In the general population, yearly variation in influenza vaccination coverage in the different states ranged from 30–66% in 1993 to 45–70% in 1995 and to 54–74% in 1997 (28).

Similarly, influenza vaccination coverage for adults with diabetes varied across states in 1997, ranging from 29% in Puerto Rico to 80% in Maine (19). Multiple factors probably account for these state and regional differences, including physician practice patterns, provision of public health adult vaccination programs, and patient attitudes and access to care (28). However, in this population with access to care, these regional variations in vaccination coverage are most likely due to inconsistent implementation of evidence-based guidelines. Therefore, strategies to improve the adoption of the ACIP guidelines (4) and Healthy People 2010 (12) goals for influenza vaccination need to be better implemented. This is an area where aggressive provider education by the Centers for Disease Control and Prevention through its state-based diabetes-control programs, the ADA, and professional physician associations can have tremendous impact.

The major implication of this study is that missed influenza vaccination opportunities for diabetic adults may become a major hindrance to attaining the goals of Healthy People 2010 if it is not urgently addressed. Although current efforts, such as the educational programs implemented by the Centers for Disease Control and Prevention (19), the decision to reimburse the cost of the influenza vaccine and its administration for adults aged ≥65 years by Medicare (28), and the increased availability of influenza vaccines outside physician offices in places like nursing homes and assisted-living facilities (25) are laudable, more work still needs to be done. There is a dire need to widely implement evidence-based strategies that have been shown to be effective in primary care, such as the use of standing orders and provider and patient reminders during the influenza season (29), to minimize missed vaccination opportunities in primary care settings.

It is important that the use of standing orders that authorize nurses and pharmacists to administer vaccinations according to an institution- or physician-approved protocol without a physician's exam should be widely adopted in primary care (25). In addition, the widespread implementation of provider reminder or recall systems, which inform the physician that individual patients are either due (reminder) or overdue (recall) for immunization (29), are needed. Finally, physician practices and primary care clinics need to be able to identify diabetic adults and contact them during the influenza season to increase vaccination coverage in this high-risk group. These strategies can easily be implemented in a variety of settings, from clinical settings with sophisticated electronic medical systems to those with simple paper charts.

The results of this study are subject to some limitations. First, it is possible that a proportion of these visits were made to non–primary care physicians who are typically not expected to provide preventive care services. However, the fact that >80% of physician visits across the different visit categories (0, 1–3, 4–9, and ≥10) included a visit to a primary care physician indicates that a significant proportion of missed opportunities for influenza vaccination occur in primary care settings. Second, a valid medical reason such as adverse drug reactions could have prevented the administration of the influenza vaccine. This is unlikely to play a significant role because evidence shows that life-threatening reactions to the influenza vaccine are rare (4). Third, patient refusal may have contributed to nonvaccination. However, as suggested previously, it is unlikely that patient refusal contributed to such high levels of nonvaccination (18,26,27). Finally, recall bias is another possible reason for the high levels of nonvaccination. This reason also inadequately explains the low influenza vaccination coverage levels in this study because it is established that self-reports of influenza vaccination are reliable (30).

In conclusion, in this nationally representative sample of diabetic adults with access to care, repeated physician visits were associated with only modest increases in influenza vaccination coverage and the odds of influenza vaccination was not significantly associated with the number of physician visits, except among diabetic adults with ≥10 visits.

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