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ORIGINAL RESEARCH

Targeting Diabetes Preventive Care Programs: Insights From the 2001 Behavioral Risk Factor Surveillance Survey

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Abstract

Introduction

Many individuals with diabetes do not receive flu or pneumonia vaccinations or dilated eye exams, despite the documented efficacy of these practices. Understanding the individual factors associated with not receiving recommended vaccinations and exams is essential to developing effective targeted promotional programs.

Methods

Data from the 2001 Behavioral Risk Factor Surveillance Survey were analyzed to identify predictors of failure to report flu and pneumonia vaccinations and dilated eye exams. Key predictors included indicators of disease severity, access to care, and demographic characteristics.

Results

Significant factors varied by vaccination. For all 3 practices, failure to receive was associated with being younger, being a member of an ethnic minority group, having had no diabetes education, not taking insulin, and engaging in fewer prevention practices requiring physician contact. Other salient characteristics included having no health insurance, having less education, and reporting good general health.

Conclusion

Promotional programs should be tailored for younger, minority patients, and those messages should encourage preventive care despite general good health or less severe disease. Indirect methods of promotion may include participation in diabetes education programs and regular contact with physicians. Additionally, health care professionals may be appropriate target groups for preventive care campaigns.

Introduction

Annual vaccinations for influenza, lifetime vaccination for pneumonia, regular foot and dilated eye exams, and maintenance of tight glycemic control through self-monitoring of blood glucose levels and periodic HbA1c testing are all recognized means of preventing serious complications and potential mortality associated with diabetes (1-3). The Centers for Disease Control and Prevention (CDC) and the American Diabetes Association currently recommend that adults with diabetes receive the following: 1) an annual test for the presence of microalbuminuria; 2) an annual dilated eye examination; 3) an annual flu vaccination; 4) at least one lifetime pneumococcal vaccination, with revaccination recommended for individuals ages 65 years and older; 5) a visual inspection of feet at each routine visit and an annual comprehensive foot examination; and 6) HbA1c testing at least twice a year (3). These organizations, along with other local, state, and national partners throughout the nation, have worked extensively with providers and patients to promote guideline-concordant care, including educational efforts such as the National Diabetes Education Program (4). Recent comparisons of reports from individuals with diabetes in the 1995 and 2001 Behavioral Risk Factor Surveillance Surveys

(BRFSS) have indicated increased proportions of individuals reporting that they obtained the recommended vaccinations and exams, suggesting that the combined efforts of these partners may be producing some successes (5). For example, the proportion of individuals with diabetes who reported having had a flu vaccination within the past 12 months increased by 14% — from 38% in 1995 to 43.5% in 2001. In addition, the proportion who reported ever having had a pneumonia vaccination increased nearly 75% — from 20% in 1995 to 35% in 2001 (5). Similarly, the proportion who reported receiving dilated eye exams rose 12% over the same period, as did the proportion of individuals reporting professional foot exams (11%) (5).

However, despite these improvements, many individuals with diabetes still fail to follow the recommendations. In 2001, the CDC reported that nearly one half (46.5%) of individuals with diabetes had not received a flu vaccination in the past 12 months; just over half (54%) had not received the recommended pneumonia vaccination; and nearly one third (29%) had not received a dilated eye exam within the past 12 months (5). Subgroup analyses indicated the following: 1) whites were more likely than blacks or Hispanics to obtain vaccinations; 2) older individuals (aged 65 years or older) were more likely than younger individuals to obtain vaccinations; and 3) individuals with at least a high school education were more likely than individuals with lower levels of educational attainment to obtain vaccinations (5). It is likely, however, that these subgroups overlap in membership, making it difficult to determine the independent relationships between receipt of vaccinations and age, minority status, and educational level.

The analyses reported below were based on a hypothesis that multivariable models could be constructed to identify the characteristics most closely associated with failure to receive recommended preventive care, simultaneously taking into consideration other factors. A review of the literature related to health care utilization and preventive care indicated that, on average, males (6,7) and relatively healthier individuals (8,9) visit doctors less often than women and individuals who perceive their health status to be poor. In addition, individuals of color (10), individuals with fewer financial resources, including health insurance (8), and individuals residing in more urban areas (11) do not receive flu and other vaccinations as often as their counterparts do. Further, it was noted that individuals who participated in diabetes education programs utilized health care more effectively than individuals who did not participate in such programs (12). Thus, factors expected to show significant associations with a failure to receive preventive care in these analyses included younger age, male gender, minority racial/ethnic origin, lesser access to care, less utilization of care overall, and no diabetes education.

Methods

Data from the 2001 BRFSS public use data set were analyzed to address the research questions. The BRFSS is a telephone survey of the non-institutionalized population administered by 50 states, the District of Columbia, and 3 U.S. territories, in collaboration with the CDC (13). Households are selected within each state or territory so that respondents represent a probability sample of all households with telephones within the state (13). In 2001, interviews were conducted with a total of 212,510 individuals aged 18 years and older (14). State-specific response rates varied from 33.3% to 70.8%, with a median rate of 52.1% (5). Data are weighted after collection to reflect the age, sex, and racial/ethnic distributions within each state/territory.

The questionnaire includes core questions asked of all respondents in all states; the core question related to diabetes asks respondents if a doctor or other health professional has ever told them they have diabetes. States can select optional modules to provide additional detailed information about conditions or risk behaviors of special interest to the state. In 2001, all 54 states and territories administered the optional diabetes module. This module, administered only to individuals with a positive response to the core diabetes question, investigates diabetes history, insulin or oral medication use, physician contact, and completion of recommended care routines, including vaccinations, HbA1c testing, blood glucose checks, and foot and eye exams.

A nationwide total of 14,633 individuals indicated that they had been told they had diabetes (excluding women suffering from gestational diabetes only) and subsequently completed the optional diabetes questions. Analyses were completed using SAS Version 8.2© software with SUDAAN® to accommodate the complex sampling design. Selected outcome variables included having had a flu vaccination within the past 12 months, ever having had a pneumonia vaccination, and having had a dilated eye exam within the past 12 months. Other potential outcome

variables representing other preventive care practices (i.e., having had HbA1c testing within the past 12 months, performing routine self-checks of blood glucose, routinely checking one's feet, and having had a foot exam performed by a health professional) were not included so that analyses could be focused more specifically. Recommended vaccinations were chosen because obtaining vaccinations does not necessarily require financial resources — they may frequently be obtained through pharmacies or free clinics. A dilated eye exam was selected to represent a preventive care practice that requires a physician visit.

Key variables included the following: 1) age (18 to 44 years, 45 to 64 years, or 65 years and older); 2) taking insulin (yes or no); 3) insurance coverage (insured or uninsured); 4) education (lhigh school diploma or no high school diploma); 5) racial/ethnic origin (white or nonwhite); 6) gender (male or female); 7) general health status (excellent, very good, good/fair or poor); 8) participation in a diabetes education program (yes or no); 9) had at least one HbA1c test within past 12 months (yes or no); 10) had a foot exam done by a healthcare professional within the past 12 months (yes or no); 11) had been told diabetes had affected eyes (yes or no); 12) had flu vaccination within past 12 months (yes or no); 13) had ever had pneumonia vaccination (yes or no); and 14) had dilated eye exam within past 12 months (yes or no). Values for having had an HbA1c test, a professional foot exam, and a dilated eye exam were combined to create a variable summarizing completion of doctor-involved preventive care practices (logical range 0 to 3). A second summary variable, omitting the eye exam variable (logical range 0 to 2), was constructed for inclusion in analyses related to eye exam outcomes.

Logistic regression analyses modeled the likelihood of failing to receive each of the 3 preventive care practices under study: obtaining a dilated eye exam within the past 12 months, receiving a flu vaccination within the past 12 months, and ever receiving a pneumonia vaccination. Separate models were constructed for each of the 3 care practices using a 2-stage process. First, bivariate logistic models were constructed to identify characteristics significantly associated with the outcome variable. A multivariable logistic model was subsequently constructed, modeling the likelihood of failing to report the recommended practice and including as predictor variables those variables that yielded significant associations in bivariate analyses. All second-stage analyses modeling failure to obtain an eye exam were also adjusted for having been told diabetes had affected one's eyes.

Results

Sample Description

Table 1 presents characteristics of the sample, summarized for the overall sample and for gender and racial/ethnic groups. The sample included larger percentages of whites than nonwhites and slightly more females than males. Approximately half of the respondents were between 40 and 64 years of age; nearly one fourth had less than a high school education; one third had family incomes of less than $20,000 annually; and 10% were uninsured. Percentages of respondents in each of these 3 categories (low income, low educational attainment, uninsured) were greater among nonwhites than whites and among females than males. Greater percentages of nonwhites and women were unemployed as well.

Table 2 summarizes the proportions of individuals who received vaccinations or an eye exam by individual characteristics. Overall, fewer nonwhites, younger individuals, individuals with less education, those not taking insulin, uninsured individuals, and those who had not participated in a diabetes education program reported having received the recommended vaccinations or eye exams than their counterparts. Fewer males reported having received a pneumococcal vaccination, but the proportions of males and females receiving influenza vaccinations and eye exams were similar.

Flu Vaccination

Table 3 summarizes results of logistic regression analyses for failure to obtain a flu vaccination. Bivariate analyses indicated that younger age, being nonwhite, not having participated in a diabetes education program, not taking insulin, having no health plan, and engaging in fewer doctor-involved preventive care practices overall were significantly associated with failure to obtain a flu vaccination. Gender, education, and general health status were not significantly associated with the failure to obtain a flu vaccination. When all significant variables were included in a single logistic regression model, they were significantly associated with the failure to obtain a flu vaccination, although the strength of the individual associations was reduced by the adjustment for other factors.

Pneumonia Vaccinations

Similarly, bivariate analyses of factors associated with a failure to obtain a pneumonia vaccination indicated that all variables considered were significantly associated with failure to obtain the vaccination — younger age, male gender, being nonwhite, having less than a high school education, having a positive perception of overall health status, not having participated in a diabetes education program, not taking insulin, having no health plan, and engaging in fewer doctor-involved preventive care practices overall (Table 4). When these variables were included together in a single logistic regression model, having no health plan dropped out of the model, but all other variables maintained their association with the failure to obtain a pneumonia vaccination.

Dilated Eye Exams

Bivariate analyses of factors associated with failure to obtain a dilated eye exam indicated, after adjustment for having been told that diabetes had affected the eyes, that younger age, being nonwhite, having less than a high school education, having a positive perception of overall health status, not having had diabetes education, not taking insulin, having no health plan, and engaging in fewer doctor-involved preventive care practices overall (excluding eye exams) were significantly associated with failure to obtain an eye exam (Table 5). Only gender was not associated with the likelihood of failure to obtain an exam. When all significant variables were included in a single model, being nonwhite dropped out of the model, but all other variables maintained their associations. Having a positive perception of overall health was associated with a reduced likelihood of failing to obtain an eye exam (i.e., an increased likelihood of obtaining such an exam), and the direction and strength of this association was maintained after adjustment for other factors.

Discussion

These findings suggest that a multivariate approach may be useful in assessing the likelihood of obtaining recommended vaccinations and eye exams among individuals with diabetes. Being in a younger age group, having less severe disease (as indicated by not taking insulin), not having participated in a diabetes education program, and receiving fewer recommended exams involving a health care professional were consistently associated with not reporting the recommended vaccinations and eye exams. Other predictive factors included being nonwhite (flu and pneumonia vaccinations), being uninsured (flu vaccination and eye exams), being less educated (pneumonia vaccination and eye exam), and perceiving good overall health (pneumonia vaccination and eye exam). Except for the failure to find a consistent association between gender and failure to obtain preventive care, the results were consistent with the a priori hypotheses. These findings are consistent generally with those of previous investigations, which have found that, among individuals with diabetes, those who were older, white, and had more education were more likely to report having had the recommended vaccinations and eye exams (1,5,8,10,11). A literature review did not reveal, however, any other investigations that considered the various risk factors together. Buchwald and colleagues obtained similar findings when they investigated vaccination practices among Native American elders (8). Their results indicated that older individuals with Medicare and more health problems were more likely to receive flu and pneumococcal vaccinations (8).

These findings may provide guidance for programs aimed at increasing the percentages of individuals with diabetes who receive necessary preventive care. Effective culturally specific programs are already available to encourage preventive care among diabetics of diverse racial and ethnic origins (4,15-19), and these efforts should be continued and expanded. Programs that target young people with diabetes should be developed and tested as well. With the ongoing challenge of Type 1 diabetes and the growing prevalence of Type 2 diabetes among youth and young adults, this target group is increasingly important in preventing disease complications.

Programs encouraging preventive care should emphasize the need for preventive care regardless of general health status and severity of disease, countering possible perceptions that only seriously ill individuals need to receive vaccinations or eye exams. Media campaigns and other programs should deliver clear messages that vaccinations and dilated eye exams, along with regular foot exams and glycemic control, are essential to preventing or retarding disease progression and complications — that is, they are not activities reserved exclusively for individuals with advanced disease.

Lack of participation in a diabetes education program was associated with failure to obtain each of the 3 preventive practices; thus, diabetes education programs should be strongly promoted among all individuals with diabetes.

The Task Force on Community Preventive Services recently recommended that community-based self-management programs be provided to adults with Type 2 diabetes and that in-home programs be provided to children and adolescents with Type 1 diabetes (2). A key element of such programs is encouraging patients to be familiar with and request preventive care (4,20); recent investigations have documented the positive influence of patient requests on receiving tests, referrals, and medications (21).

Further, it may be helpful to encourage regular and routine involvement with health care professionals as an indirect means of promoting preventive care. The Task Force on Community Preventive Services has documented the efficacy of comprehensive disease management in preventing disease complications and comorbidities and has strongly recommended these training interventions for health care systems and providers (2). To the extent that health care providers are aware of and follow guidelines for diabetes care, regular contact with providers should increase the likelihood that preventive care practices will be recommended to patients by physicians. Since other investigators have found that physician recommendation is a key factor in the patient decision to obtain an influenza vaccination (22), it may also be useful to continue ensuring that providers of all types — such as primary and specialty care physicians, nurses, diabetes educators, and others — make guideline-concordant recommendations to their patients. It will also be important to work with both providers and patients to identify and remove barriers to access to care. Barriers include lack of awareness of need (23,24) and options (25) for receiving vaccinations; perceptions that vaccinations do not work or may make one sick (26); fear of diagnosis (27); and cost, including copays or failure of health insurance to pay for preventive care (27).

This investigation is subject to some important limitations. First, the findings reported here can only be considered representative of the large sample on which they were based and cannot necessarily be generalized to the population of individuals with diabetes overall. Second, because of the nature of the BRFSS, the sample does not include individuals living in households without telephones or relying solely on cellular telephones for communication. Third, the diabetes status of individuals is based solely on self-reported diagnoses; thus, only individuals with a memory of a diagnosis of diabetes are included in the sample, and those individuals who have not been diagnosed or do not remember the discussion with their physician are excluded from the sample. All information obtained within the interviews may be subject to recall errors or to the tendency of individuals to give socially desirable responses within interviews. Finally, a number of potentially important variables were not available within the data set and, thus, could not be included in the predictive models, particularly measures of barriers to obtaining care (e.g., cost; lack of access; and knowledge, attitudes, and beliefs about efficacy of preventive care).

Future investigations should be undertaken to validate the associations identified in this study by completing focus groups and more targeted surveys of individuals with diabetes. Information should be sought to identify the perceived or real barriers that may underlie the associations. Such information would be highly informative to future efforts to tailor educational and service programs for diabetes prevention and control.

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Table 1.
Characteristics of Individuals With Diabetes Responding to the 2001 Behavioral Risk Factor Surveillance Survey, Overall and by Gender and Race (%)

Characteristics	Overall (n= 14,633)	White (n= 10,105)*	Nonwhite (n= 4,337)*	Male (n= 6,053)	Female (n= 8,580)
Gender					
Male	48.3	49.9	45.4	NA	NA
Female	51.7	50.1	54.6	NA	NA
Racial/ethnic origin					
White	65.2	NA	NA	67.3	63.3
Nonwhite	34.8	NA	NA	32.7	36.8
Age (y)					
18-39	9.7	7.7	1..4	9.4	9.9
40-64	51.5	47.4	59.1	54.5	48.3
65 +	38.8	44.9	27.5	36.1	41.8
No high school diploma	22.9	15.7	36.5	20.6	25.5
Annual income <$20,000	33.6	26.8	46.1	24.8	42.8
Takes insulin	26.5	27.2	25.2	24.8	28.3
Uninsured	10.0	6.5	16.6	9.2	10.8
Perception of general health status as good	51.4	55.3	44.2	55.8	47.2
Participated in diabetes education program	51.2	52.9	48.1	50.3	52.1

*191 respondents did not provide racial/ethnic origin, so these numbers do not add up to 14,633.

Table 2.
Individuals With Diabetes Responding to the 2001 Behavioral Risk Factor Surveillance Survey: Percentages Receiving Preventive Care Practices by Individual Characteristics

Characteristic	Influenza vaccination received	Pneumococcal vaccination received	Dilated eye exam received
Gender			
Male	53.1	40.9	68.2
Female	53.2	46.2	69.0
Racial/ethnic origin			
White	58.5	49.8	70.1
Nonwhite	43.2	32.1	65.7
Age (y)			
18-39	32.4	20.0	59.6
40-64	44.5	33.2	65.8
65 +	69.9	63.2	74.4
Education			
No high school diploma	50.9	40.3	63.5
High school diploma	53.8	44.6	70.2
Takes insulin			
Yes	60.6	51.2	78.3
No	50.8	40.8	67.3
Uninsured			
Yes	29.3	28.0	49.4
No	55.9	45.4	70.8
Perception of general health status			
Good or better	53.6	41.2	69.4
Fair or poor	53.0	46.3	67.8
Participated in diabetes education program			
Yes	58.1	48.3	76.3
No	48.6	38.6	63.9
Number of physician-driven practices*			
0	41.4	25.5	0.0
1	45.0	36.6	30.5
2	53.9	41.5	63.3
3	62.7	51.2	100.0

* Dilated eye exam, HbA1c test, foot exam.

Table 3.
Individual Bivariate and Multivariate Logistic Regression Analyses, Modeling Failure to Receive Flu Vaccination by Individuals With Diabetes Responding to the 2001 Behavioral Risk Factor Surveillance Survey

Characteristic	Bivariate Odds Ratio (95% CI*)	Adjusted Odds Ratio† (95% CI)
Age (y)		
18-39	4.8 (3.93-5.97)	3.6 (2.69-4.78)
40-64	2.9 (2.55-3.28)	2.5 (2.12-3.02)
65 +	1.0 (ref)	1.0 (ref)
Male	1.0 (0.89-1.13)	NA‡
Nonwhite	1.8 (1.62-2.12)	1.4 (1.12-1.66)
No high school diploma	1.1 (.97-1.30)	NA
Positive perception of health	1.0 (0.87-1.10)	NA
No diabetes education	1.5 (1.29-1.67)	1.4 (1.16-1.65)
Not taking insulin	1.5 (1.29-1.72)	1.3 (1.09-1.59)
No health plan	2.1 (1.65-2.72)	1.8 (1.17-2.66)
Provider-involved medical care		
0	2.4 (1.45-3.90)	1.7 (1.10-3.04)
1	2.1 (1.64-2.59)	1.8 (1.37-2.26)
2	1.4 (1.20-1.73)	1.3 (1.10-1.60)
3	1.0 (ref)	1.0 (ref)

* CI, confidence interval.
† Variables for this model included younger age, nonwhite racial/ethnic origin, no diabetes education, no insulin use, no health plan, and engaging in fewer provider-involved preventive care practices.
‡ NA, not applicable.

Table 4.
Individual Bivariate and Multivariate Logistic Regression Analyses, Modeling Failure to Receive Pneumonia Vaccination by Individuals With Diabetes Responding to the 2001 Behavioral Risk Factor Surveillance Survey

Characteristic	Bivariate Odds Ratio (95% CI*)	Adjusted Odds Ratio† (95% CI)
Age (y)		
18-39	6.9 (5.47-8.70)	7.4 (5.36-10.27)
40-64	3.5 (3.05-3.93)	3.6 (3.03-4.34)
65 +	1.0 (ref)	1.0 (ref)
Male	1.2 (1.11-1.39)	1.4 (1.17-1.64)
Nonwhite	2.1 (1.83-2.40)	1.7 (1.38-2.06)
No high school diploma	1.2 (1.03-1.37)	1.4 (1.05-1.75)
Positive perception of health	1.2 (1.09-1.38)	1.3 (1.05-1.51)
No diabetes education	1.5 (1.30-1.69)	1.4 (1.20-1.71)
Not taking insulin	1.5 (1.32-1.77)	1.3 (1.10-1.59)
No health plan	1.3 (1.00-1.70)	0.93 (.062-1.39)
Provider-involved medical care		
0	3.1 (1.95-4.84)	2.3 (1.45-3.56)
1	1.8 (1.43-2.31)	1.5 (1.19-2.01)
2	1.5 (1.24-1.77)	1.3 (1.11-1.61)
3	1.0 (ref)	1.0 (ref)

* CI, confidence interval.
† Variables for this model included younger age, male gender, nonwhite racial/ethnic origin, no high school diploma, positive perception of health, no diabetes education, no insulin use, no health plan, and engaging in fewer doctor-involved preventive care practices.

Table 5.
Individual Bivariate and Multivariate Logistic Regression Analyses, Modeling Failure to Obtain Dilated Eye Exam by Individuals With Diabetes Responding to the 2001 Behavioral Risk Factor Surveillance Survey*

Characteristic	Bivariate Odds Ratio (95% CI†)	Adjusted Odds Ratio‡ (95% CI)
Age (y)		
18-39	2.0 (1.58-2.51)	2.0 (1.43-2.66)
40-64	1.5 (1.31-1.78)	1.6 (1.30-1.95)
65 +	1.0 (ref)	1.0 (ref)
Male	1.0 (0.90-1.19)	NA§
Nonwhite	1.3 (1.07-1.48)	0.90 (0.71-1.12)
No high school diploma	1.5 (1.22-1.75)	1.5 (1.14-1.94)
Positive perception of health	0.8 (0.73-0.99)	0.8 (0.65-0.99)
No diabetes education	1.8 (1.54-2.04)	1.5 (1.20-1.78)
Not taking insulin	1.6 (1.36-1.97)	1.5 (1.24-1.92)
No health plan	2.3 (1.75-2.99)	2.0 (1.38-3.00)
Provider-involved medical care		
0	1.9 (1.38-2.63)	1.6 (1.16-2.27)
1	1.6 (1.28-1.89)	1.4 (1.17-1.77)
2	1.0 (ref)	1.0 (ref)
3	H**	H

* All models with outcome variable = dilated eye exam adjusted for having been told diabetes had affected eyes.
† CI, confidence interval.
‡ Variables for this model included younger age, nonwhite racial/ethnic origin, no high school diploma, positive perception of health, no diabetes education, no insulin use, no health plan, and engaging in fewer doctor-involved preventive care practices (excluding eye exams).
§ NA, not applicable.
**H Models related to outcome variable = dilated eye exam included modified provider-involved medical care variable, omitting eye exam and with logical range 0 to 2.