Self-reported Receipt of Dilated Fundus Examinations Among Patients With Diabetes: Medicare Expenditure Panel Survey, 2002–2013

ELAINE MY TIEN TRAN, JAY BHATTACHARYA, AND SUZANN PERSHING

• PURPOSE: To evaluate self-reported adherence to diabetic retinopathy screening examinations among diabetic subjects.
• DESIGN: Retrospective, population-based cross-sectional study.
• METHODS: Medical Expenditure Panel Survey (MEPS) consolidated full-year and prescribed drugs data from 2002–2013 were reviewed; multivariable logistic regression was used to identify patient characteristics as potential barriers to receiving examinations.
• RESULTS: Of 13 299 persons in the MEPS sample, only 39.62% (95% confidence interval [CI] 38.56%–40.67%) reported receiving annual dilated eye examinations, and 90.31% (CI 89.70%–90.91%) reported ever having received an eye examination. Significant factors related to ever receiving an eye examination included completed high school (odds ratio [OR] = 1.53; CI, 1.33–1.75), bachelor's degree or higher (OR = 1.94; CI, 1.56–2.41), private health insurance (OR = 2.07; CI, 1.70–2.52), public insurance (OR = 1.90; CI, 1.56–2.31), household income > 400% of the poverty threshold (OR = 1.75; CI, 1.36–2.25), prescribed diabetes medication (OR = 1.45; CI, 1.27–1.65), diabetic kidney disease (OR = 1.31; CI, 1.08–1.59), prior foot examination (OR = 1.49; CI, 1.28–1.74), prior hemoglobin A1c test (OR = 1.45; CI, 1.28–1.64), and having a usual care provider (OR = 1.50; CI, 1.25–1.80). Self-reported Asian ethnicity (OR = 0.51; CI, 0.39–0.65), needing assistance for at least 3 months (OR = 0.79; CI, 0.62–1.00), and proxy needed to fill out the survey (OR = 0.72; CI, 0.61–0.85) were associated with lower odds of reporting ever having received a dilated eye examination.
• CONCLUSIONS: In this national-representative sample, 90.31% of patients with diabetes reported ever having a dilated eye examination; only 39.62% reported receiving one annually as recommended. These low rates appear associated with possibly modifiable factors, including having a regular care provider, increasing access to care, enrollment in health insurance, and higher education. (Am J Ophthalmol 2017;179:18–24. Published by Elsevier Inc.)

AMONG THE 29.1 MILLION PEOPLE WITH DIABETES IN the United States (9.3% of the total US population), diabetic retinopathy has an estimated prevalence of 28.5% and accounts for 10%–12% of new cases of legal blindness each year.[1–3] All people with diabetes will likely experience some form of diabetic retinopathy over the course of their disease, and this prevalence rises with increasing diabetes duration.[4] Studies including the Diabetic Retinopathy Study and Early Treatment Diabetic Retinopathy Study, among many others, have shown that timely treatment can reduce severe vision loss, in turn depending on regular dilated eye examinations for early detection of retinopathy and preservation of sight.[5,6]

The American Diabetes Association[7] and the American Academy of Ophthalmology[8] have published diabetes vision care guidelines to detect retinopathy in early, treatable, often asymptomatic stages. These guidelines recommend a dilated eye examination at least 5 years after diagnosis for individuals with type 1 diabetes, a dilated examination concurrent with diagnosis for those with type 2 diabetes, and dilated eye examinations at least annually thereafter for both type 1 and type 2 diabetes patients.

Despite the benefits of early detection, recent studies suggest that a substantial fraction of the diabetes population is not receiving timely dilated eye examinations consistent with the recommended guidelines for preventing visual impairment and blindness.[9–12] Specifically, the 1990–1992 Wisconsin Epidemiologic Study of Diabetic Retinopathy estimates that 37% of patients report not receiving a dilated eye examination in the previous year,[12] the 1999 Salisbury Eye Evaluation Project found this proportion to be 32%,[13] and a 1993–1994 trial held in Suffolk County, New York, found that 69% did not receive any eye examination in the year preceding the study.[14] Additionally, according to a 1993 study using Independent Practice Association (IPA) plan data in upstate New York reports, the percentage of patients not receiving

AJO.com Supplemental Material available at AJO.com.
Accepted for publication Apr 12, 2017.

From the Stanford University School of Medicine (E.M.T.T.); Center for Health Policy/Primary Care Outcomes Research, Stanford University (J.B.); Department of Medicine (J.B.), and Byers Eye Institute, Department of Ophthalmology (S.P.), Stanford University School of Medicine; and Veterans Affairs Palo Alto Health Care System (S.P.), Palo Alto, California.

Inquiries to Suzann Pershing, Byers Eye Institute, Department of Ophthalmology, 2452 Watson Ct, Palo Alto, CA 94304; e-mail: pershing@stanford.edu

0002-9394/$36.00
http://dx.doi.org/10.1016/j.ajo.2017.04.009

a dilated eye examination was even higher—84%—among diabetic patients who did not receive an annual screening examination for 2 consecutive years.[15]

The consequences of untreated diabetic retinopathy manifest both financially and in terms of lost quality of life. There have been several cost-effectiveness analyses of screening for diabetic retinopathy, and while they have used different modeling techniques and input costs, the basic conclusions have been consistent. Early screening for diabetic retinopathy prevents the onset of vision loss at a relatively low cost, often less than the disability payments provided to people who would go blind in the absence of such screenings.[16,17]

Prior studies have used patient data as well as health facility reports to evaluate factors affecting adherence to diabetes vision care guidelines. In this study we use self-reported data from a nationally representative sample to investigate factors associated with patients' reporting receipt of a dilated fundus examination.

METHODS

• **DATA SOURCE:** We conducted a retrospective cross-sectional analysis using 2002–2013 data from the Medical Expenditure Panel Survey (MEPS), which is collected annually by the Agency for Healthcare Research and Quality. It consists of data gathered from a nationally representative subsample of households in the civilian noninstitutionalized United States population that participated in the prior year's National Health Interview Survey (NHIS), an annual household survey of approximately 109 000 people conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention. The MEPS is designed to provide yearly national data on the types of health services Americans use, how often they use them, how much is paid for the services, and who pays those payments. Survey questions relevant to eye care included the question "Which of the following year(s) did you have an eye examination in which your pupils were dilated? This would have made you temporarily sensitive to bright light." As the data used were all obtained from public-use, de-identified files, our study was exempt from institutional review board approval.

• **SAMPLING STRATEGY:** Of households that participated in the previous year's NHIS that year, a subsample of households is chosen for the MEPS. The NHIS uses a stratified multistage sample design, first involving sampling Primary Sample Units consisting of 1 or more counties. Using census population distributions of Hispanic and black people, density strata were formed, and clusters of housing units within each were selected for data collection. Oversampling for Hispanic and black subjects occurred throughout our sample dates (2002–2013), and began for Asian subjects in 2006. From this NHIS sample, a subsample was selected for further data collection in the MEPS. For each of the annual MEPS samples, data are gathered through a series of computer-assisted personal interviews over the course of 30 months, resulting in data that span 2 full calendar years. MEPS additionally oversamples low-income households.

For the diabetes sample, people were asked whether a doctor or health professional had told them that they had diabetes. Those who responded "yes" were sent a Diabetes Care Survey (DCS). MEPS reports that between 2002 and 2013, the average response rate was approximately 90.67%. The demographic data for those whose DCS response was not obtained are included in Supplemental Table 1 (Supplemental Material available at AJO.com). All responses to the DCS are self-reported.

• **VERIFICATION OF DIABETES MEDICATION:** MEPS includes the Medical Provider Component, a survey of the medical providers, facilities, and pharmacies that provided care or services to sample persons, and collects detailed data on the amount and source of payment for medical services and medications. As household respondents are not always the most reliable source of information on medical expenditures, information from these medical provider surveys regarding diagnosis and procedure codes, charges, and payments were used to verify and supplement household reports. For our investigation, charges for diabetes medication were matched for persons who reported that their diabetes care included diabetes medication in the Diabetes Care Survey.

We extracted and pooled data from the MEPS consolidated person data files, as well as the prescribed medicine files, which include all the components described above.

• **STATISTICAL ANALYSIS:** Codes provided by MEPS were used to identify persons who reported a diagnosis of diabetes and treatment of their diabetes with insulin or oral medication. This sample was then cross-checked using MEPS prescription files to identify patients treated with diabetes medication.

We used cross-tabulations to calculate prevalence estimates. Multivariable logistic regression was used to identify predictors of reported receipt of a dilated fundus examination—adjusted for persons for whom data are available over multiple surveys and analyzed, respectively, with an outcome variable of dilated eye examinations received at least annually (as per screening recommendations) and outcome of ever receiving a dilated eye examination. Independent variables include demographics such as age; ethnicity (Hispanic, non-Hispanic black, Asian, or other); family income, categorized as poor (<100% federal poverty level), near poor (100%–124% federal poverty level), low income (125%–199% federal poverty level), middle income (200%–399% federal poverty level), or high income (>400% federal poverty level); highest level of education

TABLE 1. Patient Demographics, 2002–2013

By Person	Proportion of Sample[a]
Sample (n)	21 055
Age (y), mean (CI)	61.08 (60.72–61.44)
Male sex	49.40%
Race	
Hispanic	14.01%
Black/African American	15.61%
Asian	4.00%
White	66.38%
Highest level of education	
No high school diploma	23.92%
High school diploma	47.77%
Bachelor's degree or higher	28.31%
Health insurance	
No insurance	7.13%
Private insurance	60.24%
Public insurance	32.63%
Income	
Poor (below 100% FPL)	13.99%
Near poor (100%–124% of FPL)	6.00%
Low income (125%–199% of FPL)	16.67%
Middle income (200%–399% of FPL)	30.74%
High income (above 400% of FPL)	32.60%

FPL = federal poverty level; MEPS = Medicare Expenditure Panel Survey.

[a]Proportions were calculated from the total number of observations (21,055), adjusted using MEPS weight variables to make the sample representative of the overall diabetes population. Minorities and low-income groups were oversampled to increase precision.

(no high school, high school diploma/GED, or bachelor's degree or above), and insurance coverage (private, Medicaid, Medicare, and no insurance). Insurance holders were categorized based on whether respondents had any private, Medicaid, or Medicare insurance over the course of 1 year; uninsured respondents were defined as those who had no insurance coverage over the course of 1 year. Other independent variables describe access to care or are specific to diabetes care. These include whether the survey participant has diabetes causing kidney problems, had a prior foot examination, had a prior test for hemoglobin A1c (HbA1c), has difficulty seeing with glasses, is blind, feels confident in treating his or her diabetes, has self-perceived good general health, has a usual health care provider, has no difficulty getting to usual care provider facility, needed assistance for at least 3 months, or needed a proxy to fill out survey. Covariates were selected based on initial univariate regressions that indicated statistical significance; we also conservatively included other variables that we believed could affect receipt of dilated eye examinations (eg, needing assistance within the past 3 months, and difficulty getting to the health provider's office). Logistic regression analyses were used to derive all odds ratios, 95% confidence intervals, and *P* values. Odds ratios and 95% confidence intervals were calculated for all potential factors included in our analysis. To evaluate for an effect from collinearity, we sequentially tested our models by removing individual variables that we believed could be correlated (diabetes care variables, insurance, and income). With these changes, we did not observe any substantial shifts in odds ratios for other variable, and *P* values did not change in significance. *P* values were calculated with a statistical significance cut-off level of $<.05$. All statistical analysis was performed using Stata (version 12, StataCorp, College Station, Texas, USA).

RESULTS

• **PREVALENCE:** The sample includes 21 055 observations for 13 299 persons with diabetes in the United States, all of whom were receiving treatment with prescribed medication (Table 1). Of these, 5575 persons were unique to 1 survey year, 7724 were surveyed for 2 years, and 32 for 3 years.

Between 2002 and 2013, 90.31% (95% confidence interval [CI] 89.71%–90.91%) of participants self-reported having received at least 1 dilated eye examination; and 39.62% (CI 38.56%–40.67%) reported receiving a dilated eye examination for 2 consecutive years, during the year of survey and the year prior.

• **DEMOGRAPHICS:** The participants ranged in age from 3 to 85 years, with a median age of 61 years. Older patients were more likely both to have had an annual dilated eye examination for 2 consecutive years (odds ratio [OR] = 1.03; CI, 1.02–1.03; $P \leq .01$) and to have ever had a dilated eye examination in the past (OR = 1.04; CI, 1.03–1.04; $P \leq .01$) (Table 2). Men appeared less likely than women to have ever had a dilated eye examination (OR = 0.75; CI, 0.66–0.85; $P \leq .01$). And, of the odds ratios for race and ethnicity, being Asian was significantly associated with not having ever received a dilated eye examination (OR = 0.51; CI, 0.39–0.65; $P \leq .01$). Though not meeting the $P < .05$ threshold for statistical significance, Hispanic ethnicity also showed a trend toward lower odds of ever receiving a dilated eye examination (OR = 0.85, CI 0.72–1.02, $P < .1$). Compared to the general population of the United States, racial distributions in the MEPS sample include higher percentages of minorities and low-income groups (Table 1).[18]

• **SOCIOECONOMIC FACTORS:** *Insurance*. Having insurance (whether public or private) was significantly associated with receiving an annual dilated eye examination for 2 consecutive years, as well as for ever having received a dilated eye examination. Those with private insurance were substantially more likely to have received annual

TABLE 2. Multivariable Logistic Regression With General Insurance Covariates

	Received Eye Examination as Recommended		Ever Received Eye Examination	
	Adjusted OR (95% CI)	Marginal Effect[a]	Adjusted OR (95% CI)	Marginal Effect[a]
Age (1-year increments)	1.03[b] (1.02–1.03)	0.0253[b]	1.04[b] (1.03–1.04)	0.0356[b]
Male sex	1.03 (0.95–1.12)	0.0320	0.75[b] (0.66–0.85)	−0.288[b]
Race (reference group: white)				
Hispanic	0.97 (0.86–1.09)	−0.0333	0.85[d] (0.72–1.02)	−0.158[d]
Black/African American	0.99 (0.88–1.11)	−0.0126	0.98 (0.82–1.17)	−0.0226
Asian	0.95 (0.78–1.16)	−0.0487	0.51[b] (0.39–0.65)	−0.683[b]
Highest level of education (reference group: no high school diploma)				
High school diploma	1.25[b] (1.13–1.39)	0.225[b]	1.53[b] (1.33–1.75)	0.423[b]
Bachelor's degree or higher	1.48[b] (1.30–1.68)	0.391[b]	1.94[b] (1.56–2.41)	0.664[b]
Health insurance (reference group: no insurance)				
Private insurance	2.22[b] (1.85–2.65)	0.796[b]	2.07[b] (1.70–2.52)	0.727[b]
Public insurance	2.06[b] (1.70–2.51)	0.724[b]	1.90[b] (1.56–2.31)	0.641[b]
Income (reference group: income below 100% of FPL)				
Near poor (100%–124% of FPL)	1.00 (0.85–1.19)	0.0021	1.02 (0.82–1.27)	0.0195
Low income (125%–199% of FPL)	1.04 (0.91–1.20)	0.0420	0.99 (0.83–1.19)	−0.0101
Middle income (200%–399% of FPL)	1.07 (0.95–1.21)	0.0692	1.10 (0.90–1.35)	0.0980
High income (>400% of FPL)	1.45[b] (1.27–1.67)	0.374[b]	1.75[b] (1.36–2.25)	0.557[b]
Diabetes care				
Prescribed diabetes medication	1.17[b] (1.08–1.27)	0.155[b]	1.45[b] (1.27–1.65)	0.369[b]
Has diabetes causing kidney problems	1.25[b] (1.11–1.41)	0.224[b]	1.31[b] (1.08–1.59)	0.273[b]
Had prior foot examination	2.39[b] (2.19–2.61)	0.870[b]	1.49[b] (1.28–1.74)	0.401[b]
Was tested for A1C	1.49[b] (1.36–1.63)	0.399[b]	1.45[b] (1.28–1.64)	0.370[b]
Vision and general health		(0.0449)		(0.0629)
Has difficulty seeing with glasses	1.16[c] (1.03–1.30)	0.146[c]	1.09 (0.90–1.31)	0.0853
Self-perceived general good health	0.99 (0.91–1.08)	−0.0125	0.98 (0.85–1.12)	−0.0230
Has a usual health care provider	1.17[d] (0.99–1.38)	0.154[d]	1.50[b] (1.25–1.80)	0.406[b]
Has no difficulty getting used to usual care provider facility	1.12 (0.97–1.30)	0.114	1.01 (0.81–1.25)	0.00664
Needed assistance for at least 3 months	0.82[b] (0.71–0.95)	−0.202[b]	0.79[d] (0.62–1.00)	−0.235[d]
Needed a proxy to complete the survey	0.92 (0.81–1.05)	−0.0823	0.72[b] (0.61–0.85)	−0.330[b]

FPL = federal poverty level.

[a]Percent change in predicted probability eye examination for a given variable, relative to reference group and holding all other variables constant.

[b]$P < .01$.

[c]$P < .05$.

[d]$P < .1$.

dilated eye examinations, with a predicted probability 79.6% ($P \leq .01$) higher than those without insurance (Table 2). Those with private insurance were also more likely to have ever had a dilated eye examination in the past, with a predicted probability of 72.7% ($P \leq .01$) higher than those who do not have insurance. Though still statistically significant, this likelihood was slightly less for those with public health insurance. Nonetheless, having public insurance compared with having no insurance showed a higher predicted probability of 72.4% ($P \leq .01$) for receiving an annual dilated eye examination for 2 consecutive years, and 64.1% ($P \leq .01$) for ever receiving a dilated eye examination in the past (Table 2). When we analyzed public insurance types independently (Medicare and Medicaid, respectively), we found that Medicare had a slightly stronger effect than Medicaid on increasing likelihood of receiving dilated eye examinations, and in fact exceeded the effect of private insurance (Supplemental Table 2; Supplemental Material available at AJO.com). Significant interactions between Medicare and Medicaid (OR = 0.66; CI, 0.53–0.83; $P \leq .01$) or private insurance (OR = 0.69; CI, 0.56–0.84; $P \leq .01$), indicate lower likelihood of receiving dilated eye examinations among patients with 2 types of insurance.

Education. Relative to an incomplete high school education, having a high school diploma or GED certificate as the highest level of education was strongly associated both with having an annual dilated eye examination (OR = 1.25; CI, 1.13–1.39; $P \leq .01$; predicted probability 22.5% higher than for no high school diploma/GED) and with having ever had a dilated eye examination (OR = 1.53; CI, 1.33–1.75; $P \leq .01$; predicted probability 42.3% higher than for no high school diploma/GED) (Table 2). This association was even stronger for having a bachelor's degree or higher: a predicted probability for annual dilated eye examinations 39.1% higher than with no high school diploma/GED (OR = 1.48; CI, 1.30–1.68; $P \leq .01$) and a predicted probability for ever having had a dilated eye examination 66.4% higher than with no high school diploma/GED (OR = 1.94; CI, 1.56–2.41; $P \leq .01$).

Income. Compared with those with income below the federal poverty level, participants with household income categorized as "Near Poor," "Low Income," or "Middle Income" (collectively representing 100%–399% of the poverty level) were not significantly associated with different odds of receiving a dilated eye examination (Table 2). However, persons with "High Income" (household income over 400% of the poverty level) were significantly more likely than those with income below the poverty line to receive dilated eye examinations as recommended (predicted probability 37.4% higher; OR = 1.45; CI, 1.27–1.67; $P \leq .01$), as well as more likely to have ever received a dilated eye examination (predicted probability 55.7% higher; OR = 1.75; CI, 1.36–2.25; $P \leq .01$).

• **OTHER MEDICAL CARE:** Other diabetes-related medical care was significantly associated with receiving dilated eye examinations, both as recommended and at any time in the past (Table 2). For receiving dilated eye examinations as recommended, this association was strongest for prior foot examinations (an 87.0% increase in predicted probability; $P \leq .01$), followed by HbA1c testing (39.9% increase in predicted probability; $P \leq .01$) and diabetes causing kidney problems (22.4% increase in predicted probability; $P \leq .01$). For ever receiving a dilated eye examination in the past, the trend was similar, with prior foot examinations showing the strongest association (40.1% increase in predicted probability; $P \leq .01$), followed by HbA1c testing (37.0% increase in predicted probability; $P \leq .01$) and diabetes causing kidney problems (27.3% increase in predicted probability; $P \leq .01$).

Having difficulty seeing with glasses was significantly associated with having dilated eye examinations as recommended, but not with ever having had a dilated eye examination. However, when a univariate regression was used to analyze the effects of having difficulty seeing with glasses, the results were statistically significant, both for having ever had a dilated eye examination (OR = 1.16; CI, 0.98–1.38; $P \leq .1$) and for receiving dilated eye examinations as recommended (OR = 1.14; CI, 1.02–1.28; $P \leq .05$). There was no significant effect for self-perceived good general health or self-reported difficulty in getting to the patient's usual health care provider. Needing assistance for at least 3 months was significantly associated with receiving a dilated eye examination as recommended, while needing a proxy to fill out the survey was significantly associated with having ever received a dilated eye examination. Having a usual care provider was significantly associated both with receiving dilated eye examinations as recommended and with ever receiving dilated eye examination(s) in the past.

DISCUSSION

ALTHOUGH 90.31% OF DIABETIC PATIENTS IN THE MEPS SAMple self-reported ever having received a dilated eye examination, we found low adherence to minimum recommendations of annual dilated eye examinations, consistent with prior studies showing a high percentage of patients who had not received a dilated eye examination in the preceding year.[12–15] In our study, 60.38% of patients did not report having dilated eye examinations for 2 consecutive years. Our results were closest to those from New York IPA plan data, which found that 84% of patients did not receive a dilated eye examination if they did not have one in the preceding 2 years (that is, 3 consecutive years of dilated eye examinations).[15] Including our findings (based on 2 consecutive years of dilated eye examinations) with those from previous studies, we see a graduated increase in likelihood of not receiving dilated eye examinations (as low as 32% for 1 year failure, 60% for 2 years failure, 84% for 3 years failure). Though a direct comparison is not possible, this may suggests that failure to receive a dilated eye examination in the preceding year(s) is predictive of future likelihood.

Failure to receive diabetic dilated eye examinations may in turn be associated with demographic and socioeconomic factors, and with access to and use of medical care. Unsurprisingly, we found increasing age was significantly associated with higher odds of receiving dilated eye examinations as recommended and higher odds of ever receiving a dilated eye examination. Though race was largely not statistically significant, self-reported Asian ethnicity was strongly associated with not ever receiving a dilated eye examination. The implication of disparities in access to care, especially given the higher proportion of minorities in this sample relative to the US population (Table 1), invites question of whether Asian people are less likely to have dilated eye examinations and warrants further research.

Socioeconomic variables such as education and income followed expected trends for health care utilization. The education variables appeared to have the strongest association with receiving dilated eye examinations, and this

positive association is consistent with past studies, including the Wisconsin Epidemiologic Study of Diabetic Retinopathy[12] as well as the 1999 SEE Project.[13] Furthermore, higher levels of education are more strongly associated with receiving dilated eye examinations than a high school education alone. Higher household income levels (particularly at the very high end, >400% of the federal poverty level) were also associated with higher odds of receiving diabetic screening dilated eye examinations.

Also consistent with prior studies, having insurance was strongly associated with receiving a dilated eye examination. Having private insurance was more strongly associated with both receiving a dilated eye examination as recommended and having received one at all, suggesting that there may be some difference in how care is provided for the publicly insured compared with the privately insured. However, when Medicare and Medicaid public insurance were analyzed as separate variables, the effect of Medicare exceeded that of private insurance. Surprisingly, patients with 2 types of insurance (Medicare and Medicaid or private insurance) had lower odds of reporting dilated eye examinations than patients with Medicaid or private insurance alone. This may reflect poorer general health in this patient population, with less access to or use of health care, but warrants further investigation.

Factors involving diabetes-related care as well as having a usual care provider were associated with increased odds both of having dilated eye examinations per recommendations and of ever having a dilated eye examination. This trend may reflect better patient recollection or may indicate better care coordination. It is likely that at least some component of care coordination may be implicated, particularly because the odds ratio for having a prior foot examination was higher than for all other variables.

The variables "needed assistance for at least 3 months" and "needed a proxy to fill out survey" demonstrated a trend toward lower odds of receiving dilated eye examinations, whereas having a usual care provider led to increased odds of receiving dilated eye examinations. This may indicate that difficulty getting to a provider hinders the chances of receiving a dilated eye examination, and that access to care also plays a role in adherence to vision care guidelines.

For patients reporting "difficulty seeing with glasses," we noted a statistically significant increase in odds of receiving dilated eye examinations as recommended, but odds were relatively lower for ever receiving a dilated eye examination. The effect of difficulty seeing with glasses was, however, slightly higher. This suggests that the effect of visual impairment is dampened by demographic and socioeconomic effects in regression analyses, particularly affecting odds of having ever received a dilated eye examination. Though we expect poor vision to be strongly associated with an increased likelihood of receiving dilated eye examinations, other socioeconomic and demographic variables were found to be more strongly associated.

A common problem of MEPS is underreporting, and 1 study has found that households underreported office visits by 19% and that this was consistent across all sociodemographic groups.[19] We recognize that this may represent a source of bias. Our analysis indicates that 39.62% reported receiving a dilated eye examination for 2 consecutive years, during the year of survey and the year prior. Even if all of the 19% that may have underreported had had eye examinations for 2 consecutive years, this percentage increases to approximately 60%, still suggesting that a large portion of the population is not receiving adequately frequent dilated eye examinations. Additionally, as this underreporting cuts across all sociodemographic groups,[19] we believe the behavioral analyses remain largely unaffected.

For the MEPS and surveys like it, the quality and accuracy of the data obtained are inherently linked to the fundamental survey design and its ability to minimize survey error and reach response rate targets. This self-report survey design is also limited by the ability of respondents to report accurately on certain types of information, such as diagnoses or detailed event information. However, patient self-report of a diabetes diagnosis was previously shown in a different survey-based study population to have high reliability relative to manual review of medical records (91.8% positive predictive value and 94.5% negative predictive value for prevalent diabetes).[20] Additionally, owing to its ability to link medical care use and health insurance coverage, its insight into patients' knowledge of their own health and health care, and the level of detail with which it covers health conditions, access to health care, demographic characteristics, and employment, MEPS remains a valuable nationally representative data source for the research and policy community.

Our results are limited by the nature of the MEPS data set, because all values were self-reported and external validation using physician-reported or claims-based data was not possible. In the MEPS data set, 83.44% of patients with prescribed diabetes medications self-reported having diabetes. However, our analyzed sample only included patients who reported both having diabetes and being treated with diabetes medication—a more stringent requirement that may have biased our results toward higher, more conservative estimates of adherence, because these patients were aware of and consistent in their reporting of diagnoses and treatments. Future analyses will benefit from inclusion and comparison to objective physician-reported claims or clinical data.

Dilated eye examinations are critical to preventing diabetes-related vision loss, and self-reported receipt of screening dilated eye examinations is associated with possibly modifiable factors, including having a regular care provider, increasing access to care, enrollment in health insurance, and higher education.

FUNDING/SUPPORT: FUNDING FROM THE STANFORD UNIVERSITY SCHOOL OF MEDICINE MEDSCHOLARS FUND (STANFORD, California, USA) to E. Tran; support from the National Institute on Aging grant R37 AG036791 and P30 AG7253 (Bethesda, Maryland, USA) to J. Bhattacharya; departmental support from Research to Prevent Blindness, Inc, (New York, New York, USA) to S. Pershing. Financial Disclosures: The following authors have no financial disclosures: Elaine My Tien Tran, Jay Bhattacharya, and Suzann Pershing. All authors attest that they meet the current ICMJE criteria for authorship.

REFERENCES

1. Leonard RM. Statistics on vision impairment: a resource manual. New York, NY: Lighthouse International; 2001.
2. Zhang X, Saaddine JB, Chou C, et al. Prevalence of diabetic retinopathy in the United States, 2005-2008. *JAMA* 2010; 304(6):649–656.
3. Centers for Disease Control and Prevention. National diabetes statistics report: Estimates of diabetes and its burden in the United States, 2014. Atlanta, GA: US Department of Health and Human Services; 2014.
4. Klein R, Klein BE. Vision disorders in diabetes. In: Aubert R, ed. Diabetes in America. Collingsdale, PA: DIANE Publishing; 1995:293–338.
5. Diabetic Retinopathy Study Research Group. Photocoagulation treatment of proliferative diabetic retinopathy: clinical application of diabetic retinopathy study (DRS) findings, DRS report number 8. *Ophthalmology* 1981;88(7):583–600.
6. Early Treatment Diabetic Retinopathy Study Research Group. Early photocoagulation for diabetic retinopathy: ETDRS report number 9. *Ophthalmology* 1991;98(5): 766–785.
7. American Diabetes Association. Diabetic Retinopathy. *Diabetes Care* 2002;25(Suppl 1):s90–s93.
8. American Academy of Ophthalmology Retina/Vitreous Panel. Preferred Practice Pattern Guidelines Diabetic Retinopathy 2016. San Francisco, CA: American Academy of Ophthalmology. Available at, https://www.aao.org/preferred-practice-pattern/diabetic-retinopathy-ppp-updated-2016. Accessed April 10, 2017.
9. Legorreta AP, Hasan MM, Peters AL, Pelletier KR, Leung K. An intervention for enhancing compliance with screening recommendations for diabetic retinopathy: a bicoastal experience. *Diabetes Care* 1997;20(4):520–523.
10. Brechner RJ, Cowie CC, Howie LJ, Herman WH, Will JC, Harris MI. Ophthalmic examination among adults with diagnosed diabetes mellitus. *JAMA* 1993;270(14):1714–1718.
11. Witkin SR, Klein R. Ophthalmologic care for persons with diabetes. *JAMA* 1984;251(19):2534–2537.
12. Moss SE, Klein R, Klein BE. Factors associated with having eye examinations in persons with diabetes. *Arch Fam Med* 1995;4(6):529–534.
13. Orr P, Barrn Y, Schein OD, Rubin GS, West SK. Eye care utilization by older Americans: the SEE project. *Ophthalmology* 1999;106(5):904–909.
14. Schoenfeld ER, Greene JM, Wu SY, Leske MC. Patterns of adherence to diabetes vision care guidelines: baseline findings from the Diabetic Retinopathy Awareness Program. *Ophthalmology* 2001;108(3):563–571.
15. Mukamel BD, Bresnick HG, Wang Q, Dickey FC. Barriers to compliance with screening guidelines for diabetic retinopathy. *Ophthalmic Epidemiol* 1999;6(1):61–72.
16. Javitt JC, Canner JK, Frank RG, Steinwachs DM, Sommer A. Detecting and treating retinopathy in patients with type I diabetes mellitus: a health policy model. *Ophthalmology* 1990; 97(4):483–495.
17. Klonoff DC, Schwartz DM. An economic analysis of interventions for diabetes. *Diabetes Care* 2000;23(3):390–404.
18. US Census Bureau American FactFinder. Comparative demographic estimates: 2013 American Community Survey 1-year estimates. Available at, https://factfinder.census.gov/bkmk/table/1.0/en/ACS/13_1YR/CP05. Accessed April 10, 2017.
19. Zuvekas SH, Olin GL. Validating household reports of health care use in the medical expenditure panel survey. *Health Serv Res* 2009;44(5 p1):1679–1700.
20. Jackson JM, DeFor TA, Crain AL, et al. Validity of diabetes self-reports in the Women's Health Initiative. *Menopause* 2014;21(8):861–868.