

The Role of Usual Source of Care in Cholesterol Treatment

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Background: A usual source of care (USOC) has been associated with improved preventive and chronic care, but its relationship with lipid management has not been well described. The objectives of this study were (1) to examine the association of USOC with statin use among persons meeting eligibility guidelines for treatment, and (2) to examine the association of USOC with low-density lipoprotein goal attainment among those receiving statins.

Methods: We examined statin use among adults aged 21 to 79 years who participated in the National Health and Nutrition Examination Survey, 1999 to 2006. We used criteria from the third Adult Treatment Panel about the treatment of high cholesterol to assess eligibility and the examined factors that predicted current use of statins. Among those currently taking statins, we assessed achievement of target low-density lipoprotein cholesterol based on the third Adult Treatment Panel's goals.

Results: Among the 12,979 participants, nearly 14% were eligible. Having a USOC was significantly associated with the use of statins among those who were eligible but not with goal attainment among those taking statins. Significant predictors of goal attainment were higher income and education and being in a more recent cohort.

Conclusion: In a national sample USOC was significantly associated with the use of statins among eligible adults but not with low-density lipoprotein cholesterol goal attainment for those using statins. (J Am Board Fam Med 2010;23:179–185.)

Keywords: Cholesterol, Usual Source of Care, Lipid, Statin, NHANES, Data Pooling

Having a usual source of care (USOC; eg, first contact) is a core feature of primary care and is embedded in the principles of the patient-centered medical home.¹ Having a USOC has been associated with improved access to care, improved receipt of preventive care,^{2,3} weight loss among patients screened for hypertension or cholesterol, and improved communication,⁴ adherence, and health sta-

tus.⁵ When a USOC is combined with provider accessibility and well-organized care, key health care disparities are eliminated.⁶ Disruptions in USOC are associated with emergency department visits⁷ and avoidable hospitalizations.⁸ USOC is also associated with better chronic care management and disease control for human immunodeficiency virus, asthma, hypertension, and diabetes.^{9–13}

There are few data regarding the impact of continuity of care on cholesterol management beyond improvements in cholesterol screening.^{14,15} Using recent national data, we examined 2 questions: (1) Is continuity of care associated with appropriate treatment of high cholesterol with statins? and (2) Is continuity of care associated with attainment of low-density lipoprotein (LDL) goals among persons currently being treated with statins?

Methods

Study Sample

We used publicly available data from the National Health and Nutrition Examination Survey (NHANES) conducted from 1999 to 2000, 2001 to 2002, 2003 to 2004, and 2005 to 2006 by

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the National Center for Health Statistics of the Centers for Disease Control and Prevention. NHANES is an ongoing survey designed to provide nationally representative estimates for the noninstitutionalized population of the United States based on a multistage, stratified sampling frame.¹⁶ Survey data include household interviews, examinations, and testing. After the interview, participants are invited to mobile examination centers. The protocol for each NHANES was approved by the National Center for Health Statistics of the Centers for Disease Control and Prevention Institutional Review Board. Informed consent was obtained from each participant.

Our sample was restricted to the 16,681 adults (older than 20 years) for whom criteria from the third Adult Treatment Panel (ATP III) were developed (ie, excluding those ≥ 80 years of age). LDL cholesterol (LDL-C) values were available for 16,021 persons; of these, complete data for all study variables were available for 12,979 (81.0%) participants, which corresponded to 84.4% of the target population (adjusted for population weights).

Measures

USOC was assessed by response to 2 questions: (1) Is there a place that you usually go when you are sick or you need advice about health? and (2) What kind of place do you go most often? We coded participants as having a USOC based on an affirmative response to the former question and their report of going to “a clinic or health center,” “doctor’s office or health maintenance organization,” or a “hospital outpatient department.” Sociodemographic factors included self-reported age, sex, race, ethnicity, socioeconomic status (percent of federal poverty level), and educational attainment. Risk factors for coronary heart disease (CHD) and morbidity included LDL, high-density lipoprotein (HDL), total cholesterol, blood pressure, history of CHD, myocardial infarction, stroke, angina, diabetes, cigarette smoking, use of antihypertensive medication, and family history of CHD. Access factors included the language usually spoken at home (English or other), whether the participant had any health insurance or none, and the number of visits during the past year (intervals).

Participants were classified as having hypertension if, based on the average of 3 blood pressure measurements, they had a systolic blood pressure of 140 mm Hg or more and/or diastolic blood pres-

sure of 90 mm Hg or more and/or they reported currently using antihypertensive medication. Medication use (including the use of statins) was based on a series of questions about any prescription drugs the participant reported having taken during the previous month. For each drug reported, the participant was asked to show the medication container to allow the interviewer to record the drug name. This information was used to ascertain participants’ current use of any statin.

We estimated pretreatment total cholesterol, LDL-C, and HDL cholesterol based on the expected reduction associated with the specific lipid-lowering therapy the patient was using (based on inspection of the medication bottle).^{17,18} In sensitivity analyses we examined values $\pm 35\%$ of the original estimated percent reduction. (The estimated percentage reduction for different lipid values associated with each lipid lowering drug are available on request.) Because LDL-C values were only available for a subsample, we imputed LDL-C values based on total cholesterol and HDL cholesterol using a predictive model developed using the subsample. The r^2 for LDL-C prediction was 0.90 and effect sizes for USOC (and other factors) were similar between the full sample and the subsample of participants for whom LDL-C values were obtained.

Assessment for Statin Eligibility and Target LDL-C

We applied the ATP III recommendations for the treatment of high cholesterol among adults (updated in 2004) to assess participant eligibility for statin use.^{19,20} ATP III guidelines use variable LDL-C thresholds for treatment based on 3 categories of 10-year risk for CHD ($<10\%$, 10% to 20% , and $>20\%$). Patients with no CHD or CHD risk equivalents (diabetes, stroke, or peripheral vascular disease) were assessed for major CHD risk factors; CHD risk (cigarette smoking, hypertension, low HDL cholesterol (<40 mg/dL); family history of premature CHD; and older age (men ≥ 45 years and women ≥ 55 years). HDL cholesterol ≥ 60 mg/dL was considered protective and resulted in a loss of the equivalent of a major CHD risk factor.

Patients with ≤ 1 major CHD risk factor were considered to be in the lowest risk category with a 10-year risk of $<10\%$. Participants with ≥ 2 risk factors underwent Framingham risk scoring to sort them into the same 3 risk-group categories. Participants with CHD, CHD risk equivalents, or a Fra-

mingham risk score $>20\%$ were placed in the group at highest risk.

For adults with 0 to 1 risk factors, the statin eligibility threshold for elevated LDL-C was ≥ 190 mg/dL, with a LDL-C goal of <160 mg/dL. For adults in the intermediate risk category (2+ risk factors), the goal was 130 mg/dL. The statin threshold was 130 mg/dL for those with a 10-year CHD risk of 10% to 20% and 160 mg/dL for those with a 10-year CHD risk of $<10\%$. For adults in the highest risk group, the statin threshold was ≥ 130 mg/dL, with a goal of ≤ 100 mg/dL. In the 2004 update an option was added for reducing the LDL-C to <70 mg/dL for those in the highest risk group.

Statistical Analyses

The data were analyzed using SAS-Callable SUDAAN software version 10.0.0 (SAS Institute Inc., Research Triangle Park, NC); we incorporated the complex survey design specifications to yield appropriate standard errors and parameter estimates reflecting the noninstitutionalized, civilian US population. The dependent variable for the first logistic regression model was statin use among those eligible for statin therapy according to ATP III criteria and estimated pretreatment lipids. Social risk factors included age group (<35 years old, 35 to 44 years old, 45 to 54 years old, 55 to 64 years old, or ≥ 65 years old); sex; race/ethnicity (white, black, Hispanic, or other); years of schooling (<12 years, 12 years, and >12 years); percent of Federal poverty level ($<100\%$, 100% to 199%, 200% to 299%, 300% to 499%, and $\geq 500\%$). Access factors included having a USOC, having insurance or having no insurance, and preferred language (English or other).

The dependent variable for the second set of logistic regression models was whether the LDL-C level was at goal and included only those respondents currently taking statins; the independent variables were the same as those in the first set of analyses. In both analyses, 2-way interactions among independent variables were explored. In this study we focused on social risk factors. We used 0.05 (or no overlap, with 1.0 for 95% CI) for tests of statistical significance.

Results

Of the 12,979 persons with complete data, 2,524 (19.4%) reported no USOC. The characteristics of

persons with a USOC compared with those without are shown in Table 1. Those without a USOC were younger, more likely men, more likely to be a race other than white, more likely to prefer a language other than English, poorer, less educated, more likely to be uninsured, have lower CHD risk, and less likely to be taking statins. Each of these differences was statistically significant ($P < .0001$).

Among the 12,979 participants, 1,927 were potentially eligible for statin treatment. Among these, 25% were already taking statins. After controlling for patient sociodemographic characteristics and access, eligible participants who had a USOC were significantly more likely (odd ratio, 4.47; 95% CI, 2.09–9.54) to be using statins (Table 2). Other predictors of statin use included age and participating in the survey during a later year (ie, statin use improved over time). These findings were robust to sensitivity analyses. We used a lower threshold for high-risk patients, eg, <70 mg/dL of LDL-C. The results were similar among patients in subsamples for whom LDL-C were available or for whom ankle brachial blood pressure ratio was available and peripheral arterial disease (<0.9) was included as a CHD risk equivalent. When we varied the estimated effect of cholesterol-lowering drugs on lipids by $\pm 35\%$ (of the original effect), the effect of USOC ranged from 2.0 to 2.9.

Among the 1333 participants who were appropriately treated with statins, there was a trend toward the association of USOC with the achievement of LDL-C goal (odds ratio, 2.0; 95% CI, 0.94–4.6) that did not reach statistical significance. Significant predictors of failing to reach LDL-C goal included poverty and lower education, and participation in early years included being female, higher poverty level, and lower income (Table 3). Restriction of the sample to participants using statins who were presumed eligible or to those for whom LDL-C values were available yielded similar findings.

Discussion

In this nationally representative sample we found that having a USOC was associated with appropriate treatment with statins. We also found a non-statistically significant trend for an association between USOC and the attainment of LDL-C goals among patients who were appropriately treated with statins. Interestingly, socioeconomic factors (ie, income and education) were not associated with

Table 1. Characteristics of Adults in the National Health and Nutrition Examination Survey (n = 12,979) 1999 to 2006 Sample by Usual Source of Care²¹

Descriptive Variable	Total (%)	Percentage by Usual Source of Care		P
		No	Yes	
Total	100	17.9	82.1	
Age (years)				<.0001
21–34	30.5	49.4	26.3	
35–44	24.4	23.7	24.5	
45–54	22.2	17.7	23.1	
55–64	12.2	6.2	13.5	
>65	10.9	3	12.6	
Male	48	67.2	43.8	<.0001
Race/ethnicity				<.0001
Hispanic	12.7	23.1	10.4	
White	72.2	59.4	75	
Black	10.3	11.2	10.1	
Other	4.8	6.3	4.5	
Federal poverty level (%)				<.0001
<100	11.5	18.2	10	
100–199	19.1	26.8	17.5	
200–299	15.9	17.3	15.6	
300–499	26.8	21.6	28	
>500	26.6	16.1	29	
Education (years)				<.0001
<12	17.1	26.4	15	
12	25	26.7	24.6	
>12	57.9	46.8	60.3	
No insurance	18.2	46.9	11.9	<.0001
Physician visits				<.0001
0	17.2	46.7	10.8	
1	21.6	25	20.8	
2–3	27.3	15.9	29.8	
4–9	21.6	7.8	24.6	
10 to 12	5.5	1.8	6.3	
≥13	6.8	2.8	7.7	
Prefer English language	90.6	81.2	92.7	<.00001
CHD 10-year risk (%)				<.00001
<10	83.7	87.9	82.8	
10–20	15	11.4	15.7	
>20	1.3	0.7	1.5	
Taking statin	5.35	0.9	6.3	<.0001

All results based on population weights.

CHD, coronary heart disease.

Centers for Disease Control and Prevention, National Center for Health Statistics. National Health and Nutrition Examination Survey Data. Available at <http://www.cdc.gov/nchs/surveys.htm>.

the use of statins but were associated with LDL-C goal attainment. Our findings are consistent with previous studies, which showed that having a USOC is associated with improved chronic disease management.^{9–13}

Our findings for goal attainment were consistent with previous data, showing that higher socioeconomic status is associated with improved quality of care,^{22–24} in part because of fewer cost barriers for people with a higher socioeconomic status.²⁵ This

Table 2. Use of Statins among Eligible Adults (n = 1927) in the National Health and Nutrition Examination Survey, 1999 to 2006²¹

Predictor Variable	Odds Ratio (95% CI)
Survey year	
1999–2000	1.00 (1.00–1.00)
2001–2002	1.87 (1.03–3.39)
2003–2004	5.63 (3.54–8.95)
2005–2006	6.36 (3.83–10.55)
Usual source of care	
No	1.00 (1.00–1.00)
Yes	4.64 (2.14–10.04)
Age (years)	
21–34	1.00 (1.00–1.00)
35–44	14.80 (3.25–67.41)
45–54	21.42 (4.91–93.29)
55–64	28.67 (6.73–122.12)
≥65	35.86 (8.24–156.15)
Sex	
Female	1.00 (1.00–1.00)
Male	0.87 (0.67–1.12)
Race/ethnicity	
Hispanic	0.81 (0.42–1.55)
Non-Hispanic white	1.00 (1.00–1.00)
Non-Hispanic black	0.93 (0.64–1.34)
Other	1.15 (0.58–2.30)
Federal poverty level (%)	
<100	0.98 (0.48–2.00)
100–199	1.01 (0.57–1.80)
200–299	0.99 (0.60–1.64)
300–499	0.97 (0.58–1.60)
>500	1.00 (1.00–1.00)
Education (years)	
>12	0.77 (0.45–1.30)
12	1.07 (0.77–1.47)
<12	1.00 (1.00–1.00)
Preferred language	
English	1.00 (1.00–1.00)
Other	0.87 (0.47–1.63)
Health insurance coverage	
No	1.00 (1.00–1.00)
Yes	1.98 (0.96–4.12)

All results have been adjusted for insurance, language, usual source of care, and survey year.

Centers for Disease Control and Prevention, National Center for Health Statistics. National Health and Nutrition Examination Survey Data. Available at <http://www.cdc.gov/nchs/surveys.htm>.

difference may reflect differences in the intensification of treatment by the provider or differences in patient adherence to that treatment and/or therapeutic lifestyle.^{26,27} Higher socioeconomic status

Table 3. Predictors of Low-Density Lipoprotein Cholesterol Goal Attainment among Adults (n = 1,133) Taking Statins in the National Health and Nutrition Examination Survey, 1999 to 2006²¹

Predictor Variable	Odds Ratio (95% CI)
Survey year	
1999–2000	1.00 (1.00–1.00)
2001–2002	2.27 (1.12–4.59)
2003–2004	2.92 (1.65–5.18)
2005–2006	3.81 (2.07–6.99)
Usual source of care	
No	2.04 (0.91–4.54)
Yes	1.00 (1.00–1.00)
Age (years)	
21–34	1.00 (1.00–1.00)
35–44	0.24 (0.03–2.21)
45–54	0.33 (0.03–3.27)
55–64	0.25 (0.03–2.34)
≥65	0.37 (0.04–3.24)
Sex	
Female	1.00 (1.00–1.00)
Male	0.74 (0.51–1.06)
Race/ethnicity	
Hispanic	0.73 (0.39–1.36)
Non-Hispanic white	1.00 (1.00–1.00)
Non-Hispanic black	0.89 (0.60–1.32)
Other	0.72 (0.32–1.65)
Federal poverty level (%)	
<100	0.42 (0.22–0.80)
100–199	0.59 (0.37–0.93)
200–299	1.00 (1.00–1.00)
300–499	0.87 (0.52–1.45)
>500	1.00 (1.00–1.00)
Education (years)	
<12	0.59 (0.41–0.86)
12	0.82 (0.56–1.20)
>12	1.00 (1.00–1.00)
Preferred language	
English	1.00 (1.00–1.00)
Other	1.51 (0.72–3.17)
Health insurance coverage	
No	1.76 (0.65–4.75)
Yes	1.00 (1.00–1.00)

All results have been adjusted for insurance, language, usual source of care, and survey year.

Centers for Disease Control and Prevention, National Center for Health Statistics. National Health and Nutrition Examination Survey Data. Available at <http://www.cdc.gov/nchs/surveys.htm>.

is associated with a healthy diet, physical activity, and higher rates of obesity.^{28,29} Each of these factors might contribute to lower goal attainment by

socioeconomic status. Improvement in goal attainment over time has also been previously noted.³⁰

Given the powerful effects of statins on cardiovascular and all-cause mortality,^{31,32} these results suggest that those lacking a USOC may be at higher risk. Specifically, less optimal management of high cholesterol among those without a USOC may contribute to higher long-term mortality.

Previous studies suggest that >20% of the adult population lack a USOC,³³ which is slightly higher than the 18% in this sample. Consistent with previous studies,^{33,34} we found that being uninsured, Hispanic, less educated, and poor were associated with no USOC. Among our sample nearly 50% of those without a USOC were uninsured and 45% had household incomes 200% of the poverty level.

In past studies, the most frequent reasons for lacking a USOC included lack of perceived need (ie, never/seldom sick) and cost associated with care.³³ The reasons for lack of perceived need are unclear, but they may reflect lower illness burden and lack of perceived benefit from preventive care. Costs are a well-recognized barrier to insurance.

Having a USOC is often a prerequisite for initiating and continuing chronic disease management. This may be particularly true for cholesterol management. An emergency department or urgent care physician is unlikely to assess a person's need for statins or to start statin treatment. Similarly, patients who experience an interruption in USOC may no longer be able to obtain a prescription for their statin treatment.

Our findings are subject to several limitations. First, our measure of USOC did not distinguish between primary or specialty care or provider continuity. Provider continuity provides benefits beyond USOC alone.^{2,3,35} It is conceivable that stronger effects might be observed with better measures. Second, our data are cross-sectional. We had no data about pretreatment cholesterol levels, drug doses, or the number of times that physicians intensified therapy. We estimated pretreatment lipid levels based on expected reductions in lipids with different lipid-lowering drugs. Nonetheless, our findings regarding the association of USOC with appropriate treatment with statins were robust in sensitivity analysis in which we varied the percent reduction in cholesterol with treatment. Given the relatively small subsample of participants for whom LDL-C was obtained, we imputed LDL-C based on total cholesterol and HDL cholesterol. Com-

parison of effect sizes between the full sample and subsample showed similar results. The absence of an association between USOC and LDL-C was unexpected. This may reflect limitations of the measures discussed above as well as sample size limitations, but further research is needed to clarify this. Previous studies have noted that African Americans are less likely to receive statins or reach goal attainment.^{30,36,37} Whether these differences reflect diffusion of statin across groups over time or potential bias in imputation of pretreatment LDL-C levels cannot be determined from these data.

Conclusion

These national data show that USOC is associated with appropriate statin use. Lower income and education are associated with cholesterol goal attainment among those taking statins. These findings highlight the salience of USOC and socioeconomic factors in cholesterol treatment.

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