Relation Between Cardiology Follow-Up Visits, Evidence-Based Statin Prescribing, and Statin Adherence (from the Veterans Affairs Health Care System)

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Statin use remains suboptimal in patients with atherosclerotic cardiovascular disease (ASCVD). We assessed whether outpatient care with a cardiology provider is associated with evidence-based statin prescription and statin adherence. We identified patients with ASCVD aged ≥18 years receiving primary care in 130 facilities and associated community-based outpatient clinics in the entire Veterans Affairs Health Care System between October 1, 2013 and September 30, 2014. Patients were divided into: (1) patients with at least 1 outpatient cardiology visit and (2) patients with no outpatient cardiology visits in the year before the index primary care visit. We assessed any- and high-intensity statin prescription adjusting for several patient- and facility-level covariates, and statin adherence using proportion of days covered (PDC). We included 1,249,061 patients with ASCVD (mean age: 71.9 years; 98.0% male). After adjusting for covariates, patients who visited a cardiology provider had greater odds of being on a statin (87.4% vs 78.4%; Odds ratio [OR] 1.25, 95% Confidence interval [CI] 1.24 to 1.26), high-intensity statin (34.5% vs 21.2%; OR: 1.21, 95% CI 1.21 to 1.22), and higher statin adherence (mean PDC 0.76 ± 0.29 vs 0.70 ± 0.34, PDC ≥0.8: 62.0% vs 57.3%; OR 1.09, 95% CI 1.09 to 1.11). A dose response relation was seen with a higher number of cardiology visits associated with a higher statin use and statin adherence. In conclusion, compared with outpatient care delivered by primary care providers alone, care delivered by a cardiology provider for patients with ASCVD is associated with a higher likelihood of guideline-based statin use and statin adherence. Published by Elsevier Inc. (Am J Cardiol 2019;124:1165−1170)

Despite overwhelming evidence, many patients with ASCVD are either not taking statin therapy or are treated with a suboptimal dose.[1−5] Reasons include patient-level determinants such as adverse effects related to statins, medication nonadherence, as well as provider-level gaps such as poor understanding of dyslipidemia guidelines or health care provider clinical inertia.[6−8] Many patients with ASCVD receive outpatient care from cardiology providers, however, a majority of patients with ASCVD are managed by primary care clinicians alone. Although previous studies have shown lower than optimal statin prescription rates with significant geographical and health care system variation, the impact of care by a cardiology provider on these prescription rates independent of the intensity of primary care management (i.e., the number of primary care visits) is not well known.[9,10] In addition, the impact of care from a cardiology provider on patient medication adherence is also not well-characterized. In this study, we assessed if

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Funding: This work was supported by a Department of Veterans Affairs Health Services Research & Development Service Investigator Initiated Grant (IIR 16−072), an American Heart Association Beginning Grant-in-Aid (14BGIA20460366), the American Diabetes Association Clinical Science and Epidemiology award (1-14-CE-44), and the Houston VA Health Services Research & Development Center for Innovations grant (CIN13-413)

The opinions expressed reflect those of the authors and not necessarily those of the Department of Veterans Affairs or the US government.

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See page 1170 for disclosure information.

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0002-9149/Published by Elsevier Inc.
https://doi.org/10.1016/j.amjcard.2019.07.022

outpatient care with a cardiology specialist is associated with guideline-based statin prescribing and statin adherence in patients with ASCVD.

Methods

We identified patients with ASCVD aged greater than or equal to 18 years receiving primary care in 130 facilities and associated community-based outpatient clinics in the entire Veterans Affairs (VA) Health Care System between October 1, 2013 and September 30, 2014. Details of this cohort have been described previously.[11,12] Patients were identified as having ASCVD if they had a previous history of ischemic heart disease, peripheral arterial disease, or ischemic cerebrovascular disease. Patients with ASCVD were identified using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnoses and procedure, or current procedural terminology codes.[11,13,14] They were included if they had at least 2 outpatient diagnosis codes or 1 inpatient diagnosis code for unstable angina, or 1 code for myocardial infarction, percutaneous coronary intervention, or coronary artery bypass grafting during the study period.[12,15] The positive predicted value using this algorithm to identify patients with ASCVD was 88% when compared with manual chart review.[11,12] We excluded patients if they had a history of metastatic cancer in the preceding 5 years or a history of hospice care in the preceding year.[16]

We used patient-level factors to calculate Diagnostic Cost Group (DCG) relative risk scores (RRS) for each ASCVD patient. DCG RRS serves as an indirect measure of a patient's overall illness burden. DCG RRS has been used and validated in prior studies as a surrogate marker for a patient's overall illness burden.[8,17−19] A patient with a DCG RRS score of 1.3, for example, reflects a 30% greater expected cost of care compared with an "average" patient (DCG RRS score = 1) and a 30% greater illness burden compared with an average patient.

The VA administrative pharmacy data sources were used to determine statin prescription and adherence patterns for each patient. Statin prescription was determined based on its use within 100 days before or 14 days following the most recent primary care visit. Statin intensity was defined based on the most recent statin prescription. For the purpose of these analyses, high-intensity statin use was defined as a mean daily dose of atorvastatin ≥40 mg or rosuvastatin ≥20 mg. We used proportion of days covered (PDC) as a measure of statin adherence. This is calculated by dividing the number of days "covered" by a prescription refill in a time period by the total number of days in that period.[20] This method for estimating medication adherence has been validated in previous studies.[18,21] A PDC value ≥0.8 is considered a marker of good medication adherence with values <0.8 being a marker of poor medication adherence.[22]

Our outcomes of interest were statin prescription and adherence in ASCVD patients, which we compared between (1) patients with at least 1 outpatient cardiology visit (outpatient cardiology visit group) and (2) patients with no outpatient cardiology provider visits (no outpatient cardiology visit group) in the year before the index primary care visit. We compared baseline patient-, physician- and facility-level variables between the 2 groups. Categorical variables were analyzed using the chi-square test whereas *t* Test was used for continuous variables.

We then compared the proportion of patients receiving any statin and high-intensity statin therapy between the 2 groups. We initially constructed a univariate model to assess the magnitude of difference between statin therapy and adherence between the 2 groups using odds ratios (OR) and their 95% confidence intervals (CI). This was followed by a stepwise multivariate logistic regression model adjusting for patient factors (age, sex, race, ethnicity, history of hypertension, diabetes, and type of ASCVD [ischemic heart disease, ischemic cerebrovascular disease, or peripheral arterial disease], DCG RSS) and then for patient and provider and facility-level factors (provider type [physician vs Advanced Practice Provider (APP)], receipt of care at a teaching vs nonteaching facility, urban or rural facility, and the median number of primary-care visits in the 12 months before the index visit) giving us adjusted OR. Similarly, we compared statin PDC between the 2 groups both as a continuous variable and as a categorical variable of PDC ≧80%. For analyses pertaining to PDC ≧0.8, unadjusted and adjusted OR with 95% CI using logistic regression models were provided. For the continuous PDC, we used a linear regression model for both unadjusted and adjusted models. The resultant beta-coefficients in the linear regression models can be interpreted as the change in dependent variable (PDC) as it relates to a per unit increase in the independent variable (number of cardiology visits), while adjusting for all the covariates described above. We then stratified patients with outpatient cardiology visits based on the number of visits (1 visit, 2 visits, and ≥3 visits) in the preceding 12 months and analyzed statin prescription and adherence by comparing the proportion of patients receiving statins and high-intensity statin therapy, proportion of patients with PDC ≥0.8, and continuous PDC in each group with patients with no cardiology visits and performing similar analyses as above. We also assessed the trend of statin use, high-intensity statin use, and proportion of patients with good medication adherence (PDC ≥0.8), with the number of cardiology visits (no visits, 1 visit, 2 visits, and ≥3 visits) using a parametric and nonparametric test.

SAS version 9.1.3 (SAS Institute, Inc., Cary, North Carolina) and Stata version 11 (StataCorp, College Station, Texas) were used for all analysis. The study protocol was approved by the institutional review boards at Baylor College of Medicine and the Michael E. DeBakey VA Medical Center.

Results

We identified 1,273,736 patients with ASCVD in 130 facilities and associated community-based outpatient clinics in the entire Veterans Affairs Health Care System. We excluded 24,675 patients who had metastatic cancer or were receiving hospice care. Of the remaining 1,249,061 patients, 242,980 (19.5%) had at least 1 outpatient cardiology visit while 1,006,081 (80.5%) did not have any outpatient cardiology visit in the year before the index primary care visit. ASCVD patients in the group with an outpatient cardiology visit had a higher prevalence of hypertension,

Table 1
Baseline characteristics of the study population by cardiology visit

Variable	Cardiology visit		p value
	No (n = 1,006,081)	Yes (n = 242,980)	
Age, mean ± SD (Years)	72.6 ± 10.73	68.9 ± 9.76	<0.01
Men	986,145 (98.0%)	237,531 (97.8%)	<0.01
Race			<0.01
White	789,163 (78.8%)	191,927 (79.4%)	
Black	105,221 (10.5%)	34,084 (14.1%)	
Ethnicity			<0.01
Hispanic	37,739 (3.7%)	11,240 (4.6%)	
Non-Hispanic	910,689 (90.5%)	224,015 (92.1%)	
Hypertension	800,193 (79.5%)	220,741 (90.9%)	<0.01
Diabetes mellitus	436,397 (43.4%)	125,372 (51.6%)	<0.01
Coronary heart disease	778,484 (77.4%)	216,445 (89.1%)	<0.01
Cerebrovascular disease	274,292 (27.3%)	67,550 (27.8%)	<0.01
Peripheral artery disease	154,119 (15.3%)	41,288 (17.0%)	<0.01
Urban/rural PC Facility			
Urban	819,851 (79.7%)	208,682 (20.3%)	
Rural	184,395 (84.4%)	34,096 (15.6%)	
Teaching facility	370,049 (36.8%)	125,428 (51.6%)	<0.01
Primary care provider type			<0.01
Physician providers	754,682 (78.4%)	187,913 (80.4%)	
Advanced practice providers	208,163 (21.6%)	45,617 (19.5%)	
Number of PCP visits, mean ± SD	4.02±4.60	7.42±6.47	<0.01
DCG RRS, mean ± SD	1.62±2.56	3.19±3.82	<0.01

DCG RRS = Diagnostic cost group relative risk score (marker of illness burden of patients); SD = Standard deviation.

diabetes mellitus, ischemic heart disease, and peripheral arterial disease compared with ASCVD patients with no outpatient cardiology visits (Table 1). A greater proportion of ASCVD patients in the outpatient cardiology visit group were also receiving care at teaching facilities, and also had a higher mean number of PCP visits in the year before index primary care visit. Mean DCG RRS was significantly higher in the outpatient cardiology visit group (3.19 ± 3.82) compared with the no outpatient cardiology visit group (1.62 ± 2.56; p <0.01). Differences between the 2 groups were statistically different for most variables due to the large sample size, although, some of these differences were small and likely not clinically meaningful.

Of the 1,249,061 ASCVD patients, 1,000,967 (80.1%) patients were on statins. A greater proportion of patients in the outpatient cardiology visit group (87.4%) were on statins compared with the group with no outpatient cardiology visits (78.4%) (Table 2). A higher proportion of patients in the outpatient cardiology visit group also received high-intensity statin therapy compared with the no outpatient cardiology visit group (34.5% vs 21.2%). In terms of statin adherence, ASCVD patients receiving cardiology visits had higher statin adherence and a higher proportion of patients with statin PDC ≥80% compared with ASCVD patients without outpatient cardiology visits (62.0% vs 57.3%). After adjusting for covariates, ASCVD patients who had a cardiology visit had greater odds of being on a statin, high-intensity statin therapy, and higher statin adherence compared with those who did not have any outpatient cardiology visits. After stratification by gender, there was no

Table 2
Comparison of statin prescription, statin intensity, and statin adherence among patients with atherosclerotic cardiovascular disease receiving cardiology visits and those not receiving cardiology visit.

Measures of statin prescription and adherence	Cardiology visit		OR (95% CI) (unadjusted)	OR (95% CI) (adjusted*)
	No (n = 1,006,081)	Yes (n = 242,980)		
Receiving statin therapy	788,717 (78.4%)	212,250 (87.4%)	1.403 (1.394-1.413)	1.292(1.282-1.301)
Receiving high- intensity statin therapy	211,117 (21.2%)	83,551 (34.5%)	1.369 (1.363-1.376)	1.236(1.230-1.242)
Statin PDC≥0.8	57.3%	62.0%	1.102 (1.097-1.108)	1.115 (1.110-1.121)

	Mean ± SD	Mean ± SD	Unadjusted β-coefficients (95% CI)	Adjusted β-coefficients (95% CI)
Statin PDC (continuous), mean ± SD	0.70 ± 0.346	0.76 ± 0.297	0.027 (0.026-0.028)	0.023 (0.022-0.024)

CI = Confidence interval; PDC = Proportion of days covered; SD = Standard deviation.

* Adjusted for patient's age, sex, race (whites vs others), ethnicity, diagnostic cost group relative risk score (marker of overall illness burden of patients), history of hypertension, history of diabetes, type of ASCVD (ischemic heart disease, ischemic cerebrovascular disease, history of peripheral arterial disease), advanced practice versus physician primary care provider, teaching versus non-teaching facility, urban versus rural facility and median number of primary care visits 1 year prior to the index primary care visit.

Table 3
A comparison of statin prescription, statin intensity, and statin adherence among patients with atherosclerotic cardiovascular disease with 1, 2, ≥3 frequency of outpatient cardiology visits compared with those without any cardiology visit

Measures of statin prescription and adherence	Patient without cardiology visits	Patients with 1 cardiology visit		Patients with 2 cardiology visits		Patients with ≥3 cardiology visits	
	N = 1,006081 (%)	n =111,998 (%)	OR* (95% CI)	n = 57,841 (%)	OR* (95% CI)	n=73,141 (%)	OR* (95% CI)
Statin use	78.39	85.12	1.400 (1.374-1.426)	88.33	1.717 (1.670-1.764)	89.98	2.031 (1.978-2.085)
High-intensity statin therapy use	21.21%	31.19	1.377 (1.357-1.397)	35.45	1.592 (1.562-1.622)	38.62	1.810 (1.780-1.842)
PDC (<0.8, ≥0.8)	57.27%	60.32	1.155 (1.138-1.172)	62.48	1.263(1.239-1.288)	63.79	1.366 (1.342-1.390)
	Mean ± SD	Mean ± SD	β-coefficients (95% CI)	Mean ± SD	β-coefficients (95% CI)	Mean ± SD	β-coefficients (95% CI)
PDC Continuous	0.70 (0.34)	0.74 ± 0.30	0.034 (0.032-0.037)	0.76 ± 0.29	0.051 (0.048-0 .054)	0.77 ± 0.28	0.066 (0.063-0.068)

CI = Confidence interval; PDC = Proportion of days covered; SD = Standard deviation.

* Adjusted for patient's age, sex, race (whites vs others), ethnicity, diagnostic cost group relative risk score (marker of overall illness burden of patients), history of hypertension, history of diabetes, type of ASCVD (ischemic heart disease, ischemic cerebrovascular disease, history of peripheral arterial disease), advanced practice provider versus physician primary care provider, teaching versus non-teaching facility, urban versus rural facility and median number of primary care visits 1 year prior to the index primary care visit.

gender interaction observed between cardiology visits and statin prescription (statin use: p = 0.19; high-intensity statin use: p = 0.45), or cardiology visits and statin adherence (PDC ≥0.8: p = 0.40; continuous PDC: p = 0.41).

In patients with cardiology visits, the number (%) of patients with ≥3, 2, or 1 cardiology visits were 73,141 (30.1%), 57,841(23.8%), and 111, 998 (46.0%), respectively. After further stratification of patients with outpatient cardiology visits based on the frequency of cardiology visits (Table 3, Figure 1), 90.0%, 88.3%, and 85.1% patients with ≥3, 2, and 1 cardiology visits were on statin therapy compared with 78.4% patients with no outpatient cardiology visits. Similarly, 38.6%, 35.5%, and 31.2% patients with ≥3, 2, and 1 outpatient cardiology visits were on high-intensity

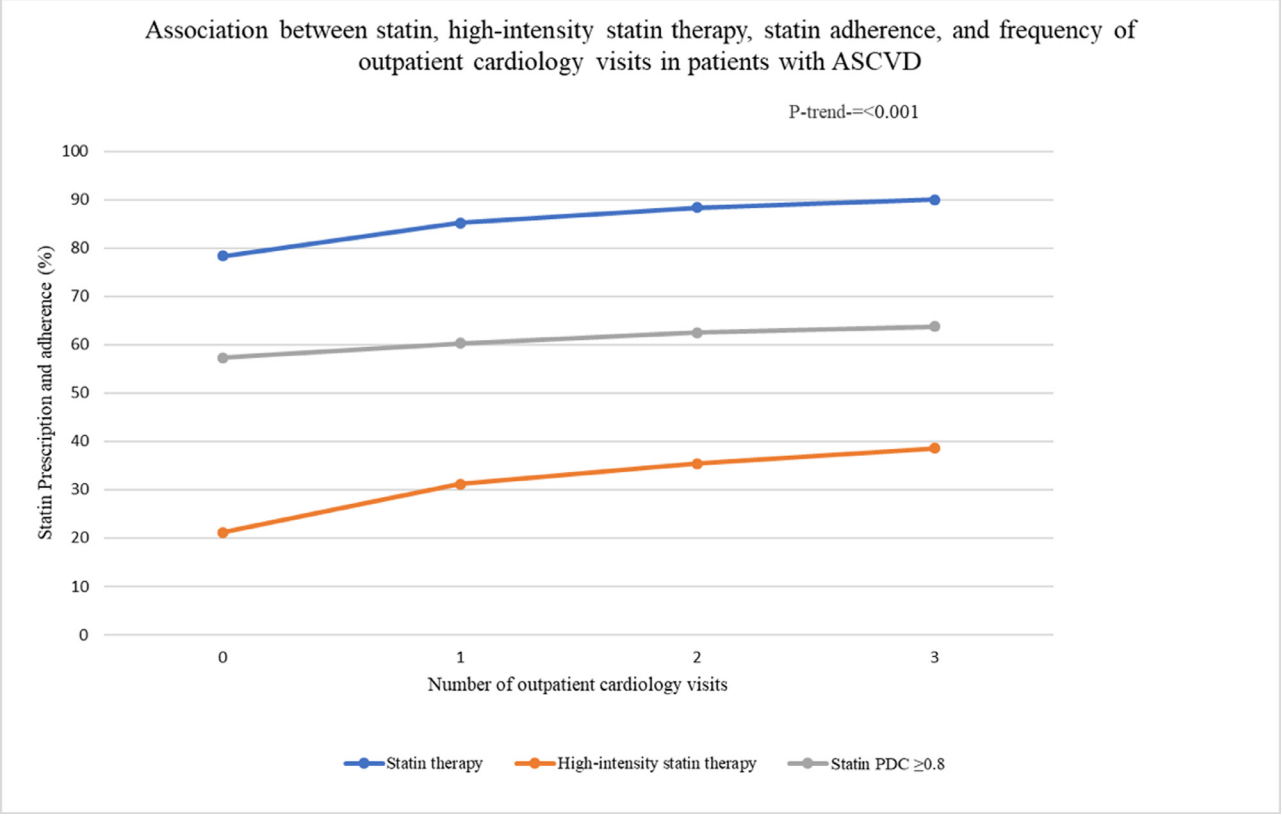

Figure 1. Association between statin, high-intensity statin therapy, statin adherence and frequency of cardiology visits in patients with atherosclerotic cardiovascular disease.
ASCVD = Atherosclerotic cardiovascular disease; PDC = Proportion of days covered.

statin therapy compared with 21.2% patients without any outpatient cardiology visits. Statin adherence was also higher in patients with ≥3 cardiology visits, 2 cardiology visits, and 1 cardiology visit, compared with patients with no outpatient cardiology visits.

Discussion

In our analyses including 1,249,061 VA patients nationwide with clinical ASCVD, we found that almost 1/5 (19.9%) patients were not on statin therapy. A significantly higher proportion of ASCVD patients were on statin (87.4% vs 78.4%) and high-intensity statin therapy (34.5% vs 21.2%) if they had an outpatient cardiology visit compared with those who did not. Patients who had an outpatient cardiology visit also had greater adherence to statin therapy (mean PDC 0.76 ± 0.297) compared with patients who were managed by their primary care providers alone (0.70 ± 0.346). These differences persisted after adjusting for various patient, provider and facility-level covariates with patients receiving cardiology visits having 25% higher odds of being on a statin, 21% higher odds of being on high-intensity statin therapy, and 9% higher odds of being adherent to statin therapy. Statin use, high-intensity statin therapy use, and statin adherence increased with the frequency of outpatient cardiology visits.

Despite strong evidence supporting the use of statin therapy, statins were not prescribed in 19.9% of our patients with ASCVD. Previous studies that examined statin prescription rates demonstrated similar results.[8,23,24] Insights from the PINNACLE registry (largest outpatient quality improvement registry for cardiovascular diseases) showed that of 1,174,545 patients in the registry, 96.1% were statin-eligible but 32.4% patients were not receiving statin therapy.[25] Reasons for lower prescription rates include perceived lack of indication for statin therapy and patient reluctance to take statins due to adverse effects. A recent study that examined primary care providers' beliefs regarding statin prescription showed that the major barrier to statin therapy was associated side effects, most commonly myopathy (47%).[26] Previous studies have shown that although knowledge gaps pertaining to cholesterol guidelines exist for both primary care and specialist providers, some of these gaps were more prevalent in primary care providers. For example, in a national survey, 22% of the primary care providers knew the definition of high-, intermediate- and low-intensity statin therapy as opposed to 33% of specialist (cardiology and endocrinology) providers.[3] Higher prescription rates in patients receiving cardiology visits would suggest higher thresholds for statin discontinuation and perhaps greater efforts to explore alternate statin drugs in cardiology providers compared with primary care providers.

We also found that patients receiving care from cardiology providers had higher statin adherence compared with those receiving care from only primary care providers. Data on the impact of specialist provider care on medication adherence are scarce. Various reasons could explain why statin adherence is higher in patients treated by cardiology providers. First, it is possible that given their primary focus on one organ system, cardiology providers may have more time to explain to patients the reasons why they are on a statin and its importance as opposed to primary care providers who have multiple co-morbidities and medical issues to address in a primary care visit. Second, the treatment of patients with ASCVD by a cardiology provider may heighten the sense of urgency and importance of initiating and adhering to a statin long-term. Lastly, our results may be impacted by the possibility that some ASCVD patients who were asked to see a cardiology provider but failed to do so would also be nonadherent to their medication regimen, including statins. These patients would be counted as not having a cardiology visit in our analyses. Although not entirely accounted for, this may be partly negated by the dose response relation between cardiology visits and guideline-based statin therapy and statin adherence.

The financial cost associated with a 20% increase in statin adherence is not known, however, a recent study showed increasing risk of death from all causes with decreasing statin adherence, compared with patients with high statin adherence (medication possession ratio >90%).[27] This may translate to higher financial costs for providing to patients with lower statin adherence.

The study brings to light the need for more qualitative work in this space to better understand the reasons underlying improved prescription rates associated with outpatient cardiology visits compared with primary care visits. Some solutions to improve statin adherence may include built-in quality improvement checks in health records that remind providers to prescribe guideline-concordant intensity of statins therapy to patients with a diagnosis of ASCVD. Utilizing services of support staff such as pharmacists to review medications and educate patients about the importance of statins in clinic as well as pharmacy settings may also result in better prescription and adherence rates in primary care. Finally, and perhaps most importantly, further research is needed to fully understand whether other novel communication methods such as teleconsultation with a cardiology provider are associated with similar increases in evidence-based statin use and statin adherence as those novel methods are less resource intensive and could be more scalable as opposed to increasing in-person visits with a cardiology provider.

Our study has limitations. These analyses represent those from the Department of Veterans Affairs where patterns of care could be different compared with other health care systems. The Department of Veterans Affairs given its patient population mostly represents male patients. Although female ASCVD patients represented a small proportion of our overall study population (~2%), it is important to note that our analyses included a large number of female ASCVD patients (n = 25,385) given the national scope of our cohort. The study also does not identify physician and patient factors at an individual-level that may have influenced the observed patterns. The study is also limited by its retrospective design which may have resulted in unmeasured confounding factors. Further qualitative work is needed to fully understand these factors at the level of an individual provider and patient.

Our study shows suboptimal statin prescription rates and suboptimal statin adherence in patients with ASCVD. Patients with ASCVD managed by a cardiology provider

had higher statin prescription rates and statin adherence compared with patients managed by primary care providers. A higher number of cardiology visits was associated with a progressively higher proportion of patients receiving statin and high-intensity statin therapy and a higher proportion of patients with good statin adherence. However, even in patients treated by cardiology providers, gaps in therapy remain with a significant percentage of patients not receiving statin therapy with only 1 in 3 patients with ASCVD receiving high-intensity statin therapy.

Disclosures

Dr Peter P. Toth is a consultant for Amarin, Amgen, AstraZeneca, Kowa, Novo-Nordisk, Regeneron, Sanofi, Theravance and part of the speakers' bureau for Amarin, Amgen, Novo-Nordisk, Regeneron, Sanofi.

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