Adherence to Blood Cholesterol Treatment Guidelines Among Physicians Managing Patients With Atherosclerotic Cardiovascular Disease

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The ACC/AHA blood cholesterol treatment guidelines recommend statin therapy for all patients after experiencing an acute cardiovascular event. Previous analyses have shown that physicians have been slow to adopt guidelines, and many patients remain untreated or undertreated with statins after a cardiovascular event. However, reasons for this remain unknown. This analysis used electronic medical records and patient chart data from Reliant Medical Group (Worcester, Massachusetts) to evaluate physician adherence to the 2013 ACC/AHA blood cholesterol guidelines when treating patients with evidence of acute atherosclerotic cardiovascular disease and the reasons for the observed treatment decisions. Less than 50% of acute atherosclerotic cardiovascular disease patients were treated according to the ACC/AHA guidelines. Nearly 42% of patients not treated according to guidelines received a lower statin intensity than recommended. The most common reason cited by 41.8% of physicians for treating with a statin intensity below the recommended intensity was low-density lipoprotein cholesterol stable or at goal, despite ACC/AHA guidelines recommending specific statin intensities rather than specific low-density lipoprotein cholesterol levels. In conclusion, physician and patient education on the importance of maximizing lipid-lowering therapy in this high-risk patient population should be emphasized. **(Am J Cardiol 2019;124:169−175)**

The 2013 ACC/AHA guidelines on the treatment of blood cholesterol to reduce atherosclerotic cardiovascular disease (ASCVD) recommends statin therapy for all adult patients with known cardiovascular disease, regardless of low-density lipoprotein cholesterol (LDL-C) level, and the more recent 2018 ACC/AHA guidelines reconfirmed these recommendations.[1,2] Various literature have explored the impact of the 2013 ACC/AHA guidelines on US cardiovascular practices, including physician prescribing patterns,[3−5] changes in patient's adherence to and initiation of statin therapy,[6,7] and implications for defining treatment targets.[8] The majority of these analyses have concluded that a large proportion of statin-eligible patients are not receiving guideline-recommended lipid-lowering therapy after an acute cardiovascular event; however, the reasons for this deficit largely remain unknown. This study used detailed electronic medical records (EMR) and chart review data to establish a more comprehensive understanding of blood cholesterol management practices in a broad sample of patients with acute ASCVD and the reasons for high-risk patients not being treated in accordance with recent guidelines, as documented by the prescribing physician. Understanding the reasons for treatment decisions supplements findings from previous analyses on physician adherence to 2013 ACC/AHA blood cholesterol guidelines and provides a more detailed framework for promoting physician education and improving patient management.

Methods

This analysis was conducted using EMR (Epic Systems, Verona, Wisconsin), administrative claims, and patient chart data from Reliant Medical Group (Worcester, Massachusetts), a multispecialty group practice with a predominantly managed care population of about 300,000 patients. Reliant Medical Group has implemented the 2013 ACC/AHA guidelines across its provider network and therefore provides a rich data source for evaluating physician adherence to the most recent blood cholesterol treatment guidelines. The retrospective analysis included data from January 1, 2013 to June 30, 2016. This study received approval from the Reliant Medical Institutional Review Board before initiation. All data were de-identified and compliant with the provisions of the Health Insurance Portability and Accountability Act of 1996.

The analysis was implemented in 2 distinct phases, each with the following objectives: (1) to evaluate physician adherence to 2013 ACC/AHA blood cholesterol guidelines when treating patients with evidence of acute ASCVD in an Integrated Delivery Network; (2) to conduct a systematic chart review in patients who are not managed according to the 2013 ACC/AHA guidelines to determine the details surrounding their treatment experience. For the first study

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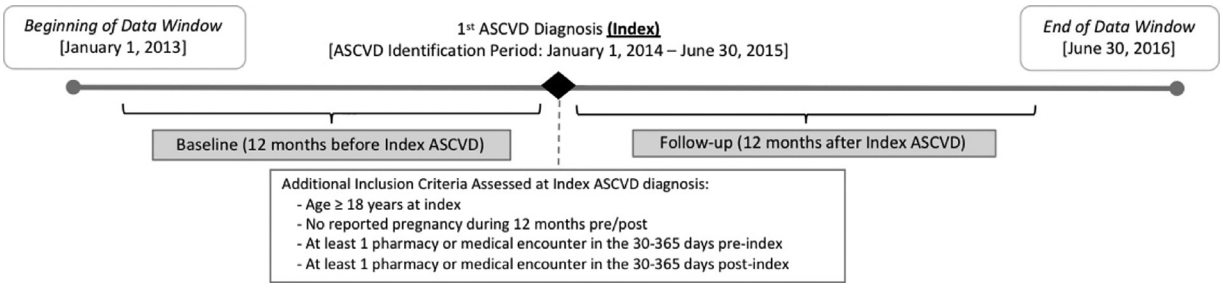

Figure 1. Patient selection for ACC/AHA guideline adherence using EMR data.

objective, patients were required to have at least 1 EMR-based encounter with a diagnosis code for an acute ASCVD event between January 1, 2014 and June 30, 2015. Acute ASCVD events included codes for acute coronary syndrome (i.e., myocardial infarction and unstable angina), stroke, or transient ischemic attack, and the first observed acute ASCVD event was flagged as the index date. Patients with coronary/peripheral revascularization or peripheral arterial disease without acute ASCVD as defined above were not included in this analysis. All patients were ≥18 years at the index date, were not pregnant anytime during the study period, and had at least 1 EMR-based encounter identified in the year before index and 1 EMR-based encounter in the year following index to ensure enrollment in the integrated delivery network pre- and postindex event (Figure 1). Patient characteristics including age, gender, select co-morbidities, and prior statin use were evaluated during the 1-year baseline period.

Physician adherence to the prescribing guidelines was assessed over a 1-year time period, starting on the day after the index date. The first statin prescribed after the index event was evaluated against the 2013 ACC/AHA guidelines for secondary prevention after a clinical ASCVD event. Specifically, patients ≤75 years of age that initiated or continued therapy with a high-intensity statin after their index event and patients >75 years of age that initiated or continued treatment with a moderate- or high-intensity statin after their index event were flagged as being treated according to guideline recommendations. Given that the exact definition for low, moderate, and high intensity therapy varies by statin type, the dosage of each index treatment was evaluated in order to determine its level of intensity consistent with ACC/AHA statin intensity definitions (Table 1). Adherence to treatment guidelines was evaluated for the overall cohort, as well as by index ASCVD type.

For the second study objective, a chart review was conducted in a random subsample of 500 patients that were not prescribed a statin after index or were prescribed a statin that did not meet the criteria detailed in the guidelines. The chart review included all available medical history and physician notes from the Reliant provider network during the 4-year study period, adding significant detail beyond what was available through the initial EMR/claims analysis. Adherence to guidelines for the index treatment, as captured by the EMR and administrative claims data, was confirmed by chart review for the random sample of patients.

A team of trained medical professionals from the Reliant provider network conducted the chart review on the randomized, de-identified set of patient IDs and abstracted data on a structured chart review form. Reviewers were provided the date and type of acute ASCVD index event identified through the EMR analysis, and recorded the following information for each patient ID: clinical characteristics, including blood pressure, body mass index, smoking status, and ASCVD events before the index; family medical history; LDL-C laboratory values closet to and before the ASCVD index date; presence of a lipid lowering therapy before the ASCVD index date; confirmation of statin medication type and intensity on or within 12 months after the ASCVD index event; reason for observed statin prescription (if patient received statin) or reason for not receiving statin; and modifications to statin treatment prescription at any point after the index event.

Results

Less than half of the 4,106 ASCVD patients that met cohort selection criteria (Table 2) were treated according to the 2013 ACC/AHA guidelines. Approximately 30% of patients did not receive any statin, and approximately 30% of patients ≤75 years not treated according to guidelines were receiving a moderate intensity statin (Table 3). Physicians were most likely to adhere to guidelines when treating patients with myocardial infarction (MI) versus other forms of ASCVD (Figure 2).

Of the 2,075 patients not treated according to guidelines, 500 were randomly identified for further analysis. In this

Table 1
Statin intensity categories

Statin treatment categories	Generic name
Low intensity statin	Simvastatin 10 mg
	Pravastatin 10−20 mg
	Lovastatin 20 mg
	Fluvastatin 20−40 mg
	Pitavastatin 1 mg
Moderate intensity statin	Atorvastatin 10−20 mg
	Rosuvastatin 5−10 mg
	Simvastatin 20−40 mg
	Pravastatin 40−80 mg
	Lovastatin 40 mg
	Fluvastatin XL 80 mg
	Fluvastatin 80 mg
	Pitavastatin 2−4 mg
High intensity statin	Atorvastatin 40−80 mg
	Rosuvastatin 20−40 mg

Table 2
Baseline demographic and clinical characteristics for electronic medical records analysis (n = 4,016)

Variable	
Average age (standard deviation) (years)	71.5 (13.8)
≤75	2,233 (55.6%)
>75	1,783 (44.4%)
Women	1,831 (45.6%)
Diabetes mellitus	1,208 (30.1%)
Hypertension	2,731 (68.0%)
Arrhythmias	1,103 (27.5%)
Peripheral artery disease	667 (16.6%)
Myocardial infarction	339 (8.4%)
Unstable angina pectoris	55 (1.4%)
Stroke	679 (16.9%)
Transient ischemic attack	350 (8.7%)
Baseline medications	
Antihypertensives	1,993 (49.6%)
Antidiabetics	837 (20.8%)
Antihyperlipidemics	2,645 (65.9%)
Statin	2,563 (63.8%)
Ezetimibe	78 (1.9%)

Source: electronic medical records data from Reliant Medical Group (Worcester, Massachusetts), January 1, 2013 to June 30, 2016.

sample, 72 (14.4%) patients were excluded from the analysis because they were found to be prescribed statins in accordance with guidelines after chart review. Reasons for this discrepancy primarily included instances where the receipt of statin therapy was not captured in the administrative claims data because the patient paid for the prescription using cash or obtained the prescription through a different medical system, such as the veterans affairs (VA) system. For the remaining 428 patients, the conclusion of nonadherence determined from the EMR and administrative claims data was confirmed by the chart review. Patients analyzed in the chart review were demographically similar to the nonadherent EMR sample. Full clinical and demographic data for the random chart review subsample are presented in Table 4.

Table 3
Statin therapy treatment characteristics after an acute atherosclerotic cardiovascular disease event (n = 4,016).

	Patient population as percentage of overall population
Adherent (as per algorithm)	1,941 (48.3%)
Aged ≤75 years, on high-intensity statins	21.3%
Aged >75 years, on high-intensity statins	10.6%
Aged >75 years, on moderate-intensity statins	16.5%
Nonadherent (as per algorithm)	2,075 (51.7%)
Aged ≤75 years, on moderate-intensity statins	15.9%
Aged ≤75 years, on low-intensity statins	2.4%
Aged ≤75 years, NO statins	16.0%
Aged >75 years, on low-intensity statins	3.6%
Aged >75 years, NO statins	13.8%

Source: electronic medical records data from Reliant Medical Group (Worcester, Massachusetts), January 1, 2013 to June 30, 2016.

Adherence algorithm: patients ≤75 years of age that initiated or continued therapy with a high-intensity statin after their index event and patients >75 years of age that initiated or continued treatment with a moderate- or high-intensity statin after their index event.

The majority (64%) of the chart review subset were prescribed a statin within 12 months of ASCVD index; however, the treatment did not meet intensity requirements. Over half (58%) of patients prescribed a statin that did not meet guidelines for intensity were prescribed a moderate intensity statin, while 42% were prescribed a low intensity statin. The remainder (36%) of the chart review subset were not prescribed a statin therapy within 12 months of ASCVD index. Across index ASCVD type, the majority of patients prescribed a statin below the recommended intensity were ≤75 years of age. In contrast, the majority of patients that were not prescribed a statin were >75 years of age at the time of index.

Among the 154 patients who were not prescribed a statin after index, the chart review for 99 (64%) provided specific reasons for this decision (Table 5). The top reasons included muscle-related adverse events before the ASCVD index date, patient request/refusal, LDL-C stability, and LDL-C goal achievement. Although the exact criteria for LDL-C stability are defined by and vary across providers, free text responses grouped as "LDL-C stable" primarily stated that LDL-C levels were low and well controlled on the prescribed treatment. Similarly, goal level was not specified on most charts and is therefore assumed to be provider defined. For the remaining 274 patients prescribed a statin with a lower intensity than recommended, the chart review for 189 (69%) provided a reason for the prescribing decision (Table 6). Similar to patients not receiving any statin therapy, the most common reasons for prescribing a lower intensity statin included LDL-C stability, LDL-C goal attainment, and muscle-related adverse events before the ASCVD index date. The majority of patients prescribed a statin that did not meet intensity guidelines received the initial prescription from a primary care physician. A summary of the reasons for nonadherence is depicted in Figure 3.

The majority of patients who were not prescribed statin therapy did not receive any lipid-lowering therapy during the study window (77.3%). For those that received an alternative lipid-lowering therapy after index, most were treated with natural supplements; 14.3% of patients received fish oil and 1.3% received red yeast. Of the remainder, 2.6% received ezetimibe, 2.6% received gemfibrozil, and 2.0% received fenofibrate. In patients who were prescribed a statin with a lower statin intensity than recommended by treatment guidelines, only 14% had any type of treatment modification to their index statin prescription (average time to modification 407 days postindex).

Discussion

At the time of this analysis, the 2018 ACC/AHA guidelines had not been released and, as such, the 2013 ACC/AHA guidelines were used to evaluate prescribing patterns. Both the 2018 and 2013 ACC/AHA guidelines on the treatment of blood cholesterol for secondary ASCVD prevention recommends high-intensity statin therapy for patients ≤75 years of age and high/moderate-intensity statin therapy for patients >75 years of age if not contraindicated. Therefore, the results of this analysis are still highly relevant even to current guidelines. One notable difference new for the 2018 ACC/AHA guidelines and not specifically evaluated in

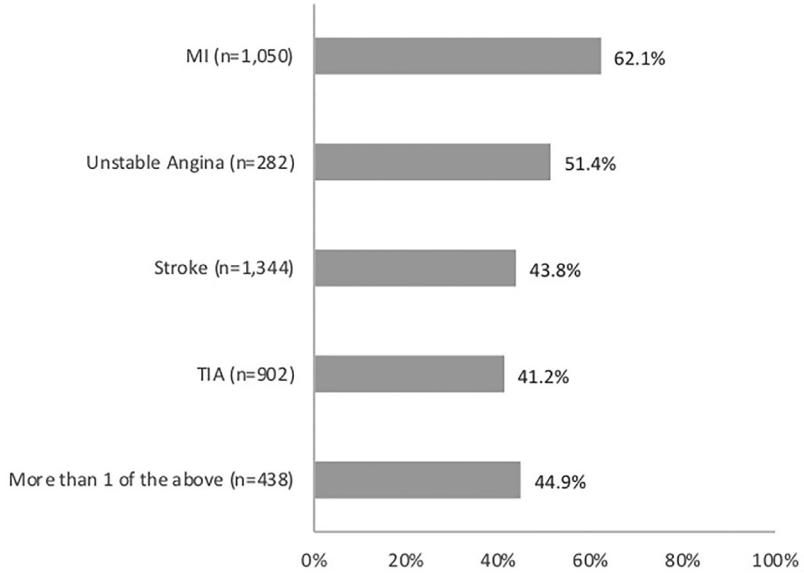

Figure 2. Physician adherence to guidelines by type of ASCVD index event.

this analysis is the identification of a very high-risk ASCVD cohort for whom addition of nonstatin therapies are recommended if LDL-C remains ≥70 mg/dL even with high or maximal tolerated statin therapy. The results from our analysis confirm findings from previous studies, namely that many patients eligible for statin therapy under the ACC/AHA guidelines do not always receive appropriate treatment. Approximately 70% of patients with acute ASCVD in our initial sample received a statin; however, in those receiving a statin, only 53% of patients ≤75 years of age and 88% of patients >75 years of age received treatment with the correct guideline-recommended intensity. This rate of adherence to guidelines is in-line or slightly above previously published estimates of statin use in nationally representative managed care populations.[5,9]

Table 4
Baseline demographic and clinical characteristics among a subset of patients not adherent to the 2013 ACC/AHA statin treatment guidelines* (n = 428)

Variable	
Average age (standard deviation) (years)	73.95 (9.96)
Women	220 (51.4%)
Previous atherosclerotic cardiovascular disease^	
Prior myocardial infarction	118 (27.57%)
Prior unstable angina pectoris	69 (16.12%)
Prior coronary artery revascularization	115 (26.87%)
Prior ischemic stroke	194 (45.33%)
Prior transient ischemic attack	131 (30.61%)
Prior peripheral artery disease	73 (17.06%)
Prior peripheral artery revascularization	13 (3.04%)
Average body mass index (kg/m^2)	49.12 (11.3)
Average blood pressure, systolic (mmHg)	129.07 (17)
Average blood pressure, diastolic (mmHg)	72.6 (9.94)
Smoking status	
Current smoker	46 (10.75%)
Never smoked	151 (35.28%)
Not noted	11 (2.57%)
Former smoker	220 (51.4%)
Number of pack-years (if current/former)	
0-<5	22 (5.14%)
5-<10	15 (3.5%)
10-<20	43 (10.05%)
≥20	135 (31.54%)
Not noted	51 (11.92%)

^ Patient history prior to index event - individual patient could have multiple events.

* Based on analysis of electronic medical record data showing patients to be non-adherent to 2013 ACC/AHA treatment guidelines.

Source: Reliant Medical Group, January 1, 2013 - June 30, 2016, electronic medical record chart review among patients non-adherent to 2013 ACC/AHA treatment guidelines

Our chart review analysis builds on previous publications that rely on physician surveys to understand observed statin treatment patterns.[10,11] By evaluating the reasons behind therapeutic decisions documented in the notes of the prescribing physician, which is not typically available through traditional database analyses, our study provides essential information needed to better understand statin prescribing patterns. These findings aid our understanding of divergence from guidelines for statin therapy in a high-risk population and help to build a more detailed platform for discussing practice patterns. For example, the relatively high presence of nonclinical reasons (e.g., patient refusal or previous patient nonadherence) is surprising given that adherence to treatment guidelines should be more stringent for these high-risk patients, and suggest the need for more patient education.

In patients prescribed a therapy that was not adherent to ACC/AHA treatment guidelines, a high proportion of physicians (41.8%) report stable or goal LDL-C levels as the primary reason for the treatment decision, despite ACC/AHA guidelines strictly moving away from a set definition for recommended cholesterol levels. Patients that were noted as having stable or goal LDL-levels did have lower average LDL-C levels before their index event than patients with other cited reasons (75 to 92 mg/dL vs >100 mg/dL); however, there were many outliers with levels above what

Table 5
Reasons for nonadherence to 2013 ACC/AHA guidelines among a subset of patients* not prescribed a statin after atherosclerotic cardiovascular disease index (n = 154)

Characteristic	Estimate	LDL-C before index event (mean)
Among patients who were not prescribed a statin following the ASCVD index date, reasons for not initiating therapy		
Muscle-related adverse events (prior to index)	28 (18.18%)	130.59
Other adverse events or contraindication (prior to index)	13 (8.44%)	126.38
Other explanation (from free text)		
LDL-C cholesterol		
LDL-C was stable	13 (8.44%)	86.15
LDL-C at goal	10 (6.49%)	91.22
Patient request	19 (12.34%)	141.16
Clinical reasons		
Elevated liver enzymes	3 (1.95%)	98.5
Intolerant to statins	5 (3.25%)	101.6
Only diet needed	5 (3.25%)	103.6
Non severe cardiovascular event	2 (1.3%)	104.5
Misc. reasons	3 (1.95%)	95
No explanation available	55 (35.71%)	101.73

* Based on analysis of electronic medical record data showing patients to be non-adherent to 2013 ACC/AHA treatment guidelines.
Source: Reliant Medical Group, January 1, 2013 to June 30, 2016, electronic medical record chart review in patients nonadherent to 2013 ACC/AHA treatment guidelines. LDL-C = low-density lipoprotein cholesterol.

would typically be considered acceptable for secondary prevention even according to the standard set by previous guidelines (i.e., <100 mg/dL set by adult treatment panel (ATP) III). Specifically, 19.5% of patients with cited controlled or stable cholesterol had LDL-C levels >100 mg/dL around the time of index. Our results also provide insight into how statin intolerance can impact treatment patterns for secondary ASCVD prevention. For instance, a large proportion of patients with previous muscle-related adverse event did not receive any statin therapy after the index event. Although this treatment decision is intuitive given the known adverse event profile, it is interesting that only a

Table 6
Reasons for non-adherence to 2013 ACC/AHA guidelines among a subset of patients prescribed a statin of lesser intensity than recommended by guidelines* (n = 274)

Characteristic	Estimate	LDL-C before index event (mean)
Reasons for not prescribing statin therapy according to 2013 ACC/AHA treatment guidelines, among patients prescribed a nonguideline statin		
Muscle-related adverse events (prior to index)	22 (8.03%)	109.32
Other adverse events or contraindication (prior to index)	6 (2.18%)	96.17
Other explanation (from free text)		
LDL-C cholesterol		
LDL-C was stable	82 (29.93%)	79.58
LDL-C at goal	74 (27.01%)	75.22
Patient led change		
Patient had stopped treatment on their own previously	2 (0.73%)	91
Patient requested dose change	3 (1.09%)	100.67
Clinical reasons		
Concerns over interaction with other treatment	3 (1.09%)	131
Patient Intolerant	6 (2.19%)	100.83
Other illness (e.g., cancer)	4 (1.46%)	65.75
Misc. reasons	3 (1.09%)	99
No explanation available	85 (31.02%)	94.73
Prescriber specialty		
Cardiologist	23 (8.39%)	78.74
Primary care physician	238 (86.86%)	87.12
Other	5 (1.82%)	93
Not noted	8 (2.92%)	64.86

* Based on analysis of electronic medical record data.
Source: Reliant Medical Group, January 1, 2013 to June 30, 2016, electronic medical record chart review in patients nonadherent to 2013 ACC/AHA treatment guidelines. LDL-C = low-density lipoprotein cholesterol.

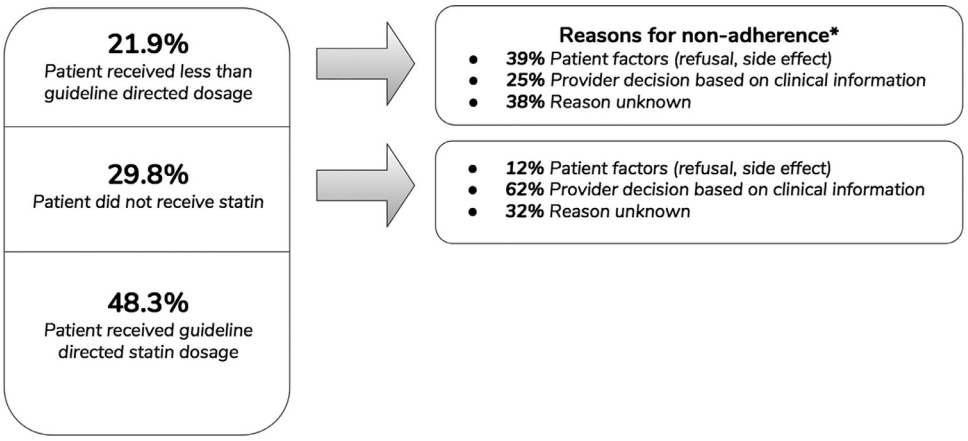

Figure 3. Summary of physician adherence to guidelines and reason for nonadherence.*Based on random sample of 500 patients determined to be nonadherent to 2013 ACC/AHA treatment guidelines through electronic medical record analysis. Patients could have multiple reasons for nonadherence.

small proportion of patients from this subgroup received an alternative lipid lowering therapy (e.g., only 2.6% were prescribed ezetimibe).

The chart review was conducted in a random subsample of patients who were found to be nonadherent to treatment guidelines; therefore, the conclusions drawn from this analysis are not necessarily generalizable to a broader ASCVD population. In addition, not all charts provided reasons for the treatment decisions observed in the EMR analysis. It is also important to note that about 15% of the patients that were flagged as having a nonadherent treatment in the administrative claims data were considered adherent after reviewing the more complete data collected during the chart review. If we were to extrapolate this error rate to the full EMR sample, the adjusted percentage of patients that received a therapy adherent to ACC/AHA recommendations would be approximately 63%.

In conclusion, this analysis found that approximately one-half of patients with acute ASCVD in a large integrated delivery network were not prescribed a statin recommended by the 2013 ACC/AHA blood cholesterol guidelines, with almost one-third of all ASCVD patients not receiving any statin therapy. A chart review conducted in a subset of patients revealed that statin intolerance related to muscle symptoms, "stable/controlled" patient LDL-C levels, and patient request was the most common reason for the observed treatment decisions. Physician and patient education on the importance of adherence to guideline-recommended lipid-lowering therapy, particularly in this high-risk patient population should be emphasized.

Disclosures

All authors have participated in the work and have reviewed and agree with the content of the article. None of the article contents are under consideration for publication in any other journal or have been published in any journal. No portion of the text has been copied from other material in the literature (unless in quotation marks, with citation). I am aware that it is the authors' responsibility to obtain permission for any figures or tables reproduced from any previous publications, and to cover fully any costs involved. This research was performed by Boston Health Economics, Inc. and Reliant Medical Group, and was funded by Amgen, Inc. Aside from being employees of Boston Health Economics or Reliant Medical Group (and therefore, receiving research funding from the study sponsor), Mr. Munsell, Dr. Ramsaran, Ms. Preusse, and Ms. Sundaresan have no additional disclosures to report. Dr. DiMario, Dr. Patel, and Dr. Harrison are employees of the study sponsor. Dr. Menzin received research funding from the study sponsor and holds equity in Boston Health Economics, Inc.

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