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Does Clinician-Reported Lipid Guideline Adoption Translate to Guideline-Adherent Care? An Evaluation of the PALM Registry

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Abstract

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Author Contributions

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BACKGROUND—The 2013 American College of Cardiology (ACC)/American Heart Association (AHA) cholesterol guideline recommends statin treatment based on patients' predicted atherosclerotic cardiovascular disease (ASCVD) risk. Whether clinician-reported guideline adoption translates to implementation into practice is unknown.

OBJECTIVES—We aimed to compare clinician lipid management in hypothetical scenarios versus observed practice.

METHODS—The Patient and Provider Assessment of Lipid Management (PALM) Registry asked 774 clinicians how they would treat 4 hypothetical scenarios of primary prevention patients with: 1) diabetes; 2) high 10-year ASCVD risk (≥7.5%) with high low-density lipoprotein cholesterol (LDL-C; ≥130mg/dL); 3) low 10-year ASCVD risk (<7.5%) with high LDL-C (130–189 mg/dL); or 4) primary and secondary prevention patients with persistently elevated LDL-C (≥130mg/dL) despite high-intensity statin use. We assessed agreement between clinician survey responses and observed practice.

RESULTS—In primary prevention scenarios, 85% of clinicians reported they would prescribe a statin to a diabetic patient and 93% to a high-risk/high LDL-C patient (both indicated by guidelines), while 40% would prescribe statins to a low-risk/high LDL-C patient. In clinical practice, statin prescription rates were 68% for diabetic patients, 40% for high-risk/high LDL-C patients, and 50% for low-risk/high LDL-C patients. Agreement between hypothetical and observed practice was 64%, 39%, and 52% for patients with diabetes, high-risk/high LDL-C, and low-risk/high LDL-C, respectively. Among patients with persistently high LDL-C despite high-intensity statin treatment, 55% of providers reported they would add a non-statin lipid-lowering medication, while only 22% of patients were so treated.

CONCLUSIONS—While the majority of clinicians report adoption of the 2013 ACC/AHA guideline recommendations, observed lipid management decisions in practice are frequently discordant.

Keywords

lipids; guideline adoption; cardiovascular disease prevention

Treatment of hyperlipidemia is an important part of atherosclerotic cardiovascular disease (ASCVD) prevention and has been shown to reduce mortality and improve patient outcomes (1–6). The release of the 2013 American College of Cardiology (ACC)/American Heart Association (AHA) Guideline on the Treatment of Blood Cholesterol to Reduce Atherosclerotic Cardiovascular Risk in Adults (7) represented a shift in focus toward treating hyperlipidemia based on underlying risk factors rather than targeting a goal lipid level, as was the main objective of prior guidelines(8). Adoption of these new recommendations and inertia for treatment change in clinical practice may lag behind guideline release. Given the importance of lipid treatment in ASCVD prevention, it is essential to understand how we can expedite guideline adherence in daily clinical practice.

The Patient and Clinician Assessment of Lipid Management (PALM) registry was designed as a nation-wide cross-sectional registry aimed at evaluating the changes in lipid management after the release of the 2013 ACC/AHA guidelines(7). In this study, we

examined clinician self-reported adoption of the guidelines via hypothetical scenarios and compared lipid management with observed practice for four patient types: 1) primary prevention patients with diabetes; 2) primary prevention patients with high ASCVD risk/high low-density lipoprotein cholesterol (LDL-C); 3) primary prevention patients with low ASCVD risk/high LDL-C; and 4) primary and secondary prevention patients with persistently high LDL-C despite high-intensity statin use. The first two scenarios reflect patients for whom guidelines provide Class I recommendations on primary prevention statin use; the third scenario reflects patients for whom guidelines no longer recommend routine statin use, but statins may be considered in the appropriate clinical scenario; and the fourth scenario reflects a patient population for whom guidelines provide a Class IIb recommendation for the addition of non-statin lipid-lowering treatment (7).

METHODS

STUDY POPULATION

The PALM registry consists of 7,938 patients enrolled at 140 outpatient cardiology, endocrinology, and primary care practices across the United States. The design, rationale, inclusion, and exclusion criteria for the PALM registry have been previously published (9). After each site obtained institutional review board approval for participation, all clinicians at participating sites were asked to complete a web-based provider survey. Sites were required to have completed surveys for >80% of participating clinicians prior to site activation for patient enrollment.

Patient enrollment was completed between May 27, 2015 and November 12, 2015. Each participant provided signed informed consent to participate. Patients were included in the PALM registry if they had prior ASCVD, active treatment with a statin medication, or were eligible for statin treatment based on the current lipid guidelines. For all patients, chart abstractions and core laboratory lipid panels were conducted to assess current lipid management, as per study protocol. Of the total PALM population, 6,839 had core laboratory data and were treated by a clinician who had completed a provider survey. Subjects were excluded if they were missing ASCVD information (n=4) or age (n=4). Among this study population, 2,297 fit criteria matching one of our four hypothetical patient scenarios described in the provider survey and were included in this analysis.

DATA COLLECTION AND DEFINITIONS

Provider surveys included questions regarding clinician and practice characteristics. Clinicians were asked, “Which guideline do you primarily use to guide cholesterol management in your patients?” and were, therefore, classified as adopters and non-adopters of the 2013 ACC/AHA lipid guidelines. The survey then asked clinicians to report changes in frequency of calculating ASCVD risk and treating to lipid goals in their practice over the last year (answer choices included: do more often, do less often, no change in practice, and I never do this). Next, each survey presented the clinician with four hypothetical patient scenarios (Table 1): 1) a primary prevention patient with diabetes; 2) a primary prevention patient with high ASCVD risk (≥7.5%) and high LDL-C (LDL-C ≥130 mg/dL); 3) a primary prevention patient with low ASCVD risk (<7.5%) and high LDL-C (LDL-C 130–189 mg/

dL); and 4) a secondary prevention patient with reported adherence to a high-intensity statin, yet persistently elevated LDL-C (≥130 mg/dL). In the first three primary prevention scenarios, clinicians were asked the likelihood of prescribing statin therapy (answer choices included very likely, likely, neutral, unlikely, and very unlikely). For each scenario, clinicians had the option to use a provided ASCVD risk calculator to help inform their answer. For the fourth scenario, clinicians were asked about next therapeutic step, and answer choices were categorized as adding a non-statin lipid-lowering medication, change to another statin, or no change in treatment.

For each enrolled patient, medical records were reviewed to collect detailed sociodemographic and medical history, as well as current and prior lipid-lowering therapy. Prior clinician-ordered lipid testing was identified with chart review, which included laboratory values for the two years prior to enrollment. If completed, the data for the highest LDL-C measurement within the last two years was collected. Each patient underwent phlebotomy on the day of enrollment. Core lab lipid panels were performed by LabCorp (Burlington, NC) and included analysis of total cholesterol, direct LDL-C, high-density lipoprotein cholesterol and triglyceride levels; results were provided to all clinicians. Enrolled patients were grouped according to the ASCVD risk category and lipid levels as described above in alignment with the four hypothetical scenarios. The highest LDL-C measurement (whether clinician ordered within the two years prior to enrollment or measured via core lab) was used to categorize patients in the first three scenarios. Core lab LDL-C levels were used for the fourth scenario.

STATISTICAL ANALYSIS

Characteristics of clinicians who reported adoption of the 2013 ACC/AHA guidelines versus preference for an alternative guideline were compared including clinician type, clinician specialty, practice type, practice location, and number of years in practice. Clinician-reported changes in management practice were grouped by reported adoption of 2013 ACC/AHA guidelines. Categorical variables were presented using frequency and continuous variables were presented using medians (25^{th} and 75^{th} percentiles). Mantel-Haenszel Chi-square test was used for all categorical variables and Wilcoxon test was used to compare differences in continuous variables.

Next, clinician responses to hypothetical patient clinical scenarios were evaluated based on reported adoption of the 2013 ACC/AHA guidelines. Utilizing the definitions from the hypothetical scenarios outlined above, enrolled patients were grouped according to risk category including primary prevention patients with: 1) diabetes, n=1496; 2) high risk (ASCVD risk ≥7.5%) and high LDL-C (LDL-C ≥130 mg/dL), n=457; and 3) low risk (ASCVD risk <7.5%), but high LDL-C (LDL-C 130-189 mg/dL), n=344. Patient data was then linked to survey data for their treating clinician in order to compare hypothetical scenario responses to observed management. Agreement was calculated as the proportion of patients treated the way their clinician said they would treat in the corresponding hypothetical scenario. In order to compare clinicians who answered likely/very likely to treat with clinicians who were unlikely to treat in the hypothetical scenarios, an unadjusted logistic regression model was used to generate an odds ratio (OR) with 95% confidence

intervals (CIs) describing the likelihood of statin treatment in diabetes, high-risk/high LDL-C or low-risk/high LDL-C cases, or addition of non-statin lipid-lowering treatment in primary or secondary prevention patients with high LDL-C despite adherence to high-intensity statin. For the fourth scenario (high LDL-C despite adherence to high-intensity statin), we also completed a secondary analysis describing the likelihood of non-statin lipid lowering treatment for secondary prevention patients only.

A p-value of <0.05 was considered significant. All statistical analyses were performed at the Duke Clinical Research Institute using SAS version 9.4 (SAS Institute, Inc., Cary, NC).

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RESULTS

PROVIDER SURVEY RESULTS

The PALM Registry collected provider surveys for 774 clinicians treating patients at 51 primary care practices, 82 cardiology practices, and 8 endocrinology practices. Among surveyed clinicians, 574 (74.2%) reported that the 2013 ACC/AHA guidelines primarily guides their lipid management, 137 (17.7%) are primarily guided by the Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (ATPIII), 16 (2.1%) by the American Association of Clinical Endocrinologists' (AACE) Guidelines for Management of Dyslipidemia and Prevention of Atherosclerosis, and 47 (6.2%) use other guidelines or do not apply any of guidelines in practice. Adopters of the 2013 ACC/AHA guidelines were more likely to be cardiologists and were also more likely to report that they had increased the frequency of calculating ASCVD risk and were less likely to treat patients to lipid level targets in their practice than in the last year (Table 2).

In the hypothetical primary prevention patient scenarios, 84.5% of providers reported they were likely to prescribe a statin to the diabetic patient, 92.9% to a high-risk/high LDL-C patient, and 40.2% to a low-risk/high LDL-C patient. Treatment rates were not significantly different between clinicians who reported adoption of the ACC/AHA guidelines versus not (Table 3). Approximately half of the clinicians elected to use the provided risk score calculator before answering the hypothetical scenarios (Table 4). Clinicians who reported adoption of the new guidelines were numerically more likely to employ this tool although the differences were not statistically significant. Clinicians who used the calculator were more likely to prescribe a statin to patients in the high-risk category and were less likely to prescribe a statin to the low-risk/high LDL-C patient (Table 4).

In the scenario of secondary prevention patients with persistently high LDL-C despite treatment with high-intensity statin therapy and maintaining adherence to this therapy, 26.9% of providers would change the statin, 51.4% would add a non-statin lipid-lowering agent (ezetimibe, fibrate, fish oil, or bile acid sequestrant), and 18.0% of clinicians would not change treatment. There was no difference of these medication adjustment rates for clinicians who reported adoption of the new guidelines versus those who did not (p=0.09).

OBSERVED PRACTICE

Next, we examined clinician adherence to guideline recommendations based on statin therapy use among enrolled PALM registry patients. Among enrolled patients, 1,496 patients had diabetes mellitus with no history of ASCVD. Among non-diabetic primary prevention patients, 374 patients were found to be high risk (calculated 10-year ASCVD risk ≥7.5%) and have high LDL-C (LDL-C ≥130 mg/dL). An additional 83 patients had LDL-C ≥190 mg/dL and, consequently, were also classified high risk/high LDL-C, yielding a total of 457 patients. Finally, 344 patients were found to have high LDL-C (LDL-C 130-189 mg/dL), but were low risk (calculated 10-year ASCVD risk <7.5%). Overall, diabetic patients were more likely than other groups to be treated with a statin (Figure 1); however, 475 (31.8%) of the diabetic patients and 282 (61.8%) of the high-risk/high LDL-C patients had no statin prescription at the visit. Among these, only a small number of patients had previously attempted a statin, including 61 (13.1%) of patients with diabetes and 53 (18.8%) of patients with high risk/high LDL-C. High-intensity statin therapy was infrequently prescribed in these populations.

Among the 288 primary and secondary prevention patients with LDL-C ≥130 mg/dL and already on high-intensity statin therapy, clinicians were observed to change the statin in 8 patients (2.8%), add ezetimibe in 11 patients (3.8%), and add fibrate, fish oil, or bile acid sequestrant in 57 patients (20.0%). The majority of patients (n=217, 75.4%) were managed by continuation of statin therapy without change in drug or dose, nor addition of a non-statin lipid-lowering medication. Similarly, when only secondary prevention patients were examined (n=161), 34 (21.1%) were managed with a non-statin lipid lowering medication.

COMPARING PROVIDER SURVEY RESPONSES WITH OBSERVED PRACTICE

Clinician responses to hypothetical scenarios frequently did not agree with observed statin prescription for similar clinical scenarios among enrolled patients (Table 5). Agreement was highest (63.6%) for patients with diabetes; 68.9% of these patients treated by clinicians who responded likely/very likely to use statin in the hypothetical scenario were treated with a statin at the time of their clinic visit. Among high-risk patients with high LDL-C levels, only 37.7% of patients treated by clinicians who responded likely/very likely to use statin in the hypothetical scenario were actually prescribed a statin. In patients with high LDL-C levels but low risk, 48.3% of the patients seen by clinicians who were unlikely to prescribe a statin in the hypothetical scenario were prescribed statin therapy. In patients with persistently high LDL-C despite high-intensity statin therapy, agreement was 44.1%. When only secondary prevention patients with persistently high LDL-C despite high-intensity statin therapy were evaluated, agreement between hypothetical and observed treatment was similar at 46.6%. Clinicians who would treat in the hypothetical scenario were not more likely to treat in actual practice as shown by the non-significant OR (95% CI) in Table 5.

DISCUSSION

In this analysis of the PALM registry, we compared clinician responses to hypothetical scenarios with the observed treatment of their patients. We demonstrated that: 1) the majority of cardiologists reported adoption of the 2013 ACC/AHA guidelines and were

more likely to adopt than primary care physicians or endocrinologists. 2) Clinician responses to hypothetical scenarios do not always align with observed lipid management decisions. 3) When the risk calculator was utilized, more guideline adherence was observed. 4) While clinicians are likely to prescribe statin therapy to patients with diabetes or who are at high risk of ASCVD in hypothetical scenarios, guideline-recommended statin therapy remains under-utilized in these patients in observed practice. 5) Clinicians have mixed management patterns in patients with elevated LDL-C in the absence of high ASCVD risk, as well as in patients with persistently elevated LDL-C in the presence of high-intensity statin use.

The release of the 2013 ACC/AHA lipid management guidelines resulted in a shift in management of blood lipid levels. In contrast to the Adult Treatment Panel III (ATP III) recommendations (8), which focused on achieving a target LDL-C level, the 2013 guidelines emphasize statin intensity dosing based on underlying risk (7). We observed that cardiologists were more likely to report adoption of the new guidelines when compared with primary care physicians and endocrinologists, which may be a reflection of the availability of different society guideline recommendations, including those published by the United States Preventive Services Task Force (1,10) and the American Association of Clinical Endocrinologists (11). Not surprisingly, clinicians who reported adoption of the 2013 ACC/AHA guidelines were also more likely to calculate ASCVD risk (a key component in determining the need for statin therapy in these guidelines) and were less likely to treat to an LDL-C goal.

Next, we examined whether clinician responses to hypothetical scenarios aligned with practice decisions. We specifically chose both scenarios with strong recommendations across guidelines (patients with high ASCVD risk and high cholesterol, patients with diabetes) and scenarios where guideline recommendations are ambivalent or offer less firm recommendations (low ASCVD risk and high cholesterol, persistently elevated LDL-C despite high intensity statin use). While the majority of clinicians responded to the survey questions according to guideline recommendations, this was not reflected in observed practice.

The ACC/AHA guidelines provide Class I recommendations for high-intensity statin therapy for patients with LDL-C >190 mg/dL (level of evidence B), at least moderate-intensity statin for patients with an estimated 10-year ASCVD risk ≥7.5% (level of evidence B), or those with diabetes (level of evidence A). In these scenarios, one might expect more consistent management among clinicians. Treatment rates were highest among diabetic patients, and the agreement between hypothetical and observed practice was also highest for these patients. For patients with high ASCVD risk and an LDL-C ≥130 mg/dL, the hypothetical statin treatment rate was 93%, but only 40% of these patients were observed to be on statin therapy. These results echo prior studies that showed statin underutilization and underdosing even among high-risk patients(12) (13). Little of this is explained by discontinuation of a prior statin attempt. Additionally, when statin medications were prescribed in our study, they were frequently under-dosed based on the 2013 ACC/AHA guidelines. Untreated or undertreated patients may represent missed treatment opportunities and unsuccessful previously attempted statin therapy.

In contrast, the 2013 ACC/AHA guidelines no longer recommend routine statin use for all patients with low ASCVD risk, but LDL-C levels 130–189 mg/dL; rather, these new guidelines suggest statin use based on clinical judgment and discussions with individual patients. However, the prior ATP III guidelines would support initiation of pharmacologic lipid treatment with LDL-C >160 mg/dL and the American Association of Clinical Endocrinologists guidelines currently recommend treatment for the low-risk patient to achieve an LDL-C <130 (14). In the setting of guideline change or conflicting guideline recommendations, it is not surprising to observe heterogeneity in treatment. In provider surveys, 40% of clinicians reported statin use, and half of patients in observed practice were treated with statin therapy. Similar practice inertia was seen for patients with persistently elevated LDL-C levels despite high-intensity statin use. The ACC/AHA guidelines provide a weak Class IIb recommendation to consider the addition of non-statin lipid-lowering treatment. Provider surveys and observed practices also showed mixed responses in this setting. Further data to support firmer guideline recommendations across patient risk groups and differing guideline committees may help to bridge this gap.

However, independent of the strength of guideline recommendations, this study showed a persistent disconnect between clinician self-reported treatment patterns (perceived care) and observed treatment patterns (actual care). While some of the statin underutilization observed in our study could be attributed to a delay between guideline publication and clinician uptake in practice, this does not fully explain the observed discrepancy. The discordance between hypothetical and observed treatment patterns suggests that the problem is not clinician gaps in knowledge or misinterpretation of the guideline leading to inappropriate application (18). While clinicians generally respond “correctly” to hypothetical scenarios according to guideline recommendations, this knowledge does not appear to fully translate to action. Patients may decide not to start statin therapy after having a risk discussion with their treating provider; providers may not be readily able to calculate patient risk or review blood lipid results in a busy clinical setting. While the hypothetical scenarios display all the relevant information necessary to evaluate appropriate treatment candidacy in one location, several clicks and chart searches may be required in electronic health records. In our study, clinicians who utilized the provided ASCVD risk calculator in the hypothetical settings were significantly more likely to prescribe a statin in the hypothetical high-risk/high LDL-C patient and less likely to prescribe a statin in the hypothetical low-risk/high LDL-C patient. Embedded ASCVD risk calculators are well within the capabilities of electronic health records and offer assessment of statin candidacy to busy clinicians.

CLINICAL IMPLICATIONS AND FUTURE STEPS

Translation of care from guideline recommendations to patients seen in daily practice remains a challenge. Although clinicians demonstrated good knowledge of the 2013 ACC/AHA guidelines on treatment of blood lipid levels, a disconnect persisted in the treatment of our patients. It will be important, moving forward, to utilize all tools available, including those within the electronic health record, in order to effectively change practice. A multifaceted quality improvement system, with risk stratification tools, patient education and frequent feedback to providers may help to bridge the gap between provider perception of care and known limitations in guideline recommended statin prescription. Similar coupling

of risk stratification tools with interventions to remind clinicians as part of the routine clinical work flow (e.g., best practice alerts), educate patients at the point of care (e.g., shared decision-making tools), and facilitate treatment ordering (e.g., order sets) have been shown to improve guideline adherence in areas such as health screening and vaccinations, and can be easily translated to hyperlipidemia management and cardiovascular risk factor reduction (19–21).

STUDY LIMITATIONS

Our study had several limitations. First, given the observational nature of our examination, rationale for clinician management decisions at the time of the clinic appointment is not available. Second, while prior lipid testing results were abstracted via chart review, we could not assess whether these lipid levels were measured prior to or after statin initiation. Therefore, we could only examine patients with high LDL-C (with or without high ASCVD risk) and could not study patients with low LDL-C levels since we could not discern whether this was a treatment effect. Third, ASCVD risk was calculated for patients treated and not treated with statin medications. Calculating the ASCVD risk for patients on statin therapy may underestimate their risk; therefore, some patients who were high risk prior to statin treatment, but low risk with statin therapy, may have been excluded from the high-risk groups. Fourth, lower treatment rates with statins in the primary prevention setting could partially be related to patients opting not to take statin therapy after having a risk discussion with their treating provider. Finally, a minority of patient data could not be linked to their clinician; as a result, these patients were excluded from this analysis. Similarly, clinicians without linked patient data were also excluded from analyses of clinic management decisions.

CONCLUSIONS

Since the release of the 2013 ACC/AHA Guideline on the Treatment of Blood Cholesterol to Reduce Atherosclerotic Cardiovascular Risk in Adults, there has been variable uptake in implementation of these guidelines, with cardiologists reporting the highest guideline adoption. Despite recommendations, statin therapy remains under-utilized in primary prevention patients with diabetes or with high ASCVD risk. Additional clinician treatment uncertainty remains around the management of patients with low ASCVD risk, but elevated LDL-C, as well as in patients with persistent elevation of LDL-C despite high-intensity statin use. While the majority of clinicians respond to hypothetical scenarios in accordance to guideline-directed treatment of blood lipid levels, this does not translate into their observed clinical practice. Important gaps in care persist, particularly among patients in high-risk groups where lack of treatment and under treatment remain prevalent. These results suggest gaps in implementation rather than clinician knowledge. Improved utilization of electronic health record-based tools and interventions may help improve clinician adherence to guideline recommendations.

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ABBREVIATIONS

ACC	American College of Cardiology
AHA	American Heart Association
AACE	American Association of Clinical Endocrinologists
ASCVD	atherosclerotic cardiovascular disease
ATP III	Adult Treatment Panel III
CI	confidence interval
LDL-C	low-density lipoprotein cholesterol
OR	odds ratio
PALM	Patient and Clinician Assessment of Lipid Management

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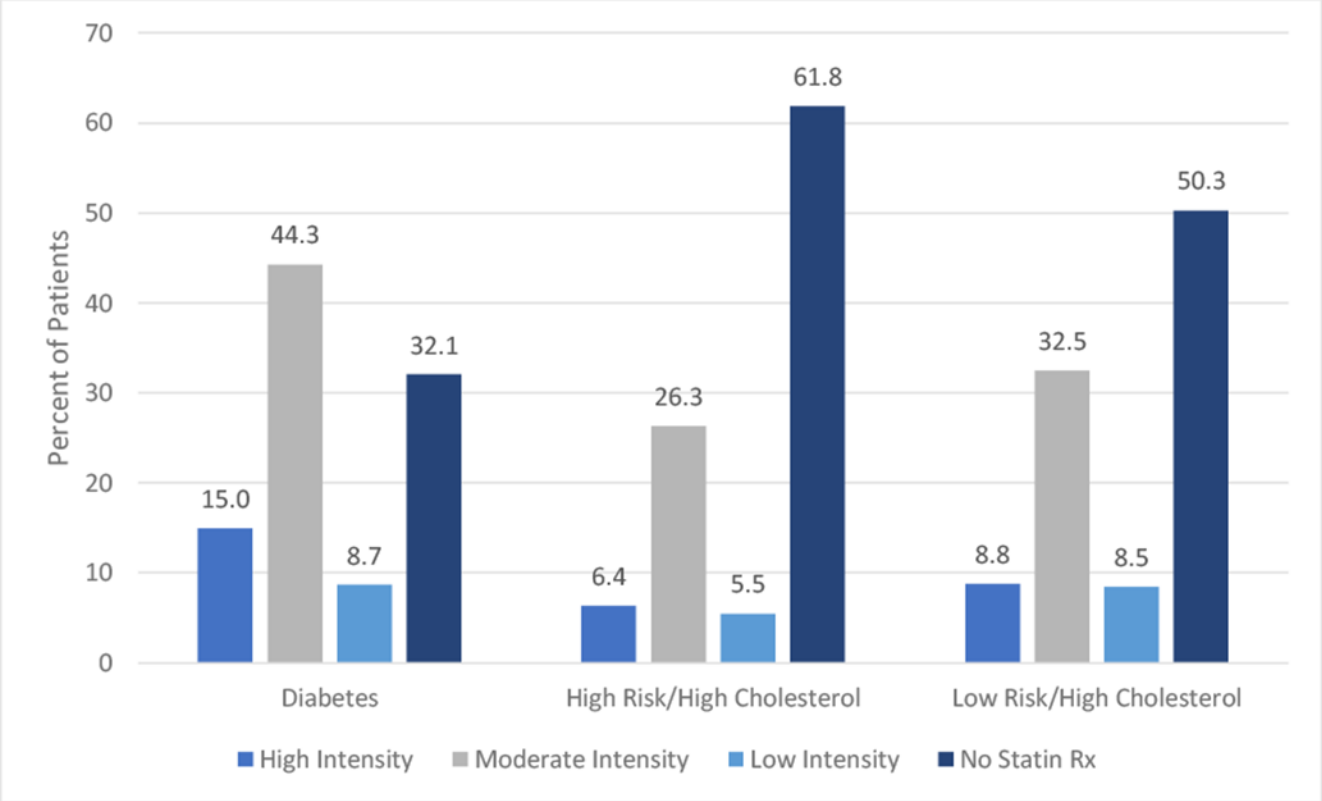

Figure 1. Statin Prescription Patterns

Rates of statin prescription, across statin intensities, among patients with diabetes, high risk/high cholesterol and low risk/high cholesterol.

Table 1.

Hypothetical Scenarios Presented in Clinician Survey

Patient Scenario	Patient Category	Patient Characteristics	Comorbidities and Symptoms	Blood Pressure	Lipid Data (mg/dL)	Lipid Treatment	10-year ASCVD Risk
1	Diabetes	45 year old African American female	Diabetes Asymptomatic	145/70	TC 220 LDL-C 140 HDL-C50	Treatment naïve	6.1%
2	High risk High LDL-C	54 year old white male	Active smoker Asymptomatic	152/70	TC 221 LDL-C 150 HDL-C 41	Treatment naïve	17.3%
3	Low risk High LDL-C	40 year old African American female	No comorbidities Asymptomatic	130/60	TC 220 LDL-C 165 HDL-C 30	Treatment naïve	4.4%
4	High LDL-C despite adherence to male high-intensity statin	64 year old	Prior CVA Active claudication	N/A	TC 220 LDL-C 130 HDL-C 30	Patient-reported adherence to atorvastatin 80 mg daily	N/A

Scenarios 1–3: Clinicians were asked to answer their likelihood of recommending a statin; if likely or very likely to recommend, clinicians then answered their likelihood of recommending a high-intensity statin.

Scenario 4: Clinicians were asked to recommend next step in treatment: no change, change to different statin, add ezetimibe, add fibrate, add fish oil, add bile acid sequestrant, refer to lipid specialist, other.

ASCVD = atherosclerotic cardiovascular disease; CVA = cerebrovascular accident; HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol; TC = total cholesterol

Table 2.

Clinician Characteristics by Adopter vs. Non-adopters of the 2013 ACC/AHA Guidelines

		Overall	Clinician-Reported Adoption of 2013 ACC/AHA Guidelines		
		N=774	Yes N=574 (74.2%)	No N=200 (25.8%)	p-value
Clinician specialty[1]	Cardiologist, N (%)	378 (57.1%)	293 (60.2%)	85 (48.6%)	0.03
	Primary Care, N (%)	234 (35.3%)	161 (33.1%)	73 (41.7%)	
	Endocrinology, N (%)	24 (3.6%)	14 (2.9%)	10 (5.7%)	
	Other, N (%)	26 (3.9%)	19 (3.9%)	7 (4.0%)	
Clinician type	Physician, N (%)	611 (78.9%)	452 (78.7%)	159 (79.5%)	0.31
	Advanced Practice Provider, N (%)	141 (18.2%)	102 (17.8%)	39 (19.5%)	
	Clinician-in-training, N (%)	20 (2.6%)	18 (3.1%)	2 (1.0%)	
	Other, N (%)	2 (0.3%)	2 (0.4%)	0 (0.0%)	
Office location[2]	Rural, N (%)	83 (12.2%)	66 (13.0%)	17 (9.7%)	0.87
	Suburban, %	205 (30.1%)	158 (31.2%)	47 (26.9%)	
	Urban, %	394 (57.8%)	283 (55.8%)	111 (63.4%)	
Years in practice	Up to 5 years, %	162 (20.9%)	125 (21.8%)	37 (18.5%)	0.79
	6-10 years, %	96 (12.4%)	71 (12.4%)	25 (12.5%)	
	10-20 years, %	233 (30.1%)	172 (30.0%)	61 (30.5%)	
	Greater than 20 years, %	283 (36.6%)	206 (35.9%)	77 (38.5%)	
Calculate ASCVD risk	Do more often	353 (45.7%)	282 (49.2%)	71 (35.5%)	0.0002
	No change	317 (41.0%)	230 (40.1%)	87 (43.5%)	
	Do less often	33 (4.3%)	22 (3.8%)	11 (5.5%)	
	Never do this	70 (9.1%)	39 (6.8%)	31 (15.5%)	
Treat to lipid target	Do more often	125 (16.1%)	93 (16.2%)	32 (16.0%)	<0.0001
	No change	410 (53.0%)	274 (47.7%)	136 (68.0%)	
	Do less often	224 (28.9%)	197 (34.3%)	27 (13.5%)	
	Never do this	15 (1.9%)	10 (1.7%)	5 (2.5%)	

[1] Clinician specialty for n=670 board certified physicians

[2] Office location had 11.9% missing data but all other fields with < 1.2% missing data

ACC = American College of Cardiology; AHA = American Heart Association; All other abbreviations can be found in Table 1.

Table 3.

Proportion of Clinicians Very Likely/Likely to Prescribe Statin Therapy in the Primary Prevention Hypothetical Scenarios

Scenario	All (N=774)	Adopted ACC/AHA Guidelines		
		Yes (N=574)	No (N=200)	p-value
	Prescribe Statin Therapy			
Diabetes	654 (84.5%)	483 (84.2%)	171 (85.5%)	0.68
High risk/high LDL-C	719 (92.9%)	537 (93.6%)	182 (91.0%)	0.23
Low risk/high LDL-C	311 (40.2%)	234 (40.8%)	77 (38.5%)	0.57
	Add a Non-Statin Lipid Lowering Treatment			
High LDL-C despite adherence to high-intensity statin	398 (51.4%)	287 (50.0%)	111 (55.5%)	0.18

All abbreviations can be found in Tables 1 and 2.

Table 4.

Clinician Utilization of Risk Score Calculator and Likeliness of Statin Prescription in Hypothetical Scenarios

	Percent of Clinicians Clicked to Calculate Risk Score				Percent of Clinicians Likely/Very Likely to Prescribe Statin			
	All (N=774)	Adopted New Guidelines		p-value	All (N=774)	Utilized risk score calculator		p-value
		Yes (N=574)	No (N=200)			Yes	No	
Diabetes	374 (48.3%)	283 (49.3%)	91 (45.5%)	0.34	654 (84.5%)	312/374 (83.4%)	342/399 (85.7%)	0.38
High risk/high LDL-C	411 (53.1%)	313 (54.5%)	98 (49.0%)	0.18	719 (92.9%)	389 /411 (94.7%)	330 / 363 (90.9%)	0.04
Low risk/high LDL-C	407 (52.6%)	310 (54.0%)	97 (48.5%)	0.18	311 (40.2%)	148 / 407 (36.4%)	163 / 367 (44.4%)	0.02

All abbreviations can be found in Table 1.

Table 5.

Agreement between Hypothetical Treatment Responses and Observed Practice

	Hypothetical	Observed	Agreement	OR (95% CI)
Statin Use Rate				
Diabetes (n=1496)	1263 (84.4%)	1021 (68.3%)	63.6%	1.20 (0.90, 1.61)
High risk/high LDL-C (n=457)	432 (94.5%)	175 (38.3%)	38.5%	0.65 (0.29, 1.47)
Low risk/high LDL-C (n=344)	137 (39.8%)	172 (50.0%)	52.0%	1.19 (0.77, 1.83)
Addition of Non-Statin Lipid-Lowering Treatment				
High LDL-C despite adherence to high intensity statin	159 (55.2%)	62 (21.5%)	44.1%	0.70 (0.40, 1.24)

* Non-statin lipid-lowering treatment included addition of ezetimibe in 11 patients, fibrate, fish oil or bile acid sequestrant in 57 patients

Agreement = % of patients treated the way clinician said they would treat in the corresponding hypothetical scenario.

OR = odds ratio for likelihood of treatment when comparing clinicians who reported likely vs. less likely to treat in hypothetical scenarios

CI = confidence interval; OR = odds ratio; All other abbreviations can be found in Table 1.