

# Implications of American College of Cardiology/American Heart Association (ACC/AHA) Cholesterol Guidelines on Statin Underutilization for Prevention of Cardiovascular Disease in Diabetes Mellitus Among Several US Networks of Community Health Centers

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**Background**—Little is known about statin underutilization among diabetes mellitus patients cared for in community health centers, which tend to serve socioeconomically disadvantaged populations. Implications of the American College of Cardiology/American Heart Association (ACC/AHA) guidelines on preexisting gaps in statin treatment in this population are unclear.

**Methods and Results**—We included 32 440 adults (45% male, 63% nonwhite, 29% uninsured/Medicaid) aged 40 to 75 years with diabetes mellitus who received care within 16 community health center groups in 11 states in the Community Health Applied Research Network during 2013. Statin prescribing was analyzed as a function of concordance with the National Cholesterol Education Program Adult Treatment Panel 2001 and ACC/AHA 2013 guidelines. More patients' treatments were concordant with the ACC/AHA (52.8%) versus the National Cholesterol Education Program Adult Treatment Panel (36.2%) guideline. Female sex was associated with lower concordance for both (odds ratio [OR] 0.90, CI 0.85–0.94; and OR 0.84, CI 0.80–0.88, respectively). Being insured, an Asian/Pacific Islander, or primarily Spanish speaking were associated with greater concordance for both guidelines: 35.5% (11 526/32 440) were concordant with neither guideline, the majority (79.7%) having no statin prescribed; 28.2% (9168/32 440) were concordant with ACC/AHA but not the National Cholesterol Education Program Adult Treatment Panel. 8.7% of these patients had a low-density lipoprotein cholesterol >160 mg/dL despite having a moderate- or high-intensity statin prescribed. And 11.6% (3772/32 440) were concordant with the National Cholesterol Education Program Adult Treatment Panel but not with ACC/AHA. Most of these patients had a low-density lipoprotein cholesterol between 70 and 99 mg/dL with no or a low-intensity statin prescribed.

**Conclusions**—Opportunities exist to improve cholesterol management in diabetes mellitus patients in community health centers. Addressing care gaps could improve cardiovascular disease prevention in this high-risk population. (*J Am Heart Assoc.* 2017;6:e005627. DOI: 10.1161/JAHA.117.005627.)

**Key Words:** cardiovascular disease prevention • cholesterol-lowering drugs • community health centers • community medicine • diabetes mellitus • guideline adherence

Statin therapy plays an important role in the primary and secondary prevention of cardiovascular events in populations at elevated risk of atherosclerotic cardiovascular disease (ASCVD).<sup>1</sup> The 2013 American College of Cardiology/American Heart Association (ACC/AHA) guidelines reinforced the previous National Cholesterol Education Program Expert Panel's Adult Treatment Panel (ATP) III identification of

diabetic patients as a particularly high-risk group, recommending at least moderate intensity statin therapy in diabetic adults aged 40 to 75 and high-intensity therapy for those with ischemic vascular disease.<sup>1–3</sup> Diabetic patients tend to have worse cardiovascular disease-related outcomes compared with nondiabetics and can significantly benefit from statin treatment.<sup>4–10</sup> Given the increased prevalence of diabetes

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## Clinical Perspective

### What Is New?

- Previously, little was known about appropriate statin prescribing as it relates to atherosclerotic cardiovascular disease prevention in the large number of diabetes mellitus patients seen in community health centers.
- We examined electronic health record data for 32 440 adults aged 40 to 75 years with diabetes mellitus who received care within 16 community health center groups in 11 states during 2013, before the publication of the American College of Cardiology/American Heart Association (ACC/AHA) cholesterol treatment guidelines.
- More patients were concordant with the ACC/AHA cholesterol treatment guideline than with the 2001 Adult Treatment Panel III guideline (52.8% versus 36.2%).
- Female sex was associated with lower concordance for both guidelines; being insured, an Asian/Pacific Islander, or primarily Spanish speaking were associated with greater concordance for both guidelines.

### What Are the Clinical Implications?

- Overall, 35.5% of diabetes mellitus patients cared for at the community health centers included in this study were not receiving cholesterol management concordant with either guideline, the majority (79.7%) having no statin prescribed.
- Significant opportunities exist to improve cholesterol management among diabetes mellitus patients receiving care in community health centers.

mellitus (DM) in the US population compared with the past and projected increases in future prevalence, ASCVD prevention in diabetics has significant public health implications.<sup>11,12</sup> In particular, minority groups and those with markers of low socioeconomic status are disproportionately affected by DM. In addition, cardiovascular disease is a leading cause of disparate outcomes by race and socioeconomic status.<sup>13</sup> Previous studies have examined the potential implications of the ACC/AHA guidelines on statin eligibility in the US population and also demonstrated a gap between this eligibility and actual prescribing.<sup>14–18</sup> However, little is known about the potential impact of these guidelines on statin utilization in community health centers (CHCs), which often provide primary care for groups of lower socioeconomic status of varied racial/ethnic backgrounds. Data on appropriate statin prescribing as it relates to ASCVD prevention in large cohorts of patients seen in CHCs are lacking. Such knowledge about gaps in ASCVD prevention in safety net settings is important to understand the full potential impact of the new guidelines, especially given suggestions that appropriate implementation of cholesterol guidelines in all statin-eligible populations could help achieve national goals in

ASCVD prevention.<sup>19</sup> Accordingly, we examined the potential implications of the recent ACC/AHA guidelines on statin-prescribing patterns in a large cohort of DM patients seen in CHCs. In the present study we investigate whether CHC patients with DM were receiving effective ASCVD prevention as a function of level of concordance with previous ATP III and ACC/AHA guidelines.

## Methods

### Data Source

In this study we utilized electronic health record data to perform a cross-sectional study using data from the Community Health Applied Research Network (CHARN). CHARN is a unique community health research network that was established by the United States Department of Health and Human Services Health Resources and Services Administration in 2010. CHARN is composed of 4 research nodes and a data-coordinating center housed in the Kaiser Permanente Center for Health Research. Each research node is affiliated with an academic medical center. In turn, these research nodes are composed of 17 CHC networks located across 11 different states (AZ, CA, GA, HI, IL, MA, MD, NY, OR, SC, WA), caring for more than 500 000 patients annually. Electronic health record data pooled from participating CHCs were stored in a common data warehouse through the data-coordinating center. The clinical and sociodemographic elements included in the CHARN data warehouse were determined by CHARN researchers, clinicians, and data programmers. The decisions were based on having the data warehouse serve multiple purposes including but not limited to using electronic health record data to address relevant research questions, characterizing the safety net population, and supporting quality improvement efforts. Data validation queries were performed at the research node level before aggregation in the common data warehouse. The data-coordinating center created the final database structure, the data dictionaries, as well as data definitions and queries to validate the data provided by the nodes. Data use agreements were in place between each CHC and its respective node and between each node and the data-coordinating center. The Kaiser Permanente Northwest Institutional Review Board and the Northwestern University Institutional Review Board deemed the study exempt from review, and the other participating organizations' review boards reviewed and approved the study or judged that it qualified to be exempt as well. A full description of CHARN can be found elsewhere.<sup>20,21</sup>

### Study Population

We identified patients between the ages of 40 and 75 years with a diagnosis of DM with 1 or more clinical office visits

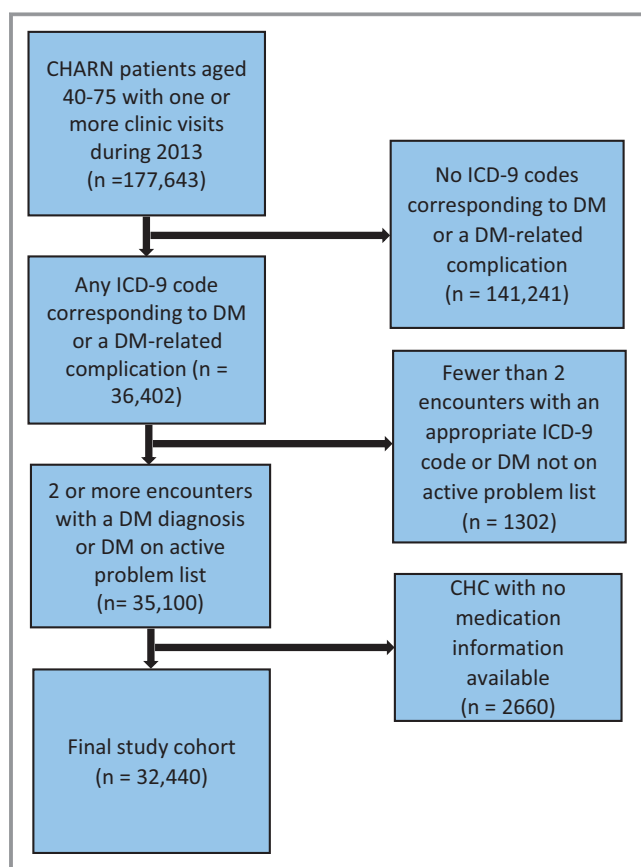
between January 1, and December 31, 2013. We chose this study time period because it directly preceded publication of recent cholesterol guidelines in 2014. We included patients with 2 separate encounters with an *International Classification of Diseases 9th revision* (ICD-9) code that corresponded to a diagnosis of DM or a complication of DM (eg, diabetic retinopathy). Patients with DM were also included if these diagnoses were present in the active problem list. Sixteen of the 17 CHC networks had all required data elements and were included in this study. Figure 1 illustrates how the study cohort was derived. The final study cohort was composed of 32 440 patients.

### Outcome Measures

Our primary outcome was the proportion of the study population that would be concordant with either, neither, or both 2001 ATP III and 2013 ACC/AHA guidelines. We chose the 2001 ATP III rather than updated 2004 guidelines because both

had the same general low-density lipoprotein cholesterol (LDL) goal, and true concordance was deemed simpler to define for the former because it lacked the optional LDL goal of <70 mg/dL. Our operational definitions for what we considered guideline-concordant prescribing practices were the following. Patients were deemed concordant with ATP III guidelines if their most recent LDL was performed in the past year and was <100 mg/dL. Patients were deemed concordant with ACC/AHA guidelines if (1) a high-intensity statin was prescribed or (2) a moderate-intensity statin was prescribed and diagnoses of ischemic vascular disease were absent or (3) the most recent LDL level was performed in the past year, was <70 mg/dL, and ischemic vascular disease was absent (Table 1).

To determine guideline concordance, we examined the medication lists of eligible patients for the presence and dose of an active statin prescription by generic name including combination pills that contained a statin. This information was used to categorize patients on December 31, 2013 as being on either no statin or low-, moderate-, or high-intensity therapy based on the medication classifications provided in the ACC/AHA cholesterol treatment guideline.<sup>1</sup> In order to avoid underestimating the number of patients who were judged to be treated in accordance with guidelines, we made 2 assumptions in the small number of cases where the statin treatment was ambiguous: (1) patients with more than 1 active statin prescription were deemed to be on the higher-intensity statin and/or dosing, and (2) in the rare cases where no dosing information was available, statins that could be low or moderate or alternatively moderate or high intensity, were classified as just moderate or just high, respectively. Next, the most recent low-density lipoprotein level during the study period was determined for each patient. Finally, we classified patients as having ischemic vascular disease based on the presence of ICD-9 codes associated with coronary artery



**Figure 1.** Study cohort derivation. Review of all CHARN (Community Health Applied Research Network) patients with at least 1 visit during 2013 and composition of the final study cohort of patients with diabetes mellitus. CHC indicates Community Health Center; DM, diabetes mellitus; ICD-9, *International Classification of Diseases*, 9th revision.

**Table 1.** Operational Definitions for Concordance With ATP III and ACC/AHA Guidelines for Cholesterol Management

Guideline	Operational Definitions for Meeting Guideline Recommendation
ATP III, 2001 <sup>2</sup>	<ul style="list-style-type: none"> <li>Most recent LDL-C was performed within the past year and &lt;100 mg/dL</li> </ul>
ACC/AHA, 2013 <sup>1</sup>	<ul style="list-style-type: none"> <li>High-intensity statin prescribed or</li> <li>Moderate-intensity statin prescribed and no diagnosis of ischemic vascular disease or</li> <li>Most recent LDL-C was performed within the past year, was &lt;70 mg/dL and no diagnosis of ischemic vascular disease</li> </ul>

ACC/AHA indicates American College of Cardiology/American Heart Association 2013 Cholesterol Guidelines; ATP III, National Cholesterol Education Program Adult Treatment Panel 2001 Cholesterol Guidelines; LDL, low-density lipoprotein.

disease, previous myocardial infarction, previous revascularization, peripheral arterial disease, or ischemic stroke.

## Statistical Analysis

To investigate our outcomes we first calculated the proportion of patients with DM who would meet the 2 operational definitions for guideline-concordant cholesterol treatment based on ATP III and ACC/AHA 2013 guidelines. These proportions were also calculated for the following demographic subgroups: sex (male, female, transgender), age, race (non-Hispanic white, Hispanic, non-Hispanic black, American Indian, Asian/Pacific Islander, multiracial, other), insurance (uninsured, Medicaid only, Medicare only, commercial only, Medicare and Medicaid ever, Medicare and commercial ever, or mixed), primary language (English, Spanish, Cantonese, Mandarin, or other), research node (1 of 4), and common clinical comorbidities that could be associated with statin prescribing. We next sought to investigate possible associations with concordance with each guideline. To account for the intraclass correlation from the nesting of patients within CHCs and because the outcome variables were dichotomous, we used hierarchical generalized linear modeling (ie, generalized linear mixed models) with a logit link and binomial distribution, where CHC was treated as a random effect.<sup>22–25</sup> We estimated the models using mode and curvature adaptive Gauss-Hermite quadrature integration with 10 integration points.<sup>26,27</sup> We constructed separate univariate models for individual demographic and clinical variables and then performed multivariate analyses to evaluate unique relationships. We used dummy coding for categorical independent variables to produce odds ratios relative to a referent group. For the purposes of these analyses, CHCs were grouped into the 4 participating research nodes, the largest node (B) serving as reference group. Because the relationship with age appeared to be nonlinear, we also included a quadratic term for age.

To further investigate potential implications of the recent guidelines, we also calculated the proportion of the cohort who would be concordant with both guidelines (group A), ATP III but not ACC/AHA (group B), ACC/AHA but not ATP III (group C), or neither (group D) guideline. We then categorized each group based on LDL level and intensity of statin prescribed (none prescribed, low, moderate, high) to further clarify reasons for guideline concordance and discordance.

We performed all analyses using Stata software version 13.1 (Statacorp, College Station, TX).

## Results

The baseline demographics of the cohort along with the proportions who met the operational definitions of the 2

cholesterol treatment guidelines are shown in Table 2. There were a total of 32 440 patients, of whom 51% (16 688) were between the ages of 51 and 64; 45% (14 456) were men, 25% (7955) Hispanic, 19% (6137) black, and 16% (5259) Asian/Pacific islander; 20% (6492) of the cohort was primarily Spanish speaking, and 6% (1883) primarily spoke Cantonese or Mandarin. In the cohort 29% (9261) were either uninsured or had Medicaid alone.

Overall, more patients were concordant with ACC/AHA (52.8%) than with ATP III (36.2%) guidelines ( $P<0.001$ , Table 2). In general, most of the subgroups—including by sex, race, and type of insurance—had overall low concordance with both sets of guidelines and had a substantial proportion concordant with neither guideline. In the case of the black and American Indian subgroups, nearly half met neither guideline.

In multivariable adjusted analyses, women were less likely than men to be concordant with both ATP III (odds ratio [OR] [95%CI] 0.84 [0.80, 0.88],  $P<0.001$ ) and the ACC/AHA (OR [95%CI] 0.90 [0.85, 0.94],  $P<0.001$ ) guidelines (Table 3). Being Asian/Pacific Islander (OR [95%CI] 1.17 [1.03, 1.32],  $P<0.02$  and 1.25 [1.10, 1.42],  $P<0.001$ , respectively) or primarily Spanish speaking (OR [95%CI] 1.33 [1.18, 1.50],  $P<0.001$  and 1.32 [1.17, 1.48],  $P<0.001$ , respectively) were associated with greater concordance with both guidelines. Black race was associated with lower concordance with ATP III (OR [95%CI] 0.77 [0.70, 0.85],  $P<0.001$ ) but not with ACC/AHA. Patients carrying diagnoses of hypertension and coronary artery disease were also statistically significantly more likely to be concordant with both guidelines. Finally, having any type of health insurance, including Medicaid alone, was statistically significantly associated with greater concordance with both guidelines compared with those who were uninsured. The association of age with ATP III and ACC/AHA concordance was more approximately linear in the former case. Inclusion of a quadratic term for age improved the overall fit for the ACC/AHA model.

A substantial portion of the overall cohort (35.5%, 11 526) was not concordant with either set of guidelines; 24.5% (7974) met criteria for both guidelines; 28.2% (9168) were concordant with ACC/AHA guidelines but not the ATP III guidelines; and 11.6% (3772) were concordant with ATP III but not ACC/AHA guidelines (Figure 2).

Of the part of the cohort that was concordant with neither set of guidelines ( $n=11\ 526$ ), 79.7% of this group had no statin prescribed regardless of LDL level (Table 4), and 60.4% had no LDL checked within the past year. Nearly all of the remainder of the patients (18.8%) were prescribed a low-intensity statin, which was the most commonly prescribed intensity of statin in this group across the range of LDL values.

Of the part of the cohort that was concordant with ATP III but not ACC/AHA guidelines ( $n=3772$ ), the vast majority

**Table 2.** Baseline Demographics of Diabetic Adults Seen in CHARN Community Health Centers by Proportion Meeting Either ATP III or ACC/AHA Cholesterol Management Guidelines

	n (% of Total Cohort)	Met 2001 ATP III Guidelines (%)	Met 2013 ACC/AHA Guidelines (%)	Met Neither ATP III nor ACC/AHA (%)
Total number of patients*	32 440	36.2	52.8	35.5
Sex				
Male	14 456 (44.6)	38.7	54.7	33.6
Female	17 920 (55.2)	34.2	51.3	37.1
Transgender	64 (0.2)	40.6	62.5	26.6
Race/ethnicity				
Hispanic	7955 (24.5)	38.4	54.9	31.8
Non-Hispanic white	11 765 (36.3)	34.4	52.5	36.6
Non-Hispanic black	6137 (18.9)	24.6	39.8	49.5
Non-Hispanic American Indian	479 (1.5)	23.0	41.3	49.3
Non-Hispanic Asian/Pacific Islander	5259 (16.2)	52.7	66.6	21.2
Non-Hispanic multiracial	161 (0.5)	38.5	54.0	31.1
Non-Hispanic other	535 (1.6)	29.9	53.5	36.8
Unknown	149 (0.5)	25.5	53.0	40.3
Age (2013), y				
40 to 50	9125 (28.1)	30.6	45.2	42.5
51 to 64	16 688 (51.4)	36.2	54.7	34.2
65 to 75	6627 (20.4)	44.0	58.6	29.3
Hypertension				
Yes	22 350 (68.9)	37.7	56.9	32.3
No	10 090 (31.1)	32.9	43.9	42.8
Coronary artery disease				
Yes	3226 (9.9)	41.7	72.3	21.9
No	29 214 (90.1)	35.6	50.7	37.0
Ischemic cerebrovascular disease				
Yes	902 (2.8)	42.7	34.7	38.8
No	31 538 (97.2)	36.0	53.4	35.4
Peripheral arterial disease				
Yes	148 (0.5)	39.2	71.6	20.3
No	32 292 (99.5)	36.2	52.8	35.6
Primary language				
English	22 230 (68.5)	32.4	49.1	39.8
Spanish	6492 (20.0)	38.8	56.2	30.5
Cantonese	1086 (3.3)	66.5	73.8	12.5
Mandarin	797 (2.5)	67.4	71.5	12.4
Russian	196 (0.6)	35.2	74.0	18.9
Other	1266 (3.9)	47.5	67.0	23.0
Unknown	373 (1.1)	27.6	55.2	38.3

Continued

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Table 2. Continued

	n (% of Total Cohort)	Met 2001 ATP III Guidelines (%)	Met 2013 ACC/AHA Guidelines (%)	Met Neither ATP III nor ACC/AHA (%)
<b>Insurance (single)</b>				
Uninsured/self-pay only	5319 (16.4)	30.5	44.6	43.4
Medicaid only	3942 (12.2)	41.3	55.8	31.4
Medicare only	2589 (8.0)	35.2	52.4	37.1
Commercial only	2627 (8.1)	25.5	45.2	44.8
Medicare+Medicaid ever	4683 (14.4)	47.3	62.5	25.2
Medicare+Commercial ever	1479 (4.6)	35.1	56.5	34.8
Mixed	11 552 (35.6)	35.7	53.4	34.7
Missing	249 (0.8)	24.1	36.5	56.6
<b>Node</b>				
A	5119 (15.8)	52.9	66.5	21.0
B	11 468 (35.4)	33.7	42.2	43.5
C	4779 (14.7)	16.0	42.0	51.6
D	11 074 (34.1)	39.7	62.2	27.0

ACC/AHA indicates American College of Cardiology/American Heart Association 2013 Cholesterol Guidelines; ATP III, National Cholesterol Education Program Adult Treatment Panel 2001 Cholesterol Guidelines; Node A, Association of Asian Pacific Community Health Organizations; Node B, Alliance of Chicago Community Health Services; Node C, Fenway Health; Node D, OCHIN.

\* $P < 0.001$  for pairwise comparison of guideline concordance based on ACC/AHA and ATP III criteria.

(84.9%) had an LDL between 70 and 99 mg/dL with no or a low-intensity statin prescribed. Only 3% of this group had an LDL <50 mg/dL (Table 5).

Of the part of the cohort that were concordant with ACC/AHA but not ATP III guidelines ( $n=9168$ ), 23.7% had an LDL >130 despite being prescribed a moderate- or high-intensity statin; 8.7% of the patients had an LDL >160 despite having a moderate- or high-intensity statin prescribed (Table 6).

## Discussion

In this study we examined statin-prescribing practices as a function of concordance with previous and current guidelines among a unique collaborative network of community health centers serving a regionally and ethnically diverse cohort of diabetic patients. To our knowledge this is the first contemporary study to examine this question on this scale in a large primarily economically vulnerable population—evidenced by the fact that 29% were either uninsured or had Medicaid alone. We demonstrate here that a suboptimal proportion of diabetic patients in CHCs met either older or newer guidelines for cholesterol treatment despite DM being a significant known risk factor for ASCVD. Regardless of application of a treatment strategy using an LDL goal or a goal based on statin dosing, significant underutilization was present. Interestingly, despite these suboptimal levels of concordance, on the eve of the implementation of the newer guidelines for statin therapy,

more patients in CHC-based practices would have been concordant with new ACC/AHA criteria compared with older guidelines. This is likely due to the presence of an LDL goal in the latter. This outcome also suggests that in CHC practice, statin prescribing for DM patients may have already become more closely aligned with the principles of the newer guidelines before their publication.

In this cohort, women were less likely to be in guideline concordance than men, which is in keeping with previous data.<sup>28</sup> Black race was associated with lower concordance with ATP III but not ACC/AHA criteria. However, in general nonwhite race was not associated with a lower likelihood of receiving guideline concordant therapy by either ATP III or ACC/AHA 2013 criteria. Previous studies focusing on diabetic patients in the ambulatory setting have suggested that blacks are less likely to be prescribed statin therapy than whites.<sup>29,30</sup> However, these analyses did not focus on diabetic patients in CHCs, suggesting that the presence of such racial gaps in prescribing may depend on the clinical setting. Among all racial groups, those patients characterized as Asian/Pacific Islander had a higher likelihood of being concordant with statin-prescribing guidelines compared with non-Hispanic whites. A similar association was seen in patients with Spanish as their primary language compared with English speakers. Previous data have demonstrated very low age-adjusted rates of statin use for higher ASCVD risk patients in the Hispanic community.<sup>18</sup> Further investigation is warranted

**Table 3.** Adjusted Odds Ratios for Predictors of Concordance With ATP III or ACC/AHA Cholesterol Management Guidelines

	Adjusted Odds for Concordance With ATP III Guideline, OR [95%CI]	Adjusted Odds for Concordance With ACC/AHA 2013 Guideline OR [95%CI]
<b>Sex</b>		
Male	1 (ref)	1 (ref)
Female	0.84 [0.80, 0.88]*	0.90 [0.85, 0.94]*
<b>Race</b>		
Non-Hispanic white	1 (ref)	1 (ref)
Hispanic	1.09 [0.97, 1.21]	1.12 [1.00, 1.25]
Non-Hispanic black	0.77 [0.70, 0.85]*	0.96 [0.88, 1.04]
American Indian	0.82 [0.65, 1.03]	0.92 [0.75, 1.13]
Asian/Pacific Islander	1.17 [1.03, 1.32] <sup>†</sup>	1.25 [1.10, 1.42]*
Multiracial	1.06 [0.75, 1.48]	1.02 [0.72, 1.43]
Other	1.00 [0.81, 1.24]	1.19 [0.98, 1.45]
<b>Age<sup>‡</sup></b>		
Linear	1.14 [1.11, 1.18]*	1.19 [1.15, 1.22]*
Quadratic	...	0.89 [0.87, 0.92]*
Hypertension	1.32 [1.25, 1.40]*	1.62 [1.54, 1.71]*
Coronary artery disease	1.26 [1.16, 1.37]*	2.33 [2.13, 2.54]*
Ischemic stroke/TIA	1.11 [0.96, 1.28]	0.25 [0.22, 0.30]*
Peripheral arterial disease	0.96 [0.67, 1.37]	1.60 [1.09, 2.34] <sup>†</sup>
<b>Primary language</b>		
English	1 (ref)	1 (ref)
Spanish	1.33 [1.18, 1.50]*	1.32 [1.17, 1.48]*
Cantonese	1.22 [0.97, 1.53]	1.03 [0.81, 1.32]
Mandarin	1.31 [1.02, 1.68] <sup>§</sup>	1.06 [0.81, 1.37]
Other	1.19 [1.03, 1.37] <sup>†</sup>	1.16 [1.00, 1.34]
<b>Insurance type</b>		
Uninsured	1 (ref)	1 (ref)
Medicaid only	1.47 [1.34, 1.63]*	1.49 [1.35, 1.64]*
Medicare only	1.39 [1.23, 1.56]*	1.70 [1.51, 1.90]*
Commercial only	1.55 [1.37, 1.77]*	1.48 [1.32, 1.66]*
Medicare+Medicaid ever	2.02 [1.84, 2.23]*	2.13 [1.93, 2.35]*
Medicare+Commercial ever	1.87 [1.62, 2.17]*	2.11 [1.84, 2.43]*
Mixed	1.58 [1.46, 1.71]*	1.56 [1.45, 1.69]*
<b>Node</b>		
A	1.43 [0.61, 3.36]	1.68 [0.91, 3.08]
B	1 (ref)	1 (ref)
C	0.40 [0.17, 0.94] <sup>§</sup>	0.86 [0.47, 1.56]
D	1.15 [0.53, 2.50] <sup>†</sup>	1.95 [1.13, 3.36] <sup>†</sup>

ACC/AHA indicates American College of Cardiology/American Heart Association 2013 Cholesterol Guidelines; ATP III, National Cholesterol Education Program Adult Treatment Panel 2001 Cholesterol Guidelines; Node A, Association of Asian Pacific Community Health Organizations; Node B, Alliance of Chicago Community Health Services; Node C, Fenway Health; Node D, OCHIN; OR, odds ratio.

\*P<0.001.

<sup>†</sup>P<0.02.

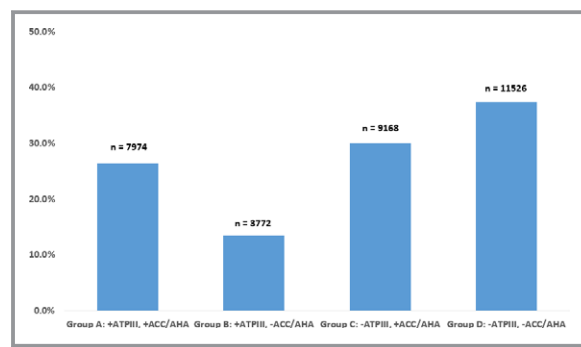
<sup>‡</sup>OR is odds ratio for 10-year increase in age.

<sup>§</sup>P<0.05.

into what aspects of care in CHCs might have improved the odds of Spanish-speaking individuals being guideline concordant and why overall some racial/ethnic disparities are present but others are not.

Not surprisingly even in the setting of CHCs focusing on providing care to low-income patients, having any form of health insurance was associated with better guideline concordance compared with being uninsured. That having Medicaid alone should be associated with improved concordance with a preventative therapy in a safety net setting is notable, given the Affordable Care Act expansion of Medicaid in many states and overall efforts to lessen the percentage of the uninsured.

Although the recent ACC/AHA guidelines have been generally well received in clinical practice, controversy still remains.<sup>31</sup> Some authors suggest that the ACC/AHA Pooled Cohort equation better identifies ASCVD risk while other authors suggest it may overestimate risk and potentially lead to overprescribing.<sup>17,19,32-34</sup> The recent United States Preventive Services Task Force statement recommends low or moderate dose statins in diabetics patients with a 10-year ASCVD risk of 10% or greater but argue that statin therapy should only be selectively offered for those with DM and a 7.5% to 10% risk.<sup>35</sup> In our study, we categorized statin prescribing as whether an individual would meet either, neither, or both 2001 ATP III and 2013 ACC/AHA guidelines. The smallest of these 4 groups was those who met ATP III but not AHA guidelines. As the vast majority of patients in this category were those on no or low-intensity statin therapy with an LDL between 70 and 99 mg/dL, this group certainly represents a target for improvement with statin initiation or intensification under ACC/AHA guidelines. However, it is important to note that the largest of the 4 groups was actually those who met neither ATP III nor ACC/AHA guidelines. The



**Figure 2.** Diabetic adults seen in community health centers categorized by proportion concordant with ATP III and ACC/AHA guidelines. (–) indicates not concordant with the guideline; (+), concordant with the guideline; ACC/AHA, American College of Cardiology/American Heart Association 2013 Cholesterol Guidelines; ATP III, National Cholesterol Education Program Adult Treatment Panel 2001 Cholesterol Guidelines.

**Table 4.** Distribution of LDL Levels and Statin Intensity for DM Patients in Community Health Centers Concordant With Neither ATP III Nor ACC/AHA Guidelines (Group D, Total N=11 526)

LDL Result During Study Year	Statin Intensity	n (% of Total)
None	No statin	5946 (51.6)
	Low	904 (7.8)
	Moderate	108 (0.9)
	Subtotal	6958 (60.4)
100 to 129 mg/dL	No statin	2071 (18.0)
	Low	756 (6.6)
	Moderate	41 (0.4)
	Subtotal	2868 (24.9)
130 to 159 mg/dL	No statin	851 (7.4)
	Low	349 (3.0)
	Moderate	23 (0.2)
	Subtotal	1223 (10.6)
160 to 189 mg/dL	No statin	239 (2.1)
	Low	122 (1.1)
	Moderate	7 (0.1)
	Subtotal	368 (3.2)
≥190 mg/dL	No statin	75 (0.7)
	Low	32 (0.3)
	Moderate	2 (<0.1)
	Subtotal	109 (0.9)

ACC/AHA indicates American College of Cardiology/American Heart Association 2013 Cholesterol Guidelines; ATP III, National Cholesterol Education Program Adult Treatment Panel 2001 Cholesterol Guidelines; LDL, low-density lipoprotein.

vast majority of these patients had no statin prescribed and an LDL above 100 mg/dL or had no LDL checked within the year. Although all of these patients may have been attempting therapeutic lifestyle changes to reach previous guidelines' LDL goal before consideration of drug therapy, this group much more likely reflects evidence of substantial statin underutilization in this population without regard to LDL level. Few would argue against the assumption that at least some of these patients would have derived some benefit in the form of reduced ASCVD risk if statin therapy had been initiated. The lack of concordance with newer guidelines merely further illuminates a preexisting significant gap in statin prescribing. However, despite our focus on statin prescribing, we would be remiss not to mention that in the group that met ACC/AHA but not ATP III guidelines, despite moderate- or high-intensity therapy some of the members of this group still had an LDL >160 mg/dL. Presumably in many cases this likely represented poor medication adherence, which would be another target area of improvement.

**Table 5.** Distribution of LDL Levels and Statin Intensity for DM Patients in Community Health Centers Concordant With ATP III but Not ACC/AHA Guidelines (Group B, Total N=3772)

LDL Result During Study Year	Statin Intensity	n (% of Total)
<50 mg/dL	Low	97 (2.6)
	Moderate	18 (0.5)
	Subtotal	115 (3.0)
50 to 69 mg/dL	Low	307 (8.1)
	Moderate	51 (1.4)
	Subtotal	358 (9.5)
70 to 99 mg/dL	None	2349 (62.3)
	Low	854 (22.6)
	Moderate	96 (2.5)
	Subtotal	3299 (87.5)

ACC/AHA indicates American College of Cardiology/American Heart Association 2013 Cholesterol Guidelines; ATP III, National Cholesterol Education Program Adult Treatment Panel 2001 Cholesterol Guidelines; LDL, low-density lipoprotein.

Our study findings have significant implications for both CHCs and for population-based primary and secondary prevention of cardiovascular events as a whole. In a recent analysis of a large registry of patients in cardiovascular-based

**Table 6.** Distribution of LDL Levels and Statin Intensity for DM Patients in Community Health Centers Concordant With ACC/AHA but not ATP III Guidelines (Group C, Total N=9 168)

LDL Result During Study Year	Statin Intensity	n (% of Total)
None	Moderate	2994 (32.7)
	High	1274 (13.9)
	Subtotal	4268 (46.6)
100 to 129 mg/dL	Moderate	1939 (21.1)
	High	790 (8.6)
	Subtotal	2729 (29.8)
130 to 159 mg/dL	Moderate	922 (10.1)
	High	451 (4.9)
	Subtotal	1373 (15.0)
160 to 189 mg/dL	Moderate	338 (3.7)
	High	198 (2.2)
	Subtotal	536 (5.8)
≥190 mg/dL	Moderate	154 (1.7)
	High	108 (1.2)
	Subtotal	262 (2.9)

ACC/AHA indicates American College of Cardiology/American Heart Association 2013 Cholesterol Guidelines; ATP III, National Cholesterol Education Program Adult Treatment Panel 2001 Cholesterol Guidelines; LDL, low-density lipoprotein.



practices, only  $\approx 60\%$  of diabetic patients who would be deemed statin eligible by new ACC/AHA guidelines were being prescribed one.<sup>16</sup> Importantly, that analysis did not take into account statin type or dosing, so the concordance rate would be expected to be even lower. Our analysis, which takes into account statin type and dosing to determine intensity, also shows suboptimal concordance with both previous and current guidelines in the CHC setting. That overall concordance in our study population for ACC/AHA guidelines was not substantially worse than that in cardiovascular based practices suggests this ASCVD prevention care gap reflects a national problem. However, although statin prescribing appeared inadequate across all groups, the variable concordance within different demographic groups also suggests that underlying disparities may partially drive these substantial care gaps in the CHC population. Given the goal set by the AHA in 2010 not only to improve the cardiovascular health of all Americans by 20% but to reduce mortality from cardiovascular disease by 20%, these findings illustrate another potential area for significant improvement.<sup>36</sup> DM has increased in incidence significantly in the past 2 decades and represents a significant risk factor for the development of cardiovascular disease.<sup>11,37</sup> At the same time, low-income and minority populations carry an undue burden of DM. In our analysis we noted a disparity in statin prescribing by sex but variable odds of achieving guideline concordance by race. We also noted a benefit on guideline concordance with Medicaid and other insurance types. Among the CHC nodes, there was variation present in guideline concordance. If we had assessed care at the 16 different CHC networks that contributed data to this study individually, we might have found even greater variation. Use of this registry may enable future work to identify CHC networks that are achieving the best performance on measures such as statin prescribing. Further examination of the organizational and clinical practices at high-performing sites may ultimately identify the best approaches to improving the quality of care and addressing disparities. We believe that to achieve long-term public health goals, understanding gaps between guidelines and practice in safety net settings will be essential, especially with issues such as appropriate statin prescribing.

In this study we were able to use a large and representative cohort of patients and pool electronic health record data within the CHARN network to begin to address important questions about cardiovascular disease prevention in CHCs on more than a local level. Strengths of this study include the large, geographically diverse group of participating CHC networks. However, these results should also be viewed with several limitations in mind. One of the 17 CHC networks was excluded from our final study cohort due to missing medication data ( $n=2660$ , see Figure 1). Although our final study

cohort contained nearly 93% of the available patients who met our inclusion criteria for a DM diagnosis, confounding from excluding this CHC is a possibility. The excluded CHC was from node A and almost entirely Asian/Pacific Islander. Thus, our findings in this study for these and related language subgroups (ie, Mandarin, Cantonese) may be less representative than for the portions of population not overrepresented in the missing CHC network. Our operational definitions of guideline concordance for previous ATP III guidelines could be viewed as strict. Because previous guidelines were based on an LDL goal, we required an LDL level within the previous year when this was not mandated in the actual guidelines. We chose this approach because determining compliance based on much older LDL levels could be problematic and potentially misleading. Nevertheless, the absence of an LDL measurement was responsible for classifying a considerable number of patients as discordant with ATP III guidelines. We also assumed that when an LDL level was not present within the year that it was not checked—as opposed to the value simply being missing. This issue represents an inherent limitation of using electronic health record data in which incomplete data are always possible. We also depended on ICD-9 codes for diagnoses of ischemic vascular disease. This could lead to underestimation of the presence of these conditions depending on local practice patterns on coding. In focusing on an LDL goal  $<100$  mg/dL as the main goal of ATP III guidelines, we also did not capture the optional goal of  $<70$  mg/dL present in the ATP III 2004 update. We elected to do this to simplify our operational definitions of guideline concordance. In this study we also focused on statin prescribing rather than adherence with therapy. We did this because we were most interested in evaluating treatment initiation in response to specific clinical conditions as a marker of the most basic level of guideline concordance. Nevertheless, it is well known that adherence to drugs including statins for primary and secondary prevention of cardiovascular disease is generally poor.<sup>38</sup> Furthermore, medication adherence can be complicated by various socioeconomic factors. Thus, it is likely that our estimates of treatment gaps are conservative and that the magnitude of these gaps is actually greater than what we show here. Further research is necessary to assess the relative importance of medication adherence as it pertains to guideline concordance of statin-prescribing practices in the CHC population.

These findings from the Community Health Applied Research Network show that significant opportunities exist to improve cholesterol management among DM patients receiving care in CHCs. The recent ACC/AHA cholesterol guidelines reemphasize preexisting gaps in statin prescribing in safety net populations. Addressing these care gaps could help reduce disparities in cardiovascular outcomes in high-risk populations in the United States.

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## Disclosures

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## **Implications of American College of Cardiology/American Heart Association (ACC/AHA) Cholesterol Guidelines on Statin Underutilization for Prevention of Cardiovascular Disease in Diabetes Mellitus Among Several US Networks of Community Health Centers**

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