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ORIGINAL RESEARCH

What Do US Physicians and Patients Think About Lipid-Lowering Therapy and Goals of Treatment? Results From the GOULD Registry

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BACKGROUND: Because of an increasing number and complexity of treatment options for lipid-lowering therapy in patients with atherosclerotic cardiovascular disease, guidelines recommend greater active involvement of patients in shared decision-making. However, patients' understanding and perceptions of the benefits, risks, and treatment objectives of lipid-lowering therapy are unknown.

METHODS AND RESULTS: Structured questionnaires were conducted in 5006 US outpatients with atherosclerotic cardiovascular disease and suboptimal low-density lipoprotein cholesterol (LDL-C) control (LDL-C ≥70 mg/dL) or on a PCSK9 (proprotein convertase subtilisin/kexin type 9) inhibitor and in 113 physician providers as a part of the GOULD (Getting to an Improved Understanding of Low-Density Lipoprotein Cholesterol and Dyslipidemia Management) Registry. Mean age of the patients was 68±10 years, 60% were men, and 86% were White race. Across all patients, 63% believed heart disease was the leading cause of death in men and 46% the leading cause of death in women. Only 28% of patients thought the primary reason they were taking lipid-lowering medication was to lower the risk of heart attack or stroke, 68% did not know their approximate LDL-C level, and 69% did not know their LDL-C goal. Patients on PCSK9 inhibitors (versus LDL-C cohort), younger patients (versus age ≥65 years), and men (versus women) were somewhat more knowledgeable about their disease and its management. Most physicians (66%) felt that a lack of understanding of the importance and efficacy of statins was the primary factor contributing to nonadherence, as opposed to costs (9%) or side effects (1%). More education was the most commonly used strategy to address patient-reported side effects.

CONCLUSIONS: A large proportion of patients with atherosclerotic cardiovascular disease remain unaware of their underlying atherosclerotic cardiovascular disease risk, reasons for taking lipid-lowering medications, current LDL-C levels, or treatment goals. These data highlight a large education gap which, if addressed, may improve shared decision-making and treatment adherence.

REGISTRATION: URL: https://www.clinicaltrials.org; Unique identifier: NCT02993120.

Key Words: cardiovascular diseases ■ low-density lipoprotein cholesterol ■ medication adherence ■ shared decision-making

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CLINICAL PERSPECTIVE

What Is New?

- Using structured questionnaires in a large cohort of US patients with cardiovascular disease and treating physicians, we found substantial deficiencies in patients' understanding of their disease and treatment.
- Most patients underestimated the risk of cardiovascular disease in the general population, did not understand their personal risk of recurrent cardiovascular events, were unaware of their cholesterol levels or goals, and either were unaware of or overestimated the benefit of cholesterol medications.
- Most physicians believed that a lack of understanding of the importance and efficacy of statins was the primary factor contributing to nonadherence, as opposed to costs or side effects.

What Are the Clinical Implications?

- These knowledge gaps may lead to poorer adherence to medications and healthy lifestyle choices, which is a particularly concerning issue given the high risk for recurrent cardiovascular events.

Nonstandard Abbreviations and Acronyms

GOULD	Getting to an Improved Understanding of Low-Density Lipoprotein Cholesterol and Dyslipidemia Management
PCSK9	proprotein convertase subtilisin/kexin type 9

Lipid management is a cornerstone of secondary prevention in patients with atherosclerotic cardiovascular disease (ASCVD). While high-intensity statins effectively reduce the risk of adverse cardiovascular events,[1] many patients have inadequate lowering of their low-density lipoprotein cholesterol (LDL-C) with statins or do not tolerate the medications. Nonstatin lipid-lowering therapy (eg, ezetimibe and PCSK9 [proprotein convertase subtilisin/kexin type 9] inhibitors) can potentially address residual ASCVD risk in these patients.[2–4]

Recent guidelines and consensus pathways on management of cholesterol emphasize the role of patient-centered shared decision-making.[5–7] However, patient-reported understanding of the benefits, risks, and treatment goals for lipid-lowering therapy have not been well described and may represent one of the key elements behind the success or failure of prevention efforts. Furthermore, with the introduction of multiple new lipid-lowering medications[2–4] and the removal and then subsequent return of LDL-C treatment goals in subsequent cholesterol guidelines,[5,7,8] the level of understanding among physicians on how best to manage lipid-lowering therapy in patients with ASCVD is unknown. In this study, we implemented questionnaires among patients with ASCVD and suboptimal LDL-C control or on a PCSK9 inhibitor, as well as physicians in order to provide insight into these questions.

METHODS

The data that support the findings of this study and research materials, as well as experimental procedures and protocols, are available from the corresponding author upon reasonable request. The Getting to an Improved Understanding of Low-Density Lipoprotein Cholesterol and Dyslipidemia Management (GOULD) is a US-based registry designed to describe longitudinal cholesterol treatment patterns among patients with ASCVD.[9] Eligible patients had (1) clinically relevant ASCVD (coronary artery disease, prior myocardial infarction, coronary or other arterial revascularization, ischemic stroke or transient ischemic attack, peripheral artery disease, and carotid artery stenosis); and (2) LDL-C ≥70 mg/dL or were on a PCSK9 inhibitor at enrollment (enrolled in separate cohorts). Ten-year risk of myocardial infarction, stroke, or cardiovascular death was estimated using the Second manifestations of arterial disease risk score.[10] All patients were required to be on some type of stable lipid-lowering therapy for at least 4 weeks before enrollment, including the PCSK9 inhibitor cohort, at the discretion of the treating physician. Patients were enrolled between December 2016 and July 2018 and followed for up to 2 years.

Patient demographic, comorbidity, and medication data were obtained through chart abstraction at the enrollment visit to the treating physician with a 1-year retrospective review of the medical chart for most recent laboratory and medication data. Vital signs and waist circumference were collected at the enrollment visit. Each patient was contacted by telephone for a structured interview at enrollment, and each enrolling physician completed a written questionnaire. Patient questionnaires included the following modules: demographics and risk factor assessment, usual source of care/access to care, lipid-lowering medication use and statin adherence, statin side effects, statin rechallenge, PCSK9 inhibitors, and ASCVD risk awareness. The validated 4-item Morisky-Green Adherence Scale[11] was used to measure patient adherence to statins, while the statin side effects and statin rechallenge modules were based on the Reasons for Geographic and Racial Differences in Stroke study surveys.[12] Physician questionnaires included modules regarding lipid measurement, statin use, use of

nonstatin lipid-lowering therapies, PCSK9 inhibitors, familial hypercholesterolemia, and patient education. All questionnaires were developed by academic collaborators. Each site obtained approval from their respective Institutional Review Board, and all patients provided written informed consent.

Patient characteristics and questionnaire results were compared between patients in the PCSK9 inhibitor cohort and the LDL-C ≥70 mg/dL cohort, between men and women, and between patients <65 years of age and ≥65 using χ^2 tests for categorical variables and *t* tests for continuous variables. All analyses were performed with SAS version 9.4 (SAS Institute, Cary, NC), and 2-sided $P<0.05$ were considered statistically significant.

RESULTS

Study Cohort

Among 5006 patients with ASCVD enrolled from 119 sites, mean age was 67.8±9.9 years, 60.3% were men, 86.1% self-reported White race, and estimated 10-year risk of myocardial infarction, stroke, or cardiovascular death was 25.8±19.0%. The response rate was 93.4% (4674/5006). There were 554 patients (11.1%) in the PCSK9 inhibitor subset with the remaining patients eligible because of LDL-C ≥70 mg/dL. Patients in the PCSK9 inhibitor cohort were more likely to be younger, women, White race, and nonsmokers (Table 1).

Table 1. Demographic and Clinical Characteristics of Patients in GOULD

	LDL-C Cohort (n=4452)	PCSK9 Inhibitor Cohort (n=554)	*P* Value
Age, y	68.0±9.9 (4451)	65.9±9.7 (554)	<0.001
Men	60.9% (2711/4452)	56.0% (310/554)	0.025
White race	85.5% (3807/4452)	91.2% (505/554)	<0.001
Current smokers	12.2% (514/4205)	6.3% (32/507)	<0.001
LDL-C, mg/dL	101.1±29.8 (4415)	79.3±52.4 (538)	<0.001
Body mass index, kg/m^2	30.6±6.2 (4412)	30.2±5.3 (546)	0.070
Estimated 10-y risk of recurrent ASCVD event (%)	26.4±19.2 (4452)	20.6±16.6 (554)	<0.001
Married	64.3% (2652/4126)	72.1% (387/537)	<0.001
College or professional degree	34.5% (1419/4108)	43.8% (235/537)	<0.001
Annual household income ≥$75 000	25.2% (1034/4109)	37.1% (199/537)	<0.001
Type of health insurance			
Private	29.4% (1192/4050)	37.9% (202/533)	<0.001
Medicare	65.2% (2641/4050)	58.5% (312/533)	0.002
Medicaid	10.8% (436/4050)	4.9% (26/533)	<0.001
How much per month do you spend on cholesterol-lowing medications?			<0.001
<$25	76.7% (2772/3613)	43.1% (195/452)	
$25–$49	15.1% (546/3613)	15.0% (68/452)	
$50–$99	4.9% (177/3613)	17.7% (80/452)	
$100–$249	2.6% (93/3613)	9.1% (41/452)	
$250 or more	0.7% (25/3613)	15.0% (68/452)	
Moderate or vigorous physical activity			0.050
None	21.5% (870/4053)	13.8% (74/538)	
1 or 2 times per wk	27.4% (1111/4053)	26.6% (143/538)	
3 or 4 times per wk	28.2% (1142/4053)	32.7% (176/538)	
5 to 7 times per wk	20.2% (819/4053)	24.5% (132/538)	
More than 7 times per wk	2.7% (111/4053)	2.4% (13/538)	
Who manages your cholesterol-lowering treatment?			<0.001
Primary care	43.6% (1749/4010)	10.4% (54/518)	
Cardiologist	35.9% (1440/4010)	60.6% (314/518)	
Multiple doctors	2.4% (96/4010)	8.9% (46/518)	
Other	18.1% (725/4010)	20.1% (104/518)	

Data are presented as mean±SD or % (n/N). ASCVD indicates atherosclerotic cardiovascular disease; GOULD, Getting to an Improved Understanding of Low-Density Lipoprotein Cholesterol and Dyslipidemia Management; LDL-C, low-density lipoprotein cholesterol; and PCSK9, proprotein convertase subtilisin/kexin type 9.

Patient Questionnaire

At the time of enrollment, patients in the PCSK9 inhibitor cohort reported having higher socioeconomic status (eg, more education, higher income, and private medical insurance compared with the LDL-C cohort) as well as higher out-of-pocket costs for cholesterol medications, with 41.8% spending $50 or more per month (versus 8.2% in the LDL-C cohort) and 15.0% spending $250 or more (versus 0.7% in the LDL-C cohort).

Regarding patient education/knowledge, 62.9% of patients believed that heart disease was the leading cause of death in men, and 46.3% believed heart disease to be the leading cause of death in women (Table 2). These percentages increased somewhat when looking at sex-specific responses, with 66.9% of men believing heart disease is the main cause of death among men, and 55.7% of women believing heart disease is the main cause of death among women (Table S1). Over half of patients (54.7%) were unable to estimate their personal risk of having a heart attack or stroke in the next 10 years, and among those who responded (N=2096), 45.5% estimated their 10-year risk to be <10%. Only 27.8% of patients believed the main reason they were taking lipid-lowering medication(s) was to lower the risk of heart attack or stroke, although 30.9% of patients overestimated the clinical benefit of medical therapies, responding that their cholesterol medication reduced the risk of heart attack or stroke by >50%, with 52.1% of patients in the PCSK9 inhibitor cohort holding this belief. Most patients did not know either their approximate LDL-C level (68.3%) or their LDL-C goal (69.3%). Patients in the PCSK9 inhibitor cohort (versus LDL-C cohort; Table 2), men (versus women; Table S1), and younger patients (versus those age ≥65 years; Table S2) were generally more knowledgeable about their disease and its management, with more patients knowing heart disease to be the leading cause of death and knowing their actual and goal LDL-C levels. Over one third of patients believed they had experienced a side effect from statins (35.5%), which was most commonly muscle-related and more likely to be reported among patients in the PCSK9 inhibitor cohort.

Physician Questionnaire

There were 113 enrolling physicians in GOULD who completed the baseline questionnaire and were included in our analysis (100% response rate). Mean age of physicians was 56.1±9.9 years with an average of 23.0±11.0 years in practice. Ninety-three of the physicians were men (82.3%), and 51 were cardiologists (45.1%), 51 primary care (45.1%), and 11 other specialties (9.8%; eg, nephrology, endocrinology). Most physicians believed the evidence for high-intensity statins was strong or very strong (78.1%; Table 3). Most physicians also targeted particular levels of LDL-C, with few reporting that they did not use LDL-C goals (6.3%) or that the goals depended on patient's risk factors (8.9%). Although 73.3% of physicians reported an LDL-C goal of <70 mg/dL, 50.9% of physicians also reported they would reduce the intensity of lipid-lowering therapy if LDL-C levels were very low.

Regarding physician-perceived barriers to lipid management, most physicians reported that nonadherence to statins was mostly because of patient belief that the medication did not work (66.4%) and not a consequence of side effects (0.9%). Physicians estimated 19.5% of patients experienced side effects from statins but that only 34.6% of patient-reported myalgias from those on statins were actually caused by the medication. There were a number of common strategies used by physicians to try to get their patients to tolerate statins, with the most common being patient education on the importance of the medication in reducing cardiovascular events.

DISCUSSION

In this large cohort of US patients with ASCVD and suboptimal LDL-C control or on a PCSK9 inhibitor, we found large deficiencies in patients' understanding of their disease and treatment. Despite their high cardiovascular risk, most patients underestimated the risk of ASCVD in the general population, did not understand their personal risk of recurrent ASCVD events, were unaware of their LDL-C levels or goals, and either were unaware of or overestimated the benefit of cholesterol medications. Patients taking PCSK9 inhibitor medications, in general, had higher socioeconomic status and self-reported a healthier lifestyle than those in the LDL-C cohort. The PCSK9 inhibitor cohort had slightly better knowledge about ASCVD and its risks but were also more likely to overestimate the risk reduction with their lipid-lowering. Men and younger patients also were more informed about their cardiovascular condition and its management, although overall knowledge was still low in these groups. Physicians continue to focus on low LDL-C goals with statins as the cornerstone of lipid-lowering therapy and believe a lack of education is a major barrier to optimal lipid-lowering treatment. These findings illustrate large education gaps that, if properly addressed, could improve the quality of shared decision-making, increase treatment adherence, and, ultimately, reduce the residual risk of recurrent ASCVD events.

Table 2. Patient Questionnaire

	LDL Cohort (n=4452)	PCSK9 Inhibitor Cohort (n=554)	*P* Value
What is your understanding of the main reason you are taking cholesterol medication?			0.003
To prevent a heart attack and/or stroke	27.3% (1120/4106)	31.4% (168/535)	
To lower cholesterol	67.0% (2750/4106)	66.4% (355/535)	
To make you feel better	1.2% (49/4106)	0.6% (3/535)	
Don't know/not sure	4.6% (187/4106)	1.7% (9/535)	
What do you think is the leading cause of death for men in the United States?			<0.001
Heart disease	61.7% (2536/4113)	72.6% (389/536)	
Cancer	10.3% (422/4113)	8.4% (45/536)	
Other	4.3% (178/4113)	2.4% (13/536)	
Don't know/not sure	23.8% (977/4113)	16.6% (89/536)	
What do you think is the leading cause of death for women in the United States?			<0.001
Heart disease	44.8% (1841/4113)	58.4% (313/536)	
Cancer	27.7% (1141/4113)	22.4% (120/536)	
Other	2.4% (100/4113)	1.7% (9/536)	
Don't know/not sure	25.1% (1031/4113)	17.5% (94/536)	
Can you estimate the chance that you will have a heart attack or stroke within the next 10 y?			0.263
<5%	12.8% (524/4096)	10.4% (55/531)	
5% to <10%	8.5% (348/4096)	4.9% (26/531)	
10% to <20%	6.6% (269/4096)	8.3% (44/531)	
20% to <50%	8.3% (338/4096)	8.5% (45/531)	
50% or greater	9.2% (376/4096)	13.4% (71/531)	
Don't know/not sure	54.7% (2241/4096)	54.6% (290/531)	
By how much do you think your cholesterol-lowering medication reduces your risk for having a heart attack or stroke over the next 10 y?			0.005
<5%	3.3% (136/4108)	2.4% (13/536)	
5% to <10%	4.4% (180/4108)	2.8% (15/536)	
10% to <20%	6.3% (257/4108)	3.2% (17/536)	
20% to <50%	14.4% (592/4108)	12.5% (67/536)	
50% or greater	28.2% (1157/4108)	52.1% (279/536)	
Don't know/not sure	43.5% (1786/4108)	27.1% (145/536)	
What is your LDL?			<0.001
<50 mg/dL	2.1% (85/4115)	22.6% (121/535)	
50 to <70 mg/dL	3.3% (135/4115)	10.8% (58/535)	
70 to <100 mg/dL	14.1% (581/4115)	9.2% (49/535)	
100 to <130 mg/dL	5.8% (237/4115)	4.1% (22/535)	
130 mg/dL or higher	3.9% (161/4115)	5.0% (27/535)	
Don't know/not sure	70.9% (2916/4115)	48.2% (258/535)	
What should your LDL be according to your doctor?			<0.001
<50 mg/dL	3.8% (157/4114)	11.7% (63/537)	
50 to <70 mg/dL	7.5% (309/4114)	13.6% (73/537)	
70 to <100 mg/dL	13.0% (534/4114)	16.2% (87/537)	
100 to <130 mg/dL	3.0% (122/4114)	3.7% (20/537)	
130 mg/dL or higher	1.4% (56/4114)	1.3% (7/537)	
Don't know/not sure	71.4% (2936/4114)	53.4% (287/537)	
Have you ever had any symptoms that you thought were due to taking a statin?			
Any side effects	29.5% (1201/4070)	81.7% (428/524)	<0.001
Muscle-related symptoms	24.0% (978/4070)	74.8% (392/524)	<0.001
Memory-related symptoms	4.9% (200/4070)	17.6% (92/524)	<0.001
Abnormal labs (liver, muscle)	4.1% (166/4070)	22.5% (118/524)	<0.001
Diabetes mellitus	0.4% (18/4070)	1.0% (5/524)	0.174

LDL indicates low-density lipoprotein; and PCSK9, proprotein convertase subtilisin/kexin type 9.

Table 3. Physician Questionnaire (n=113)

Lipid Management Goals	
LDL-C goal to achieve with cholesterol-lowering therapy	
<50 mg/dL	4.5% (5/112)
<70 mg/dL	68.8% (77/112)
<100 mg/dL	10.7% (12/112)
<130 mg/dL	0.9% (1/112)
It depends on patient's other risk factors	8.9% (10/112)
Do not use LDL-C goals	6.3% (7/112)
Choice for patients with very low LDL-C	
Make no change to lipid-lowering therapy	49.1% (54/110)
Reduce, discontinue, or change the lipid-lowering medication intensity	50.9% (56/110)
How strong is the scientific evidence supporting the use of high-intensity statins vs low/moderate-intensity statins among patients with ASCVD?	
Very strong	43.6% (48/110)
Strong	34.5% (38/110)
Moderate	20.0% (22/110)
Weak/very weak	1.8% (2/110)
Barriers to Lipid Control	
Frequently discuss adherence issues (most or always)	85.6% (95/111)
% of patients with statins experience side effects (mean±SD)	19.5%±13.2
Among patients who have muscle pain or aches while taking statins, what % do you think is due to statin? (mean±SD)	34.6%±23.9
Most common reason for nonadherence to statin	
Patients don't believe the medication works	66.4% (75/113)
Patients can't afford the medication	8.8% (10/113)
Patients experienced side effects	0.9% (1/113)
Patients don't like taking medications	16.8% (19/113)
Other	7.1% (8/113)
Frequency of actions when a patient with ASCVD reports side effects while taking statins (most or all of the time)	
Down-titrate intensity	38.4% (43/112)
Give the patient 2 to 4 wk without statins and then re-challenge them	37.5% (42/112)
Discontinue treatment	1.8% (2/112)
Educate patients on the importance of statins	86.6% (97/112)
Switch statin type	43.8% (49/112)
Advise patients to take the medication every other day	9.8% (11/112)
Add a supplement (eg, CO-Q10 or vitamin D)	21.4% (24/112)
Frequency of prescribing nonstatin lipid-lowering therapy for the following scenarios (most or always)	
Patients cannot tolerate statins	59.8% (67/112)
LDL-C remains high despite statin use	67.0% (75/112)
Further cardiovascular disease risk reduction above and beyond statin use	50.9% (57/112)

ASCVD indicates atherosclerotic cardiovascular disease; and LDL-C, low-density lipoprotein cholesterol.

An underestimation of the risks of ASCVD—particularly in women—was not unexpected, given prior work in the general US population.[13–15] The American Heart Association conducted a national survey in 1997 and showed that only 30% of women correctly identified ASCVD as their leading cause of death.[13] Likely as a result in part of the Go Red for Women campaign, this improved to 56% in a 2012 survey, although awareness was much lower among Black and Latina women (36% and 34%, respectively).[14] In a more recent survey from Cleveland Clinic of both adult men and women, 63% of people across all age groups believed they would likely develop heart disease in the next 10 years, but only 32% believed ASCVD was the leading cause of death in women, with lower percentages in male respondents.[15]

Public campaigns, such as the Go Red for Women and the American Heart Association's Check Change Control Cholesterol, can have an effect in improving awareness to some degree, although, as discussed above, these effects may not always reach key high-risk demographic groups. Furthermore, while awareness in a general population is important to get patients to adopt primary prevention efforts and to recognize and seek appropriate care for ischemic symptoms, our study shows a lack of awareness and understanding of ASCVD risks and goals of treatment in a particularly high-risk cohort of patients with known ASCVD and suboptimal LDL-C control. Improving patient understanding of their personal risk has been shown to improve health behaviors and evidence-based decisions across a range of clinical conditions.[16] In the case of ASCVD, improved perception of both risk of recurrent ischemic events and the estimated benefit of optimal risk factor control has been shown to increase statin adherence and lower LDL-C levels.[17] An Australian randomized study of patients with ASCVD showed that coaching (consisting of intermittent phone calls by trained nurses or dietitians with education regarding risk factor targets, negotiation of a plan of action, and monitoring of the patient's progress) had an effect on LDL-C of equal magnitude to being prescribed lipid-lowering drug therapy, with the mechanism hypothesized to be an improvement in adherence to both medications and to dietary recommendations.[18] In an expanded multicenter trial of this program, coaching resulted in improvement in LDL-C levels in addition to most other coronary risk factors and in patient-reported quality of life.[19] While the optimal strategy to improve lipid control remains unclear, greater study and emphasis on bridging this education gap—focusing on all of the issues that impair the effectiveness of treatments with proven efficacy—could have a marked impact on cardiovascular risk reduction. Improving the health literacy of high-risk patients with ASCVD becomes increasingly critical as the number of interventions and treatment options grow and, as a

result, so does the need for patient participation in these treatment decisions.

There are a number of potential limitations to our study that merit further discussion. First, although GOULD enrolled a large number of patients from a geographically diverse set of >100 US sites, patients were less diverse in regard to age, race, and socioeconomic status, with a concentration of older, White race, educated, and economically stable persons. Moreover, patients may differ based on their willingness to participate in the study. Educational gaps in other patient groups are likely to be even greater. Second, while we identified a number of patient-centered barriers to optimal cardiovascular risk reduction, including awareness of LDL-C levels, LDL-C goals, and the expected risk reduction in cardiovascular events associated with one's cholesterol medication, it is not clear from our data which knowledge gaps (if any) would be most important to target to improve adherence to lipid-lowering therapies and healthy lifestyle choices. Third, the results are based on questionnaires administered at patient enrollment, which occurred between December 2016 and July 2018. There have since been updates to clinical lipid guidelines as well as significant price reductions in both currently marketed PCSK9 inhibitors. We plan to track the impact of these changes to both the patient and physician experience over the 24-month follow-up period. Furthermore, these efforts to improve knowledge and understanding may also have to be specifically tailored depending on the sociodemographics, educational level, and health literacy of the patients. Fourth, a patient's individual risk of heart attack or stroke as well as the risk reduction achieved with cholesterol-lowering medications may be impacted by other clinical factors that we were unable to account for, such as atrial fibrillation, other medications that impact cardiovascular risk (eg, antiplatelet agents, novel glucose-lowering medications), heart failure, or ischemic burden. Finally, the results of the physician questionnaire are limited by the small number and selected nature of participating physicians, who could be more engaged in lipid lowering than other physicians.

In conclusion, in a study of >5000 patients with ASCVD and suboptimal LDL-C control or on a PCSK9 inhibitor and 113 physician providers, we found that despite the seriousness of their disease and challenges in management, there were substantial gaps in the knowledge and understanding of their disease and treatments, including underlying risk of ASCVD and goals of treatment. These gaps may lead to poorer adherence to medications and healthy lifestyle choices. Further efforts to institute structured direct coaching could have a marked impact on knowledge, adherence, and outcomes.

ARTICLE INFORMATION

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Supplementary Material

Appendix S1
Tables S1–S2

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SUPPLEMENTAL MATERIAL

Appendix

List of GOULD Investigators

Listed below are the primary investigators representing the 119 enrolling sites in the US; listed in order of enrollment contribution.

Thomas Knickelbine, Abbott Northwestern Hospital Minneapolis Heart Institute; Charles Augenbraun, Cardiology Associates of Fairfield County; James Talano, Southwest Florida Research LLC; Faisal Wahid, Texas Institute of Cardiology; David Suh, NSC Research; Ranchhod Khant, Bay Area Cardiology; Shamaila Aslam, Northwest Houston Heart Center; Scott Merryman, McConnell Heart Health Center; David Herrington, Wake Forest University School of Medicine; Philip Patel, Eisenhower Desert Cardiology Center; Kenneth Fox, Family Medical Associates; Sumant Lamba, First Coast Cardiovascular Institute PA; Steven Brodie, HCP Clinical Research LLC; Neil Sheth, Radiant Research- Warner Family Practice PC; Kahlid Sheikh, Brevard Cardiovascular Research; Allen Geltzer, Synexus Clinical Research US Inc Overlake Internal Medicine Associates; Michael Lillestol, Lillestol Research LLC; Kamlesh Dave, Heart Care Associates; Stanley Koch, Koch Family Medicine; Steven Lupovitch, Northwest Heart Clinical Research LLC; Carlos Piniella, Clinical Research of Homestead; Lawrence Allen, Diagnostic Center of Medicine; Rakesh Vohra, Parkway Cardiology Associates; Steven Geller, Centennial Medical Group; Rohit Amin, Pensacola Research Consultants; Charles Michieli, Synexus Clinical Research Incorporated Orange Grove Family Practice; Philip Levin, Model Clinical Research Inc; Nicolas Shammas, Midwest Cardiovascular Research Foundation; Andrew Potler, East Mountain Medical Associates, PC; Vladimir Santos, Gad Research Center; Madaiah Revana, Humble Cardiology Associates; Ellis Lader, WMCHealth Heart and Vascular Institute Kingston Division of Cardiology; David Strobl, Sparrow Clinical Research Institute; Megan Supple, Cone Health; Denes Korpas, Nebraska Heart Institute; Donna DeSantis, Radiant Research- East Valley Family Physicians; Debra Fuchs-Ertman, InterMed PA; Wael Eid, Saint Elizabeth Covington; Linda Calhoun, Cape Fear Heart Associates; Narendra Upadhyaya, Research Physicians Network Alliance; Ryan Cotter, Heart Institute of Colorado; James Maciejko, Ascension Saint John Hospital; Paul Ziajka, The Florida Lipid Institute; William Smith, Research Institute of Deaconess Clinic Downtown; Eduardo Antezano, UnityPoint Cardiology at Pleasant; Philip O Donnell, Selma Medical Associates; Lance Sloan, Texas Institute for Kidney and Endocrine Disorders; Vance Wilson, Daytona Heart Group; Denise Janosik, Mercy Research; James Kmetzo, Doylestown Health Cardiology; Sumana Gangi, Southern Endocrinology Associates PA; Neil Sheth, Synexus Clinical Research US, Inc; Chrisette Dharma, Southwest Family Medicine Associates; Darshan Godkar, Advanced Cardiology LLC; Philip Nicol, The Diabetes Center; Micheal Hong, Trinity Medical Western New York, PC; Catherine Popkin, Boca Raton Clinical Research Medical Center Inc; Rajesh Patel, Lycoming Internal Medicine Inc; Abelardo Vargas, New Phase Clinical Trials Corp; Minesh Patel, LaPorte County Institute for Clinical Research; Vikas Desai, Charles River Medical Associates; Yunsheng Ma, University of Massachusetts Medical School; Robert Block, University of Rochester Medical Center; Louis Hiotis, Radiant Research- Michigan Avenue Internists, LLC; Colby Grossman, Palmetto Clinical Research; Ahmed Arif, Ahmed Arif Medical Research Center LLC; Seth Baum, Excel Medical Clinical Trials; Carlos Sotolongo, Baptist Heart Specialists; Rebecca Jordan, Center for Clinical Trials of Sacramento Inc; Paul

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Table S1. Patient questionnaire results stratified by sex.

	Men n=3021	Women n=1985	p-value
What is your understanding of the main reason you are taking cholesterol medication?			0.806
To prevent a heart attack and/or stroke	28.3% (791/2797)	27.0% (497/1844)	
To lower cholesterol	66.4% (1858/2797)	67.6% (1247/1844)	
To make you feel better	1.1% (31/2797)	1.1% (21/1844)	
Don't know/not sure	4.2% (117/2797)	4.3% (79/1844)	
What do you think is the leading cause of death for men in the United States?			<0.001
Heart disease	66.9% (1874/2803)	56.9% (1051/1846)	
Cancer	9.2% (258/2803)	11.3% (209/1846)	
Other	4.7% (131/2803)	3.3% (60/1846)	
Don't know/not sure	19.3% (540/2803)	28.5% (526/1846)	
What do you think is the leading cause of death for women in the United States?			<0.001
Heart disease	40.1% (1125/2802)	55.7% (1029/1847)	
Cancer	29.7% (832/2802)	23.2% (429/1847)	
Other	2.5% (71/2802)	2.1% (38/1847)	
Don't know/not sure	27.6% (774/2802)	19.0% (351/1847)	
Can you estimate the chance that you will have a heart attack or stroke within the next 10 years?			<0.001
Less than 5%	12.6% (352/2793)	12.4% (227/1834)	
5% to less than 10%	9.3% (261/2793)	6.2% (113/1834)	
10% to less than 20%	7.8% (218/2793)	5.2% (95/1834)	
20% to less than 50%	9.0% (252/2793)	7.1% (131/1834)	
50% or greater	10.4% (290/2793)	8.6% (157/1834)	
Don't know/not sure	50.8% (1420/2793)	60.6% (1111/1834)	
By how much do you think your cholesterol-lowering medication reduces your risk for having a heart attack or stroke over the next 10 years?			<0.001
Less than 5%	2.6% (72/2799)	4.2% (77/1845)	
5% to less than 10%	4.2% (118/2799)	4.2% (77/1845)	
10% to less than 20%	6.4% (178/2799)	5.2% (96/1845)	
20% to less than 50%	16.0% (449/2799)	11.4% (210/1845)	
50% or greater	32.8% (917/2799)	28.1% (519/1845)	
Don't know/not sure	38.0% (1065/2799)	46.9% (866/1845)	
What is your LDL?			<0.001
Less than 50 mg/dL	5.5% (154/2803)	2.8% (52/1847)	
50 mg/dL to less than 70 mg/dL	4.5% (126/2803)	3.6% (67/1847)	
70 mg/dL to less than 100 mg/dL	15.7% (440/2803)	10.3% (190/1847)	
100 mg/dL to less than 130 mg/dL	5.2% (146/2803)	6.1% (113/1847)	
130 mg/dL or higher	3.8% (107/2803)	4.4% (81/1847)	
Don't know/not sure	65.3% (1830/2803)	72.8% (1344/1847)	
What should your LDL be according to your doctor?			<0.001
Less than 50 mg/dL	5.6% (156/2804)	3.5% (64/1847)	
50 mg/dL to less than 70 mg/dL	9.8% (275/2804)	5.8% (107/1847)	
70 mg/dL to less than 100 mg/dL	14.4% (403/2804)	11.8% (218/1847)	
100 mg/dL to less than 130 mg/dL	3.0% (84/2804)	3.1% (58/1847)	
130 mg/dL or higher	1.2% (33/2804)	1.6% (30/1847)	
Don't know/not sure	66.1% (1852/2804)	74.2% (1370/1847)	

Table S2. Questionnaire results stratified by age.

	Age <65 years n=1754	Age ≥65 years n=3251	p-value
What is your understanding of the main reason you are taking cholesterol medication?			<0.001
To prevent a heart attack/stroke	31.4% (509/1622)	25.8% (779/3019)	
To lower cholesterol	63.6% (1031/1622)	68.7% (2074/3019)	
To make you feel better	1.2% (19/1622)	1.1% (33/3019)	
Don't know/not sure	3.9% (63/1622)	4.4% (133/3019)	
What do you think is the leading cause of death for men in the United States?			0.178
Heart disease	64.0% (1042/1627)	62.3% (1883/3022)	
Cancer	8.8% (143/1627)	10.7% (324/3022)	
Other	3.9% (63/1627)	4.2% (128/3022)	
Don't know/not sure	23.3% (379/1627)	22.7% (687/3022)	
What do you think is the leading cause of death for women in the United States?			0.653
Heart disease	47.4% (771/1625)	45.7% (1383/3024)	
Cancer	26.3% (427/1625)	27.6% (834/3024)	
Other	2.5% (40/1625)	2.3% (69/3024)	
Don't know/not sure	23.8% (387/1625)	24.4% (738/3024)	
Can you estimate the chance that you will have a heart attack or stroke within the next 10 years?			0.011
Less than 5%	12.8% (207/1620)	12.4% (372/3007)	
5% to less than 10%	8.8% (142/1620)	7.7% (232/3007)	
10% to less than 20%	6.7% (108/1620)	6.8% (205/3007)	
20% to less than 50%	8.5% (138/1620)	8.1% (245/3007)	
50% or greater	11.9% (193/1620)	8.4% (254/3007)	
Don't know/not sure	51.4% (832/1620)	56.5% (1699/3007)	
By how much do you think your cholesterol-lowering medication reduces your risk for having a heart attack or stroke over the next 10 years?			0.141
Less than 5%	2.9% (47/1622)	3.4% (102/3022)	
5% to less than 10%	3.9% (64/1622)	4.3% (131/3022)	
10% to less than 20%	5.5% (90/1622)	6.1% (184/3022)	
20% to less than 50%	14.4% (233/1622)	14.1% (426/3022)	
50% or greater	34.7% (563/1622)	28.9% (873/3022)	
Don't know/not sure	38.5% (625/1622)	43.2% (1306/3022)	
What is your LDL?			0.434
Less than 50 mg/dL	4.3% (70/1624)	4.5% (136/3026)	
50 mg/dL to less than 70 mg/dL	3.2% (52/1624)	4.7% (141/3026)	
70 mg/dL to less than 100 mg/dL	12.3% (199/1624)	14.2% (431/3026)	
100 mg/dL to less than 130 mg/dL	6.7% (109/1624)	5.0% (150/3026)	
130 mg/dL or higher	5.3% (86/1624)	3.4% (102/3026)	
Don't know/not sure	68.2% (1108/1624)	68.3% (2066/3026)	
What should your LDL be according to your doctor?			<0.001
Less than 50 mg/dL	5.7% (93/1625)	4.2% (127/3026)	
50 mg/dL to less than 70 mg/dL	9.0% (146/1625)	7.8% (236/3026)	
70 mg/dL to less than 100 mg/dL	14.0% (228/1625)	13.0% (393/3026)	
100 mg/dL to less than 130 mg/dL	3.6% (59/1625)	2.7% (83/3026)	
130 mg/dL or higher	1.5% (25/1625)	1.3% (38/3026)	
Don't know/not sure	66.1% (1074/1625)	71.0% (2149/3026)	