The Association Between Type 2 Diabetes and Cardiovascular Disease: The "For Your SweetHeart™" Survey

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ABSTRACT

Introduction: It is unclear whether patients and their loved ones appreciate that cardiovascular disease (CVD) is the major cause of morbidity and mortality in type 2 diabetes mellitus (T2DM). The purpose of this survey was to evaluate the degree of awareness regarding the link between T2DM and CVD.

Methods: An online survey was conducted among US adults (general population) and adults with self-reported T2DM.

Results: Of 13,027 participants recruited, 1505 completed the survey (12% response rate): 501 with T2DM and 1004 from the general population, of whom 364 knew someone with T2DM (e.g., partner, friend, relative, colleague: "SweetHearts"). Of those with T2DM, 52% were unaware that patients with T2DM are at increased risk of CVD and related macrovascular events. People with T2DM were more likely to be aware of the increased risk of microvascular disease (blindness [57%], nephropathy [57%], neuropathy [64%]) than macrovascular disease (myocardial infarction [41%], stroke [43%]). Despite CVD being the leading cause of death in T2DM, 67% of those with T2DM and 69% of SweetHearts were unaware of this, similar figures to those of the general population (74%). People with T2DM indicated they would take preventive measures if they were aware of their increased CVD risk: 88% would modify their diet and 81% would talk to their healthcare provider. Respondents with T2DM (73%) indicated that a desire to live longer/spend more time with family would motivate them to decrease their CVD risk.

Conclusions: Findings indicate that education regarding the association between T2DM and CVD in patients and their loved ones is warranted.

Plain Language Summary: Plain language summary available for this article. Please see Fig. 1 and the following link: https://doi.org/10.6084/m9.figshare.7546817.

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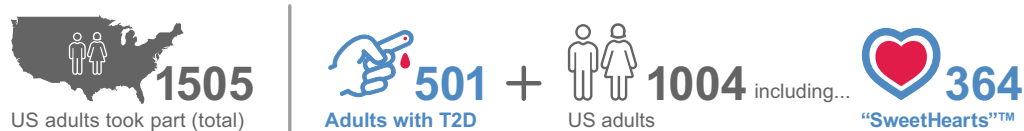M. K. Boardman
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A survey of people's understanding about type 2 diabetes and heart disease
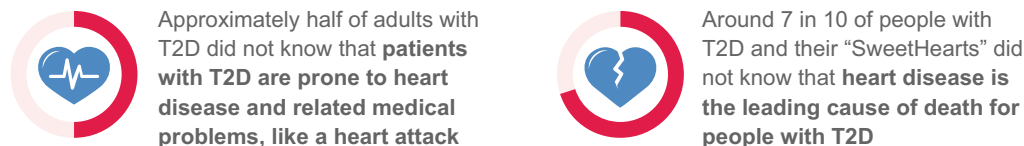
WHY WAS THIS SURVEY DONE?

- This survey was done to find out what adults with type 2 diabetes (T2D) and people close to them know about the link between T2D and heart disease
  - People close to them included their relatives, friends, partners, or colleagues. They were called "SweetHearts"™ in this survey
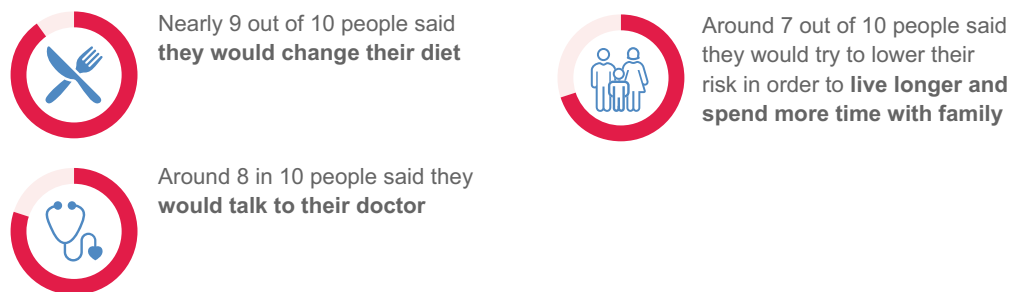
WHO TOOK PART IN THE SURVEY?

1505
US adults took part (total)

501
Adults with T2D

+

1004
US adults including...

364
"SweetHearts"™

WHAT DID THE SURVEY FIND?

Approximately half of adults with T2D did not know that **patients with T2D are prone to heart disease and related medical problems, like a heart attack**

Around 7 in 10 of people with T2D and their "SweetHearts" did not know that **heart disease is the leading cause of death for people with T2D**

MOST PEOPLE WITH T2D WERE MOTIVATED TO ADDRESS THE RISK OF HEART DISEASE

Nearly 9 out of 10 people said **they would change their diet**

Around 7 out of 10 people said they would try to lower their risk in order to **live longer and spend more time with family**

Around 8 in 10 people said they **would talk to their doctor**

WHAT WAS THE MAIN CONCLUSION REPORTED BY THE RESEARCHERS?

- These results suggest that for people with T2D and the people close to them, the overall level of knowledge about T2D and heart disease is low.

WHERE DO I GO FOR MORE INFORMATION?

- You can find more information about type 2 diabetes and heart disease here: https://KnowDiabetesbyHeart.org/

Fig. 1 Plain Language Summary

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a leading cause of morbidity and mortality in the USA and worldwide [1]. Patients with T2DM have a 2- to 4-fold higher risk of death from cardiovascular disease (CVD) compared with people without diabetes [2]. Moreover, CVD is the most common cause of mortality among people with T2DM [1, 3]. This accentuated risk is well known among those who treat T2DM [4], but it is largely unknown whether it is appreciated by patients themselves. Although there is evidence to suggest that diabetes education can improve glucose control for patients [5, 6], limited evidence from 2002 suggests that knowledge regarding heart disease, heart attack, and stroke risk among patients with T2DM is suboptimal [4], hence it is of great interest to determine the *current* level of knowledge regarding CVD risk in people with T2DM as a potential target to improve outcomes (Fig. 1).

It has been suggested that family members can play an important role in helping individuals with T2DM manage their condition [7]. Providing support and education to family members could also help improve outcomes in patients with T2DM [8]. In a survey of family members of people with diabetes (type 1 or T2DM), more than one-third of respondents (37.1%) did not know how to help the person with diabetes and also wanted more involvement in their care (39.4%) [8]. Although few family members had participated in diabetes education (23.1%), most of those who had done so (72.1%) found it to be helpful [8].

The purpose of the present survey was to evaluate the awareness of the association between T2DM and CVD among individuals with and without T2DM, as well as among those who know someone with T2DM—a "SweetHeart".

METHODS

Study Design and Participants

"For Your SweetHeart™" was a non-interventional, cross-sectional, retrospective online survey conducted by KRC Research (Washington, DC) from October 24 to November 1, 2016. Eligible participants were US adults aged 18 years or over (general population) and adults with self-reported T2DM. A subset of the general population included individuals who knew someone with T2DM (e.g., spouse/partner, friend, relative, colleague: SweetHearts). Invitations to participate in the survey were emailed to panelists.

Recruitment occurred using a non-probability sampling technique. The survey quotas were set at approximately 1000 US adults (i.e., general population) and 500 US adults with T2DM; there were no quotas for SweetHearts. These sample sizes provide a margin of error of ± 3%, which is standard survey research methodology. Participants in the general population sample were selected on the basis of demographic characteristics to be representative of the demographic composition of the estimated 2010 US Census population of 235 million US adults [9]. Similarly, the T2DM sample was selected to be representative of the demographic composition of US adults with T2DM; these results were weighted and projected to match the US-diagnosed patient population of 23 million based on an extrapolation for estimates provided by the American Diabetes Association (ADA) [10].

Survey Development

The questionnaire was developed by KRC Research with input from a multidisciplinary advisory team that included a steering committee of cardiologists and endocrinologists who reviewed the items for quality assurance. The survey results were reviewed by medical, legal, and regulatory experts from Boehringer Ingelheim and Eli Lilly & Company. Questions were designed to measure knowledge about T2DM among US adults, and their understanding of the link between T2DM and CVD.

In addition to screening and demographic questions, the survey contained sections designed to assess (1) health information gaps about diabetes, (2) health information gaps about CVD, and (3) attitudes and behaviors of

SweetHearts with regard to CVD and T2DM. Survey items included a mix of closed-ended and Likert-type response questions. Questions use non-medical terminology (i.e., nerve damage versus neuropathy). The Likert-type items were ranked on a scale of 1 to 5, where 5 means "extremely likely" and 1 means "not likely at all." For items where participants ranked likelihood of several choices, the lists were randomized.

The survey methodology was validated using a number of steps, including a thorough check of the survey link and programming; opt-in panel recruitment via proprietary, certified, and qualified sources; digital fingerprinting that flagged duplicate respondents; two-factor authentication that confirmed location prior to reward redemption; pattern recognition software to identify fraudulent respondents; monitoring and exclusion of suspicious respondents; tracking quotas and disposition reports; and ongoing checks of data while the survey was "live."

The survey followed guidelines for the conduct of non-interventional studies, and was reviewed/approved by an independent institutional review board. The survey also adhered to globally accepted guidelines for the conduct of market research from the Council of American Survey Research Organizations, the American Association for Public Opinion Research, and the Market Research Society.

Description of Methods Used for Data Analysis

The data file of responses from participants who completed the survey was coded to develop a crosstab document, a method of qualitative data analysis used to evaluate data by population subgroup (e.g., people with and without T2DM, and SweetHearts). Results are presented descriptively as percentages. Data management and statistics were conducted in accordance with the approved protocol and the statistical analysis plan. Given the primary aim of this research was to describe levels of awareness in the surveyed sample, descriptive statistics were considered appropriate and were used to summarize the results. We did not aim to manipulate variables or control conditions; this was a cross-sectional "real-world" survey and no inferential statistics were planned nor conducted post hoc.

RESULTS

Of 13,027 US participants recruited, 1505 completed the survey (12% response rate): 501 with T2DM and 1004 individuals from the general population, of whom 364 knew someone with T2DM (e.g., spouse/partner, friend, relative, colleague: SweetHearts). As shown in Table 1, 53% of adults with T2DM were male, 66% were Caucasian, and 61% were between the ages of 35 and 64 years; more individuals with T2DM were from the South (42%) than other geographic regions of the USA.

Health Information Gaps: T2DM

Respondents were asked to select from a list of 13 conditions that individuals with T2DM are "at increased risk of." Of those with T2DM, 52% ($n = 262$) were unaware that patients with T2DM are at increased risk of CVD and related macrovascular events. People with T2DM were more likely to be aware of the increased risk of microvascular disease (blindness [57%, $n = 287$], nephropathy [57%, $n = 287$], neuropathy [64%, $n = 321$]) than macrovascular disease (myocardial infarction [MI; 41%, $n = 208$], stroke [43%, $n = 216$]).

When asked about the likelihood (5 = extremely likely to 1 = not at all likely) of various events occurring in their life, less than half of individuals with T2DM chose "likely" (scale 4–5) for CVD (43%, $n = 217$), followed by heart attack (39%, $n = 194$), stroke (33%, $n = 164$), blindness (30%, $n = 149$), and amputation (24%, $n = 118$) (Fig. 2). However, this same group of individuals thought the likelihood (scale 4–5) of these events occurring in someone else with T2DM was higher: CVD (51%, $n = 253$), followed by heart attack (44%, $n = 221$), blindness (43%, $n = 214$), amputation (42%, $n = 210$), and stroke (40%, $n = 200$). To assess if respondents understood that CVD was

Table 1 Demographic characteristics

	Participants with T2DM (n = 501)	General population (n = 1004)	T2DM SweetHearts (subset of the general population) (n = 364)
Gender, n (%)			
Male	264 (53)	462 (46)	159 (44)
Female	237 (47)	542 (54)	205 (56)
Age, years, n (%)			
18–34	54 (11)	312 (31)	130 (36)
35–54	176 (35)	376 (37)	121 (33)
55–64	130 (26)	186 (18)	66 (18)
≥ 65	141 (28)	130 (13)	47 (13)
Highest level of education, n (%)			
High school	87 (17)	229 (23)	73 (20)
Some college	163 (33)	336 (33)	129 (35)
College graduate	176 (35)	294 (29)	111 (30)
Postgraduate degree	71 (14)	130 (13)	48 (13)
Region of residence, n (%)			
Northeast	86 (17)	187 (19)	53 (15)
South	212 (42)	335 (33)	130 (36)
Midwest	92 (18)	220 (22)	87 (24)
West	112 (22)	261 (26)	94 (26)
Ethnicity/race*, n (%)			
Caucasian	331 (66)	757 (75)	269 (74)
African American	110 (22)	134 (13)	52 (14)
Hispanic/Latino	90 (18)	144 (14)	52 (14)
Asian American	35 (7)	46 (5)	19 (5)
Native American	15 (3)	15 (1)	6 (2)
Pacific Islander	0	2 (< 1)	2 (1)
Other	10 (2)	42 (4)	14 (4)

*Percentages exceed 100% because participants of any race could select Hispanic/Latino as ethnicity
T2DM type 2 diabetes mellitus

the leading cause of death in T2DM, they were asked to select from several conditions; 67% (n = 336) of those with T2DM and 69% (n = 252) of SweetHearts were unaware that CVD is the number one health-related killer, responses that were comparable to those given by the general population (74%, n = 740).
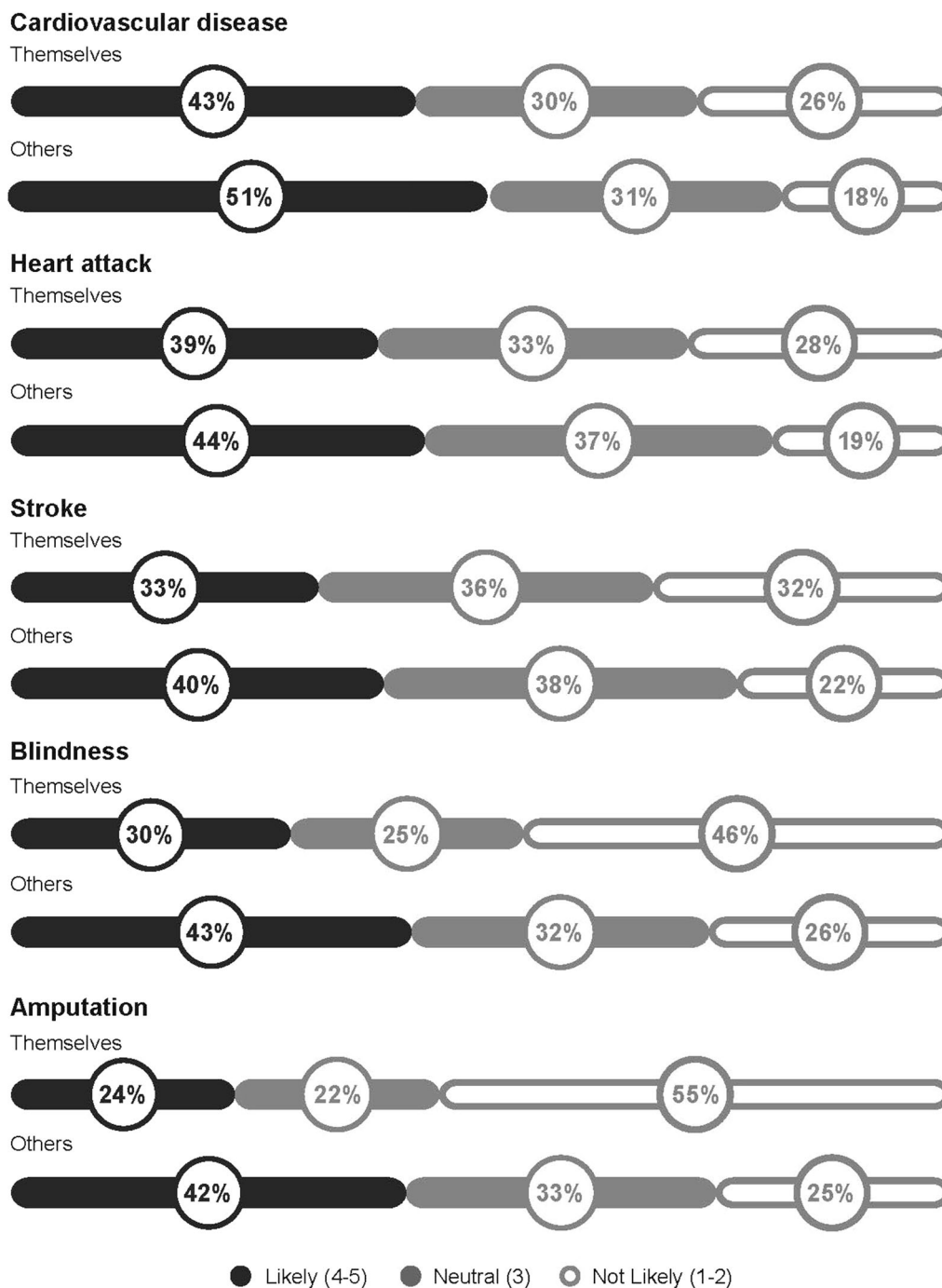
Cardiovascular disease

Themselves

43%   30%   26%

Others

51%   31%   18%

Heart attack

Themselves

39%   33%   28%

Others

44%   37%   19%

Stroke

Themselves

33%   36%   32%

Others

40%   38%   22%

Blindness

Themselves

30%   25%   46%

Others

43%   32%   26%

Amputation

Themselves

24%   22%   55%

Others

42%   33%   25%

● Likely (4-5)   ● Neutral (3)   ○ Not Likely (1-2)

Fig. 2 How individuals with T2DM perceive the likelihood of various events occurring in their lives versus the lives of other individuals with T2DM. Percentages may not total 100% because of rounding. T2DM type 2 diabetes mellitus

Health Information Gaps: CVD

Respondents were asked if they or anyone they knew had heart disease. Of those with T2DM, 26% (n = 132) responded they had CVD, 22% (n = 112) knew someone with CVD, and 53% (n = 266) did not have CVD or know someone with CVD. Among this group who had T2DM

but did not have or know someone with CVD (*n* = 266), 52% (*n* = 137) did not know whether they were at increased risk of CVD; however, 99% (*n* = 262) of these respondents indicated that they were likely to take preventive measures if they were aware of their increased CVD risk. The majority of those with T2DM (88%, *n* = 438) agreed (scale 4–5) that controlling their blood sugar or glycated hemoglobin (HbA1c) levels would reduce their risk of having a heart attack, stroke, or cardiovascular (CV) event. Of all respondents with T2DM (*n* = 501), 88% (*n* = 440) would modify their diet and 81% (*n* = 408) would talk to their healthcare provider. In addition, when asked what would motivate them to decrease their risk of CVD, 80% (*n* = 400) indicated their own quality of life and 73% (*n* = 366) indicated that a desire to live longer and spend more time with family would motivate them.

Role of SweetHearts

Family and friends can play an important role in motivating those with T2DM to seek help. Many individuals with T2DM (*n* = 501) indicated they were likely (scale 4–5) to share their health information with a loved one, such as a spouse/partner (83%, *n* = 417), parent (60%, *n* = 302), or child (55%, *n* = 274); or to share such information with a friend (55%, *n* = 273) or colleague (29%, *n* = 146). In contrast, when SweetHearts were asked how often they talked to their loved one or a person they know with T2DM about their disease in general, only 24% (*n* = 86) responded "often," 51% (*n* = 187) responded "sometimes," and 23% (*n* = 82) responded "rarely". However, SweetHearts (*n* = 364) were likely (scale 4–5) to encourage a loved one (spouse/partner [89%, *n* = 324] or parent [85%, *n* = 311]) to see a healthcare provider.

DISCUSSION

The findings from this online survey of US adults indicate that there are important gaps in knowledge of the association between T2DM and CVD among individuals with T2DM, their loved ones, and the general population. Despite CVD being the leading cause of mortality among those with T2DM, only about one-third of all individuals surveyed, irrespective of whether they had T2DM, were aware that CVD is the number one health-related killer of those with T2DM. More individuals with T2DM were aware of their risk of microvascular disease, such as blindness, neuropathy, and nephropathy, than their increased risk of macrovascular disease, such as MI, stroke, and CVD.

These findings are similar to those of an earlier survey of 2008 US patients with diabetes showing greater awareness that diabetes may cause disabilities such as blindness and amputation than awareness that diabetes may result in premature death from CVD [4]. The present results are perhaps not surprising, given that until recently evidence from clinical trials showed that the benefits of glucose lowering were primarily limited to microvascular disease [11–14]. However, the recent completion of several CV outcomes trials, including the Empagliflozin Cardiovascular Outcome Event Trial in Type 2 Diabetes Mellitus Patients—Removing Excess Glucose (EMPA-REG OUTCOME) [15], the Liraglutide Effect and Action in Diabetes: Evaluation of Cardiovascular Outcome Results (LEADER) [16] trial, the Trial to Evaluate Cardiovascular and Other Long-term Outcomes with Semaglutide in Subjects with Type 2 Diabetes (SUSTAIN-6) [17], and the Canagliflozin Cardiovascular Assessment Study (CANVAS) [18], has provided evidence that some glucose-lowering agents, such as the sodium-glucose co-transporter-2 inhibitors empagliflozin and canagliflozin and the glucagon-like 1 receptor agonists liraglutide and semaglutide, have CV benefits beyond glucose lowering when given on top of standard care in patients with T2DM at high CV risk. Interestingly, the majority of those surveyed (88%) wrongly believe that lowering their blood glucose will reduce CV risk, demonstrating a need for patient education.

The recent guidelines from the ADA [19] and the 2017 algorithm from the American Association of Clinical Endocrinologists (AACE) and the American College of Endocrinology (ACE) [20] support multiple risk factor intervention to

lower CVD risk and physicians are thus aware of the link between CVD and T2DM. Our survey shows that most individuals with T2DM did not know about their increased risk of CVD. Similarly, a survey of US adults indicated that 68% of patients with diabetes did not consider CVD to be a serious complication of their condition [4]. Moreover, although a study of 212 adults with T2DM showed high knowledge scores on the validated Heart Disease Fact Questionnaire, perceptions of susceptibility to heart attack or stroke were relatively low [21].

Loved ones and family members can play an important role in motivating health-seeking behaviors of individuals with T2DM [22]. However, published data about the role of family members in supporting the management of adults with T2DM are limited [8]. The present survey showed that SweetHearts too were unaware of the link between CVD and T2DM. Present findings also suggest that education of family members and others close to those with T2DM may help to improve outcomes in people with T2DM and, ultimately, contribute to reducing their risk of developing a CV event. Survey results further highlight a willingness of patients with T2DM to learn more about their condition and make behavioral changes to improve their health, although the percentage intending to change behavior and the percentage actually changing and maintaining the behavior would be expected to be different. Nonetheless, the Transtheoretical Model of Behavior Change, which was developed to describe how individuals establish and maintain behaviors, posits that precontemplation and contemplation of a given action are required first steps before adopting behavioral changes [23]. Additionally, the benefits of patient education [24] and family involvement [22] on outcomes have been assessed in a number of studies, but require further rigorous empirical testing. Taken together, these data unmask a unique opportunity to educate stakeholders that may prove critical to improving care for people with T2DM.

Online surveys can provide an efficient way of collecting data [25] but are not without limitations. Previous research has demonstrated that online surveys in T2DM are associated with a degree of selection bias [25], and it is possible that the survey population is not representative of the population of patients with T2DM in the USA. In addition, the survey questions were not based on available validated instruments [18, 26]. Also, as individuals move through the survey, they become better informed about the association of T2DM and CVD, which may influence answers provided later in the survey [27]. Lastly, our results were summarized descriptively; the lack of a statistical analysis precludes more complex analyses of the data.

CONCLUSION

Findings from this survey indicate that further study of the effects of education for both patients and SweetHearts on the relationship between CVD and T2DM is warranted, as effective education may contribute to improved outcomes [28].

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Prior Presentation. Some data from this survey were presented at the 67th Annual Scientific Session of the American College of Cardiology in Orlando, FL, March 10–12, 2018.

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Compliance with Ethics Guidelines. The survey followed guidelines for the conduct of non-interventional studies, and was reviewed/approved by an independent institutional review board. The survey also adhered to globally accepted guidelines for the conduct of market research from the Council of American Survey Research Organizations, the American Association for Public Opinion Research, and the Market Research Society.

Data Availability. The datasets during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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