

A Roadmap on the Prevention of Cardiovascular Disease Among People Living With Diabetes



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In 2014, the World Heart Federation (WHF) launched an initiative to develop a series of Roadmaps [1–6]. Their aim is to identify potential roadblocks on the pathway to effective prevention, detection, and management of cardiovascular disease (CVD), along with evidence-based solutions to overcome them. The resulting documents provide a framework to translate strategic intent into action on integrating epidemiology, population, and cardiovascular outcome trial data into national plans for optimal CVD management.

The Roadmap publications have become the cornerstone of WHF activities as resources for implementation to guide initiatives to support heart health globally, translating science into policy and influencing agencies, governments, and policy makers alike. The purpose of the Roadmaps is to provide a framework for countries to develop or update national noncommunicable disease (NCD) programs aligned with the WHF Global Action Plan for the Prevention and Control of NCD 2013 to 2020. The overall aim is to drive efforts within national agendas to meet the ambitious target set out in the United Nations' 17 Sustainable Development Goals: a 30% reduction in premature mortality caused by NCD by 2030.

The burden of cardiovascular diseases differs depending on context and population. The epidemiology of the selected cardiovascular diseases is essential to set the global scene before identifying roadblocks and proposed solutions. Although the focus of WHF Roadmaps (Figure 1) is truly international, the intended purpose is to find a balance in the applicability, acceptance, feasibility, and accessibility of the presented solutions for local implementation. As such, this framework offers a guide to further explore and identify measures to reduce the burden of cardiovascular disease.

EXPERT WRITING GROUP

In 2018, the WHF and the International Diabetes Federation (IDF) joint partnership convened a Roadmap writing group consisting of 14 cardiovascular and diabetes expert clinicians and researchers representing all continents and an implementation science expert. Patient perspectives

were included from patient interviews that were conducted in 2017. With a clear focus on the patient's pathway of care, the prevention and management of CVD among those living with diabetes, the aim of this WHF Roadmap is to offer perspectives of care from different audiences and provide an implementation path. Recommendations for change are identified from the standpoint of cardiovascular and diabetes experts as well as including perspectives of those living with type 2 diabetes mellitus. To tackle the burden of CVD and diabetes, a comprehensive approach from a broad group of professionals, including decision makers, health activists, health care professionals, academic and research institutions, government agencies, and patients is needed. This Roadmap provides an essential framework for all involved in the planning, organization, patient management, and implementation of approaches to CVD prevention for those living with diabetes.

TAKING THE ROADMAP FORWARD

The recommendations offered within this document are relevant at a global level but must be adapted depending on the local context. The "ideal pathway of care" for the prevention, diagnosis, monitoring, and follow-up for CVD among people living with diabetes is the foundation from which to determine barriers and potential solutions, to look toward practical examples grounded in evidence, and present key action areas that will support a better future for these patients. This high-level document is intended to provide a framework for change that will challenge leaders to address diabetes as a CVD and plan and design interventions with a focus on primary and secondary prevention of CVD among people living with diabetes.

RATIONALE

The global burden of CVD and diabetes

Type 2 diabetes mellitus is a major global health threat, affecting every 1 in 11 adults worldwide (425 million people) and accounting for approximately 90% of all patients with diabetes [7]. It is also a rising threat: Figures show an increase of 119% for men and 106% for women between 1990 and

The authors report no relationships that could be construed as a conflict of interest.

The corporate partners supporting the World Heart Federation Roadmap Programme include Amgen, Bayer, Boehringer Ingelheim, Bristol-Myers Squibb, Eli Lilly, Novartis, Novo Nordisk, Pfizer, Regeneron, and Sanofi.

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GLOBAL HEART
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VOL. 14, NO. 3, 2019
ISSN 2211-8160/\$36.00.
<https://doi.org/10.1016/j.gheart.2019.07.009>

2016 [8], and the total number of people with diabetes is predicted to increase to 629 million by 2045 [9].

The prevalence of diabetes differs greatly by age group, income group, and geographic region, with three-quarters of people with diabetes living in low- and middle-income countries [10,11]. Prevalence of type 2 diabetes mellitus is highest in the Pacific Island countries, Central Latin America, and the North Africa–Middle East region [12]. Mortality rates attributable to diabetes are lowest in Western Europe, Australia, and New Zealand and highest in the Pacific Island countries, South Asia, Sub-Saharan Africa, North Africa, the Middle East, and Central and Latin America [12]. The regions that are projected to experience the highest growth rates in the number of people with diabetes are the Africa region (141% increase by 2040) and the Middle East–North Africa region (104% increase by 2040) [12].

Those living with type 2 diabetes mellitus are twice as likely to experience all major stroke subtypes, coronary heart disease, myocardial infarction, sudden death, and angina pectoris compared with patients without diabetes [13,14]. It has been estimated that 8.4% of all-cause deaths were attributable to diabetes in adults 20 to 79 years of age, which equates to almost 5.1 million deaths globally [15]. This estimate also indicated that the highest rates of mortality attributed to diabetes were found in Southeast Asian women between 50 and 59 years of age (25.7%) [15]. The greatest number of deaths attributable to diabetes were found in countries with large populations, namely China, India, Indonesia, the Russian Federation, and the United States [15].

In 2015, the global economic burden of type 2 diabetes mellitus was estimated to be \$1.3 trillion, or 1.8% of the global gross domestic product [16,17]. Indirect costs account for 34.7% of the total burden, though this varied significantly across countries [16]. Projections estimate that this burden will increase to \$2.1 to \$2.5 trillion by 2030 [17]. Twelve percent of global health expenditure is spent on diabetes (\$727 billion) [1]. Additionally, from 2005 to 2015, total years of life lost due to diabetes rose 25.4% (95% uncertainty interval: 20.4 to 30.0) and diabetes became the 15th highest cause of years of life lost [18].

Despite the high prevalence and burden of diabetes worldwide, diagnosis and treatment continue to be sub-optimal. It is estimated that globally, as many as 212.4 million people or one-half (~50.0%) of all people 20 to 79 years of age with diabetes are unaware of their disease [9]. The Africa region had the highest percentage of undiagnosed diabetes, at an estimated 66.7% of all cases of diabetes in the region [11]. It was also estimated that >50% of adults with diabetes in the South-East Asia and Western Pacific regions were undiagnosed [11].

DIABETES AND CVD: A DEFINITION

Diabetes is well described as the metabolic disorder characterized by hyperglycemia as a result of defects in insulin secretion, typically in the metabolic setting of insulin resistance [19].

Pathophysiologically, diabetes is a vascular disease. Although microvascular complications such as retinopathy, nephropathy, and neuropathy are common in the setting of prolonged hyperglycemia, over one-half of all patients with type 2 diabetes mellitus will die from macrovascular complications [20]. The definition and recognition of diabetes for both its macrovascular complications as well as microvascular clinical presentation is central to the delivery of appropriate and effective care for patients living with diabetes [21].

PROCESS AND METHODOLOGY

This document and content have been developed using a standardized approach based on a situational model for WHF Roadmap design that outlines key project milestones and specific objectives (Figure 2).

The process is circular with the intent of continually revisiting and updating the Roadmap based on an advancing insight and data, implementation experiences, and feedback from regional and local experts. In this way, optimal treatment to reduce cardiovascular risk among those with type 2 diabetes mellitus can be implemented as efficiently and effectively as possible around the world, including approaches tailored to different settings.

The very first step in the development of the Roadmap to prevent CVD among people living with diabetes was to work together with WHF regional members and IDF to request proposals on key experts from different regions and countries that could be included within an expert writing group. After a number of months of consultation, invitations were sent to become part of the Roadmap expert writing group.

Further efforts were made in this project development to broaden the reach of CVD and diabetes experts beyond the allocated writing group. A modified Delphi technique, using a consensus-based approach via online surveys, was used to assess the applicability and acceptability of the proposed pathway of care and to identify roadblocks along this pathway and the perceived need for the most urgent solutions. Two rounds of surveys were sent out via WHF and IDF Member networks receiving 161 and 65 responses, respectively, from across 6 continents. The snowball sampling method was used to widen the consultation from regional and national Members to national representatives with a specific interest in diabetes and CVD. A possible limitation to this approach may be that those who completed the survey through an extended reach from WHF were most probably those with the highest expectations in delivery of care at national and regional levels, which questions whether those barriers reported are a true reflection of the everyday barriers for all those affected by the growing trends of diabetes, particularly type 2 diabetes mellitus and CVD. An in-depth survey analysis was conducted, and the results were used for specific information to support statements and gather evidence in practice. Many of the results are presented in the Roadblocks and Solutions section.

Importantly, as part of this process, the patient perspective has been assembled, analyzed, and added from the data collected through the Taking Diabetes to Heart Survey [22] conducted by IDF in 2018. Responses were collected from 12,000 people living with diabetes, from over 130 countries across all continents. Transcripts of patient interviews conducted in 2017 were also used to build the patient perspective based on the ideal pathway of care. This perspective brings an additional strength to the Roadmap as for the first time it has enabled WHF to present a pathway of care from both medical and patient perspectives for each of the key stages.

Although this is a positive addition, there is still a need to approach ministries for health, education, transportation, urban planning and environmental engineering, finance, and agriculture, as well as health system leaders and key decision and policy makers, to ensure a rounded and complete effort to involve and secure buy-in from all stakeholders needed to reduce the burden of CVD among people living with diabetes.

THE IDEAL PATHWAY OF CARE

The patient care gap

The gap between evidence-informed approaches to patient care and the reality of this care in practice are like magnetic poles—never quite meeting together. The noted importance of fully investigating, understanding, and considering the patient care gap within specific frameworks is an essential element that underlines the very purpose of this Roadmap. If leaders in CVD and diabetes diseases can effectively draw on evidence-based solutions to inform a best-practice approach to care, there is a real opportunity to create an ideal pathway and to use this pathway to assess the gap, which may be specific to social, contextual, and cultural backgrounds. The fundamental purpose of this Roadmap will guide leaders and decision makers to 1) consider the ideal pathway of care with a specific focus on prevention, 2) investigate from their contexts the gaps and priorities, and 3) use the roadblocks and solutions to identify key action areas.

The scope of this Roadmap is not to specifically address a pathway of care for those living with diabetes, but rather to focus on the prevention of CVD among those living with type 2 diabetes mellitus. All references to diabetes in this document linked to the pathway of care specifically refer to those living with type 2 diabetes mellitus. However, it should also be noted that many parts of the pathway may be perfectly relevant to those living with both type 1 and type 2 diabetes.

An ideal pathway of care for the prevention, treatment, monitoring, and follow-up of CVD among people living with diabetes

Outlining an ideal pathway of care is the key objective of this Roadmap. This pathway is essential to ascertain,

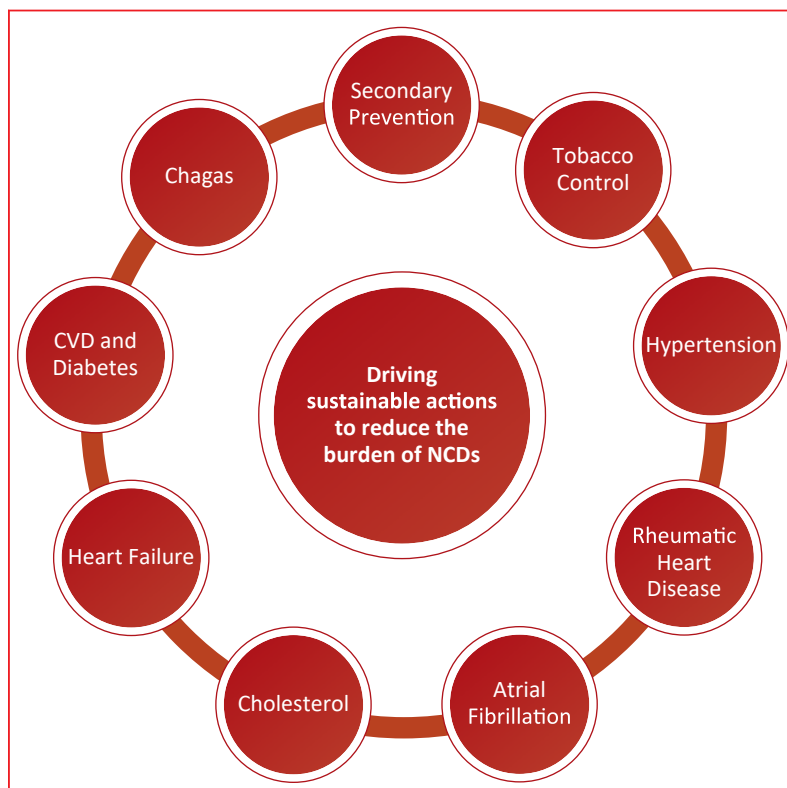


FIGURE 1. WHF Roadmap publications. CVD, cardiovascular disease; NCD, noncommunicable diseases; WHF, World Heart Federation.

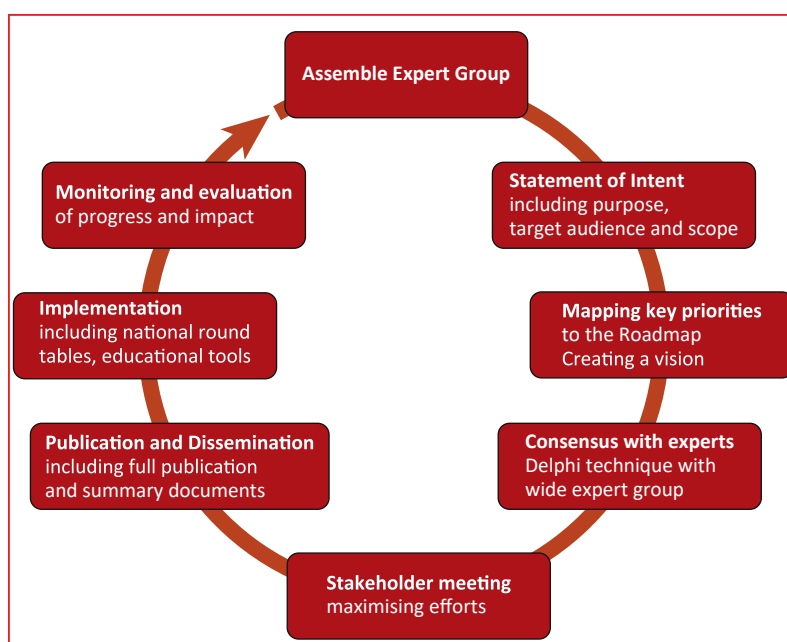


FIGURE 2. A framework for methodological design.

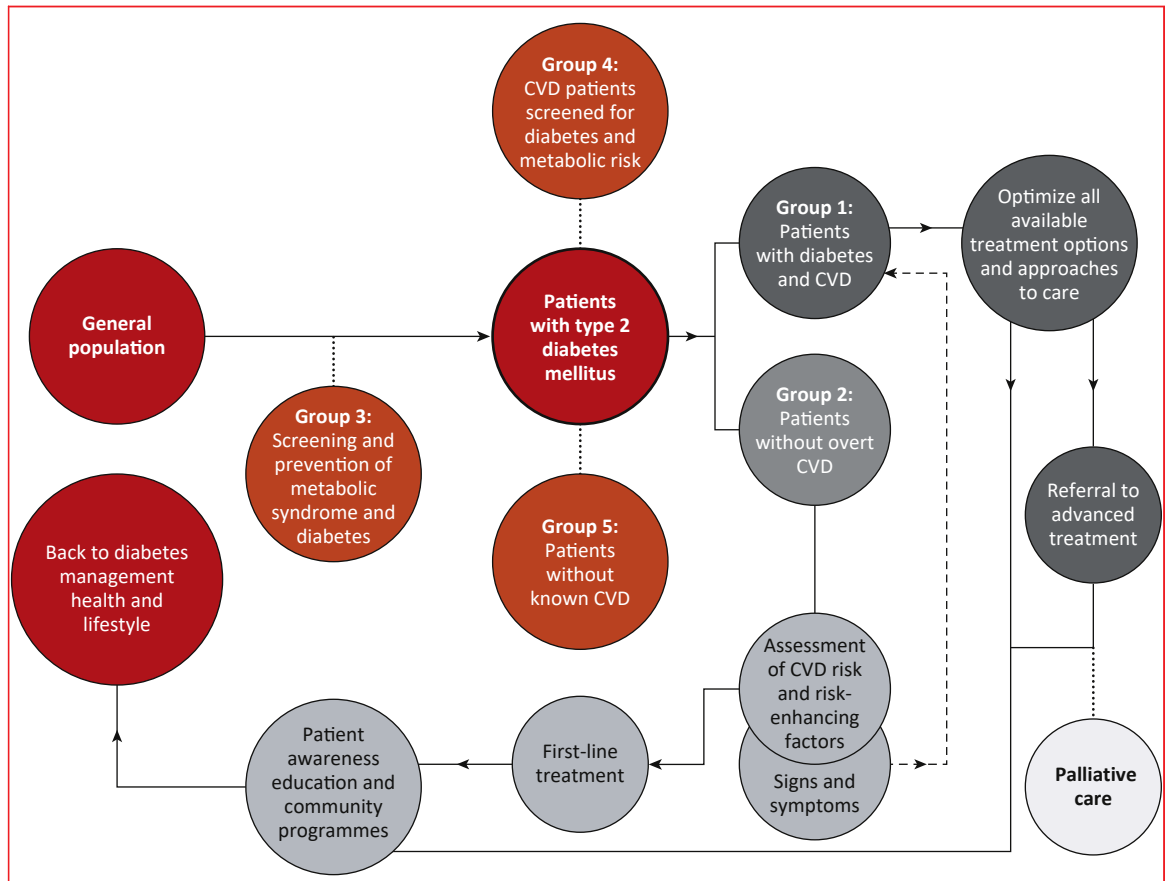


FIGURE 3. Ideal pathway of care: a perspective from health care professionals. CVD, cardiovascular disease.

first, what is expected as a minimum level of safe and effective care for those living with type 2 diabetes mellitus and CVD and, second, to distinguish those areas along the patient care pathway that do not meet prescribed levels of care and where specific roadblocks arise. Drawing on best-practice and evidence-informed approaches, this Roadmap proposes potential solutions and interventions that may minimize the care gap and that may be adapted to specific national or local contexts.

The strength of this proposed pathway is dependent on ensuring that all the appropriate stakeholders (health care professionals, decision makers, policy makers, and patients) assemble to agree on each of the steps required to deliver safe, high-quality care to those living with diabetes and CVD and strategies for CVD prevention in those living with diabetes.

Target audience

The primary focus of this Roadmap is to consider the ideal pathway of care, along with the roadblocks and potential solutions for overcoming these, for people living with diabetes: more specifically, for those diagnosed with type 2 diabetes mellitus and established CVD (group 1); and those

people living with diabetes mellitus without overt CVD (group 2).

Additional target groups were also considered within the development of this pathway, which are indicated by a dotted line within Figure 3. These are the general population with unknown type 2 diabetes mellitus (group 3), those living with CVD without known type 2 diabetes mellitus (group 4), and people living with diabetes without known CVD (group 5). Whereas these groups (groups 3, 4, and 5) are not the specific focus within this Roadmap, the expert writing group felt that it was important that these groups were included to note their important place within this pathway.

Guideline comparison

Those living with diabetes are at heightened risk of CVD, making the prevention of CVD onset a major priority [23]. International clinical practice guidelines exist regarding prevention of CVD events [20,24–26]; each considers important patient groups at particularly high risk for incident CVD, notably including those with type 2 diabetes mellitus. A comparison of various clinical practice guidelines regarding prevention of CVD in patients with type 2 diabetes mellitus is detailed in Table 1. Considerable

TABLE 1. Comparison of international clinical practice guidelines for the prevention of CVD in those living with type 2 diabetes mellitus

Risk Factor	ACC/AHA	ADA	ESC/EASD
Tobacco use	Cessation	Cessation	Cessation
Blood pressure	<130/80 mm Hg	<140/90 mm Hg for most <130/80 mm Hg for higher risk patients	<140/85 mm Hg
LDL-C	Age \geq 40 and \leq 75 yrs: LDL-C level 70–189 mg/dl: moderate-intensity statin \geq 7.5% 10-yr ASCVD risk: high-intensity statin >20% 10-yr ASCVD risk: high-intensity statin Presence of risk enhancers [*] : high-intensity statin Age <40 or >75 yrs: individualize treatment	<40 yrs with other ASCVD risk factors: moderate-intensity statin \geq 40 and \leq 75 yrs without other ASCVD risk factors: moderate-intensity statin Regardless of age if >20% 10-yr ASCVD risk: high-intensity statin	Patients at very high risk (i.e., if combined with severe CKD or with 1 or more CV risk factors and/or target organ damage): statin therapy with an LDL-C target of <70 mg/dl) or at least a \geq 50% LDL-C reduction if this target goal cannot be reached Without any other CV risk factor and free of target organ damage: statin therapy with an LDL-C target <100 mg/dl
Fasting triglycerides	135–499 mg/dl, at high risk for CVD: consider high-dose EPA \geq 500 mg/dl: treat	\geq 500 mg/dl: treat	>100 mg/dl, at very high risk: treat >130 mg/dl, at high risk: treat
Glucose	HbA _{1c} \leq 7% If medication is indicated, metformin is the first-line therapy, but sodium-glucose cotransporter 2 inhibitors and glucagon-like peptide-1 receptor agonists might be considered	HbA _{1c} \leq 7% for most HbA _{1c} \leq 6.5% for new-onset disease, long life expectancy, or no CVD as long as hypoglycemia risk is low HbA _{1c} <8% or higher for patients with severe hypoglycemia, limited life expectancy, and/or comorbid conditions If medication is indicated, metformin is the first-line therapy, but sodium-glucose cotransporter 2 inhibitors and glucagon-like peptide-1 receptor agonists should be considered and individualized based on CVD risk, as second-line therapy	HbA _{1c} \leq 7%
Overweight and obesity	BMI \geq 25 kg/m ² : Sustained loss of 3%–5% of body weight BMI \geq 30 kg/m ² with comorbidity: behavior therapy, medications, bariatric surgery BMI \geq 40 kg/m ² : behavior therapy, medications, bariatric surgery	BMI \geq 25–39.9 kg/m ² : sustained loss >5% of body weight BMI \geq 27 kg/m ² : consider medications to assist weight loss BMI \geq 30 kg/m ² with unsuccessful conservative management: bariatric surgery BMI \geq 40 kg/m ² : bariatric surgery	Overweight or moderately obese people: weight reduction In very obese individuals: bariatric surgery
Nutrition	A tailored nutrition plan focusing on a heart-healthy dietary pattern is recommended to improve glycemic control, achieve weight loss if needed, and improve other ASCVD risk factors. The Mediterranean, DASH, and vegetarian and/or vegan diets have all been shown to help in the achievement of weight loss and improve glycemic control in type 2 diabetes mellitus. Restriction of saturated fat to <7% of total energy	Mediterranean style diet may improve glycemic control and CVD risk factors Consumption of fruits, vegetables, legumes, whole grains, and dairy in place of other carbohydrate sources Carbohydrate monitoring as an important strategy for glycemic control	Total fat intake should be <35%, saturated fat <10%, and monounsaturated fatty acids >10% of total energy Dietary fiber intake should be >40 g/day (or 20 g/1,000 kcal/day), about one-half of which should be soluble

(continued)

TABLE 1. Continued

Risk Factor	ACC/AHA	ADA	ESC/EASD
Physical inactivity	150 min of moderate aerobic exercise or at least 75 min of vigorous aerobic exercise per week No more than 2 consecutive days without physical activity	150 min or more of moderate-to-vigorous intensity aerobic activity per week, spread over at least 3 days/week. No more than 2 consecutive days without physical activity Shorter durations (minimum 75 min/week) of vigorous intensity or interval training may be sufficient for younger and more physically fit individuals	150 min of moderate-to-vigorous intensity physical activity
Aspirin therapy	Low-dose aspirin (75–100 mg orally daily) might be considered for the primary prevention of ASCVD among adults 40 to 70 yrs of age at higher risk for CVD not at increased bleeding risk Aspirin recommended for secondary prevention	Routine use in low-risk individuals is not recommended 75–162 mg daily may be considered for patients at increased CV risk after discussion regarding risks and benefits Aspirin recommended for secondary prevention	Routine use in low-risk individuals is not recommended 75–162 mg daily may be considered for patients at increased CV risk after discussion regarding risks and benefits Aspirin recommended for secondary prevention

ACC, American College of Cardiology; ADA, American Diabetes Association; AHA, American Heart Association; ASCVD, arteriosclerotic cardiovascular disease; BMI, body mass index; CKD, chronic kidney disease; CV, cardiovascular; CVD, cardiovascular disease; DASH, Dietary Approaches to Stop Hypertension; EASD, European Association for the Study of Diabetes; EPA, eicosapentaenoic acid; ESC, European Society of Cardiology; HbA_{1c}, hemoglobin A_{1c}; LDL-C, low-density lipoprotein cholesterol.

*Risk enhancers include prolonged duration of diabetes, presence of retinopathy, nephropathy, neuropathy, or low ankle-brachial index in those living with diabetes mellitus.

similarities exist across these various guidelines and although minor variations for target therapy exist, there is a common theme of careful attention to CVD risk factors such as tobacco use, hypertension, and blood lipids. One important difference between guidelines from the United States and Europe is the former's recommendation for use of estimating equations for CVD risk to support clinical decision making; those at highest risk for CVD (e.g., >20%) have more aggressive recommendations for therapeutic intervention than do lower-risk patients. The recent adoption of sodium-glucose cotransporter-2 (SGLT-2) inhibitors and glucagon-like peptide-1 receptor agonists (GLP-1RA) for prevention of CVD events by U.S.-based guidelines is also noteworthy. Lastly, the United States no longer routinely recommends aspirin for primary prevention only for secondary prevention; presently, each guideline recommends aspirin use only in the highest risk patients, in whom risk for bleeding is low. Though recommendations are becoming increasingly common across geographic locations, even greater unified consistency across international prevention guidelines would be expected to facilitate more coherent recommendations for clinicians globally.

An overview of the pathway of care

Prevention of CVD among people living with diabetes. This ideal pathway of care designed to deter onset CVD among people living with type 2 diabetes mellitus is grounded in prevention: 1) prevention of obesity, metabolic syndrome, and type 2 diabetes mellitus among the general population; 2) prevention and early detection of type 2 diabetes mellitus among cardiovascular patients;

and essentially 3) prevention of cardiovascular disease among people living with diabetes.

For the purpose of this Roadmap, the pathway of care for the “prevention of CVD among people living with diabetes” is the main focus. Prevention strategies for people living with type 2 diabetes mellitus focus on CVD prevention: from a lifestyle management perspective, including following a heart-healthy diet, regular exercise, smoking cessation, and managing body weight; and risk factor interventions including lowering blood pressure, lowering low-density lipoprotein cholesterol, controlling glycemia, and taking heart protective medications as prescribed [27].

Perhaps the most pertinent part of this pathway of care is the essential role of lifestyle management. Newly diagnosed diabetes patients inherently shift to a high-risk category for CVD, and so lifestyle management and specific interventions can measurably improve cardiovascular risk factors [25], setting a viable goal for those living with type 2 diabetes mellitus in managing their disease without cardiovascular complications.

It is also important to note the unprecedented link between obesity and the development of onset type 2 diabetes mellitus, with reports of as many as 90% of people with diabetes being overweight or obese [28], making this risk factor indirectly responsible for a consequential upward trend in CVD for this growing percentage of our global population.

Screening of CVD among people living with diabetes. Dysglycemia is referred to as type 2 diabetes mellitus and impaired glucose tolerance and has a negative

prognostic implication, increasing the risk of cardiovascular complications [29].

A coronary event is often the first time type 2 diabetes mellitus is recognized [30–32], and therefore screening for dysglycemia is important in at-risk individuals as recommended in current guidelines [20]. A best-practice approach to screening varies in relation to the assumed prevalence of dysglycemia in any particular population. The method used should be adapted to the risk for a positive outcome of the screening procedure. When screening a general or low-risk population, it is best to start with a questionnaire to assess the risk for future diabetes followed by further tests only in individuals with high scores: a commonly used tool for this is FINDRISC (Finnish Diabetes Risk Score). In populations at high risk, such as people with CVD, screening should be conducted by means of an oral glucose tolerance test (OGTT) or glycosylated hemoglobin. Screening at the level of general practice may identify those at high risk with the metabolic syndrome.

There are several definitions of this clustering of CVD risk factors that enhance the risk for future type 2 diabetes mellitus. In 2009, a joint group representing several important international organizations harmonized definitions for high-risk individuals. For a diagnosis of metabolic syndrome, 3 of the following risk factors should be present: 1) central obesity (sex- and ethnicity-specific values); 2) increased triglycerides or treatment for hypertriglyceridemia; 3) low high-density lipoprotein cholesterol, sex-specific values or treatment for high-density lipoprotein cholesterol; 4) raised blood pressure or treatment for diagnosed hypertension; 5) increased fasting plasma glucose; or 6) diagnosed type 2 diabetes mellitus [33]. Metabolic syndrome is not always recognized, but it importantly, if it is identified, it offers an ideal opportunity to prohibit or at least delay the onset of type 2 diabetes mellitus.

Figure 4 outlines a pragmatic way to address dysglycemia screening in populations with varying risk for dysglycemia [34].

Assessment of cardiovascular risk and diagnosis of CVD among people living with diabetes. *Assessment of cardiovascular risk and risk-enhancing factors:* Assessment of cardiovascular risk and diagnosis of CVD among people living with type 2 diabetes mellitus does not pertain to the typical diagnosis pathway for specific disease areas, the science and technology of which are beyond the scope of this Roadmap. Ideal patient care pathways and best-practice approaches to diagnosis of specific disease areas may be found in previously published WHF Roadmaps [1–6].

A holistic approach and comprehensive care plan for those living with type 2 diabetes mellitus is needed to reduce the risk of CVD. As part of this care plan, and according to the American Diabetes Association (ADA), cardiovascular risk factors including obesity and/or overweight, dyslipidemia, smoking, a family history of

premature coronary disease, chronic kidney disease, and the presence of albuminuria should be systematically assessed at least annually in all those living with type 2 diabetes mellitus [24]. Risk score calculators may also support health care practitioners, particularly in primary care settings. Supporting interventions for the reduction of cardiovascular risk are now being widely adopted by health care teams across settings including ADVANCE (Action in Diabetes and Vascular disease: preterax and diamicron-MR controlled evaluation) risk scores (for patients without CVD) and SMART (Second manifestations of arterial disease) risk score and CardioSmart (for patients with overt CVD), U-Prevent (to support the selection of secondary prevention medication and calculate risk reduction), as well as the DIAL (Diabetes Lifetime-perspective prediction) model (to assess lifetime treatment effect).

This Roadmap repeatedly emphasizes the increased cardiovascular risk associated with type 2 diabetes mellitus. Parameters including hypertension and low-density lipoprotein cholesterol must be managed. New evidence outlining the link between prediabetes and higher risk of future diabetes and cardiovascular events and emerging evidence demonstrating that specific glucose-lowering agents can decrease cardiovascular events [35] can inform health care practitioners on best-practice approaches to reduce the risk of onset CVD among people living with type 2 diabetes mellitus.

Signs and symptoms: The assessment of signs and symptoms of those living with diabetes for CVD can have a measurable impact on early detection. Diabetes mellitus is a specific risk factor for atherosclerosis and is present in many patients with multisite atherosclerosis. Careful history taking, systematic clinical examination, and appropriate investigations are required to follow a best-practice approach [20]. Physical examination markers must also be considered during routine screening for CVD among people living with type 2 diabetes mellitus. Attention to widened pulse pressure, peripheral pulses, ankle-brachial index, obesity, retinal arteriolar narrowing, and assessment for ejection murmur of calcific aortic sclerosis are office-based clues to CVD risk [36].

Treatment of CVD among people living with diabetes and approaches to care. As a consequence of the fact that type 2 diabetes mellitus is recently considered a CVD equivalent, its treatment is currently based on a patient-centric approach with a comprehensive management of strategies focused on both glycemic levels and CVD risk reduction, in contrast to the previous glucose-centered paradigm. There are multiple options available for the treatment of those living with diabetes, including biguanides, sulfonylureas, meglitinides, thiazolidinediones, alpha-glucosidase inhibitors, GLP-1RA, dipeptidyl-peptidase-4 (DPP-4) inhibitors, SGLT-2 inhibitors, and insulin. However, the 2018 Consensus Report on the Management of Hyperglycemia in type 2 diabetes mellitus by the American College of Cardiology (ACC) and endorsed by the ADA

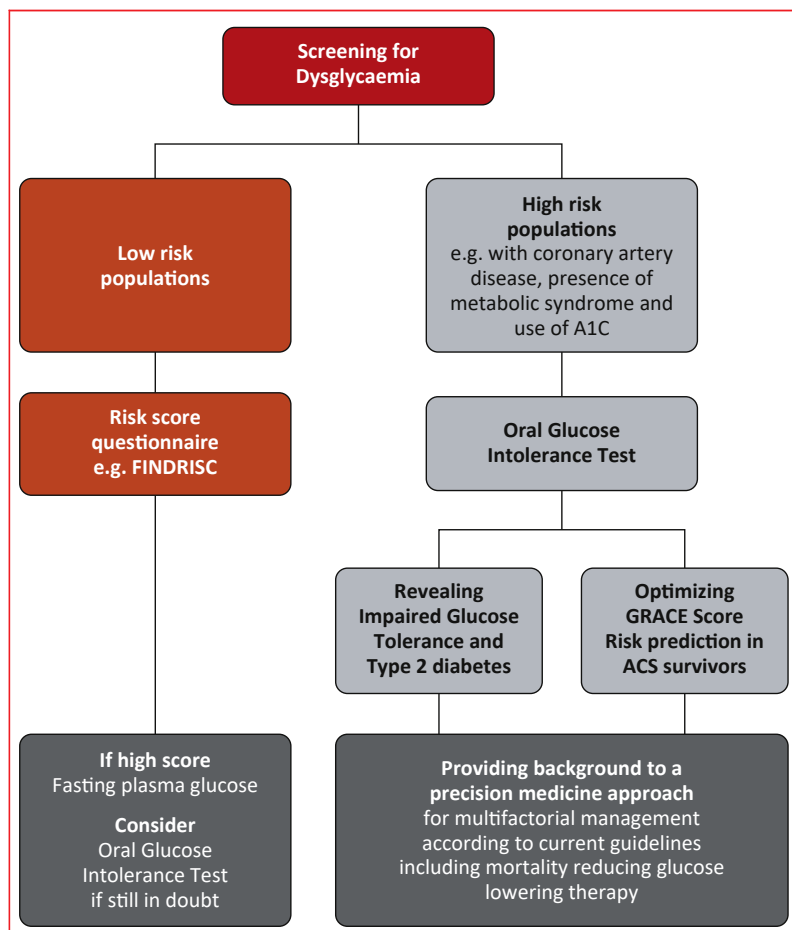


FIGURE 4. Screening for dysglycemia. ACS, acute coronary syndrome; FINDRISC, Finnish Diabetes Risk Score; GRACE, Global Registry of Acute Coronary Events.

suggests that specific categories of patients with different coexisting comorbidities would benefit more (in terms of morbidity and mortality) from receiving specific drug regimens. This consensus document recommends the tailoring of therapy based on presence and type of CVD [37].

The ADA/European Association for the Study of Diabetes consensus emphasizes the importance of avoiding clinical inertia, by intensifying the treatment in a 3-month interval if the glycemic targets are not met, and of assessing the presence of atherosclerotic cardiovascular disease (ASCVD), heart failure, and chronic kidney disease. These recommendations are based on evidence from recent large cardiovascular outcome trials that have shown significant benefits for GLP-1RA and SGLT-2 inhibitors. Regarding the treatment of those living with type 2 diabetes mellitus:

1. The first-line of therapy consists of lifestyle management aspects, including medical-nutrition therapy, physical activity, weight loss, smoking cessation, psychological support; moderate- to high-intensity statin therapy; and metformin for those that tolerate it and that do not have contraindications for it.

2. If the patient was or is diagnosed with ASCVD or chronic kidney disorder, an agent with proven cardiovascular benefit should be added as a second-line drug if glycemic targets are not met. Specifically, if the ASCVD predominates in a patient, the ADA/European Association for the Study of Diabetes and ACC consensus documents suggest the use of either a GLP-1RA or a SGLT-2 inhibitor with metformin. If heart failure or chronic kidney disorder predominates, a SGLT-2 inhibitor is preferred [38].
3. If the patient does not have ASCVD, heart failure, or chronic kidney disorder, it is recommended to establish the priority of the treatment for deciding the second-line drug (if needed)—either weight loss (with a preference for GLP-1RA or SGLT-2 inhibitors), the minimization of the risk of developing hypoglycemia (DPP-4 inhibitors, GLP-1RA, SGLT-2 inhibitors, or thiazolidinediones), or the lowering of the costs of the therapy (sulfonylureas or thiazolidinediones).
4. If hemoglobin A_{1c} (HbA_{1c}) is higher than 10% (or is 2% higher than the target), an injectable combination should be considered.
5. The GLP-1RA is the preferred injectable agent, except in cases where HbA_{1c} is higher than 11% or where the patient has symptoms of insulin deficiency or where the presence of type 1 diabetes mellitus is possible [39].

Furthermore, although guidelines vary in their recommendations, while managing the CVD risk factors, the addition of a statin and, in some cases, an antiplatelet agent to the drug regimen of those living with diabetes should be considered. However, this treatment must be accompanied by the treatment of all of the other risk factors with anti-hypertensive drugs, statins, and antiplatelet agents [20] and as part of a patient-centered approach. A comprehensive approach to evidence-based CVD risk reduction is the most important focus of treatment for those living with type 2 diabetes mellitus.

Monitoring and follow-up. The monitoring and follow-up of patients diagnosed with a CVD among those living with type 2 diabetes mellitus are a crucial aspect of the pathway of care. As part of this, patient education and community or home support programs are essential interventions to support lifestyle that can maintain quality of life for those living with CVD and type 2 diabetes mellitus.

It is important to remember that education is not only focused on raising patients' awareness about their disease, but equipping them with the knowledge, skills, and attitudes to know their risks, adapt their lifestyle, and modify a lifetime of suboptimal behaviors. For the purpose of this Roadmap, we specifically distinguish between communication, focused on informing the patient, and education, providing knowledge, skills, attitudes, and behaviors on specific content.

The study of population and environment help to determine the burden of type 2 diabetes mellitus and the development of CVD, given that race [40] and socioeconomic

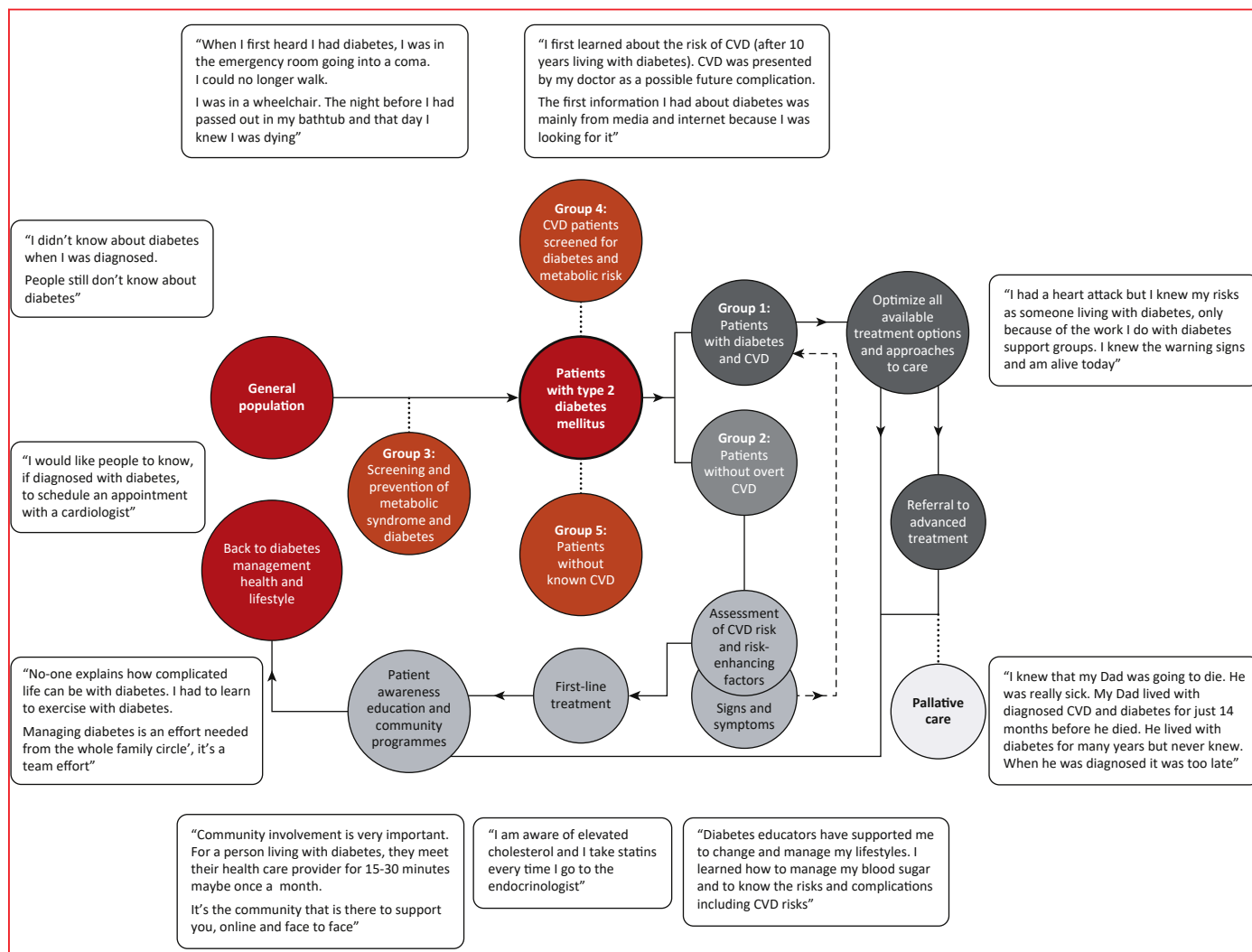


FIGURE 5. Ideal pathway of care: a patient perspective. CVD, cardiovascular disease.

status [41] are predictors of risk. Moving past individual interventions, this pathway also emphasizes the importance of the social environment and the need to consider environmental engineering that addresses pollution [42], local ecology [43], socioeconomic status [44], and other context-specific examples of important determinants of cardiovascular health [41].

A PATIENT'S PERSPECTIVE

Behind every statistic there is a personal journey, and each patient story is fraught by challenges too often caused by many of the roadblocks presented within the Roadmap including a lack of resources, psychosocial impact (emotions and relations), inefficient health systems, or lack of education.

Differences in perspectives between patients and health care professionals may have an impact on patient care. Studies consistently highlight that perspectives of patients and health care professionals are not consistently aligned [45]. Patient

benefits are reported when health care providers consider challenges from multiple perspectives [46]. A patient-centered approach to care requires an improved understanding and appreciation of the daily challenges faced by patients and caregivers, dedicated funding, and well-designed health systems that meet the specific needs of these patients.

Opening the door to this perspective, the ideal patient care pathway is populated with viewpoints of those living with type 2 diabetes mellitus, to offer a better understanding of the intricate parts of a care pathway and what this means to the patient (see Figure 5).

APPROACHES TO CARE FOR CARDIOVASCULAR DISEASE AMONG PEOPLE LIVING WITH DIABETES

For the purpose of this Roadmap, barriers and possible solutions to care are presented from the perspective of 1) people living with diabetes: patients, patient families, patient organizations, and civil societies; 2) health care

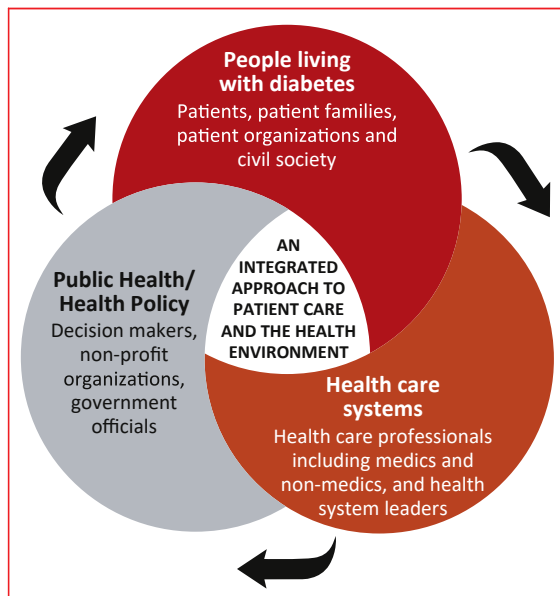


FIGURE 6. An integrated approach to patient care.

systems: health care professionals including medics and nonmedics—in primary, secondary, and community settings—and health system leaders; 3) public health and/or health policy: decision makers, nonprofit organizations, and government officials. Defining the needs of these 3 groups ensures that an essential first step is to assess barriers of care from the perspective of the different audiences, resulting in an integrated model that enables targeted solutions to be developed based on specific needs and taking into consideration population and environmental health (see Figure 6). Evidence to support integrated care programs is seen in the effects of quality care [47], on improved patient outcomes [48] and quality of life [49]. A practical guide to integrated type 2 diabetes mellitus care supports an approach that is patient-centered, addresses the need to deliver care to those living with diabetes and CVD across settings, and is flexible and adaptable to patients' needs [50].

The key information shared between the patient living with diabetes and the care provider (doctor or nurse) has sometimes as much importance for achieving an accurate diagnosis as the physical examination and other diagnosis means and lab tests do [51].

This WHF Roadmap proposes strategies and interventions to help improve care for patients across settings. Without alignment among perspectives of patients on the priority areas, clinicians' understanding and appreciation of the daily challenges faced by patients and caregivers, and the role of leaders in cardiovascular health to assign funding and design appropriate and efficient care systems, it will be difficult to achieve an integrated approach to care. Each solution proposed will require a role to be fulfilled across all target groups and an approach that will strengthen collaboration across all those affected

by the growing burden of type 2 diabetes mellitus and the risk of CVD.

OVERCOMING BARRIERS ALONG THE PATHWAY OF CARE

A Roadmap framework to identify key action areas

The prescribed pathway of care, barriers along this pathway, and consideration of solutions based on both evidence and on practical examples offer a springboard from which to plan, design, and implement change for a better future for those living with type 2 diabetes mellitus and CVD. Consolidating the information from specific examples into measurable actions requires an additional step: to organize and frame the presented information in a way that is useful, practical, acceptable, and applicable at national and local levels. Identifying collective actions is an approach built on a public health drive for change and on the premise that public health should be defined as the “collective action for sustained population-wide health improvement” [52] and adapted with permission from the CANMeds framework model (Royal College of Physicians and Surgeons of Canada, Ottawa, Ontario, Canada). These action areas of this Roadmap have been modeled and elaborated from this collective action approach as well as a comprehensive review of other action areas emerging from comments and feedback collated through the Delphi (consensus-based surveys). In defining a context-specific strategy for overcoming barriers along this ideal pathway of care, the consideration of each of the key action areas will support a strategic plan for design and implementation that takes into account all stakeholders, specific action areas, and targeted integrated solutions.

This section of the Roadmap will present the barriers to care based on the ideal pathway for CVD among patients with type 2 diabetes mellitus and a number of possible solutions along this pathway. The tables presented in each section of the pathway will guide readers through this section presenting listed roadblocks and possible solutions in line with key action areas. It must be noted that the presented roadblocks are not all encompassing and by no means offer a “quick fix” solution. This collective action framework is practical and can be applied to each of the key sections of the patient care pathway, to assess which domains are missing or should be applied to improve care (see Figure 7). For example, for the monitoring and follow-up of CVD among patients living with diabetes, is there an integrated approach to care with strong collaboration across settings?

Although not all barriers and solutions are addressed at an individual level, a strategic approach to key action areas are offered for some examples, from prevention to monitoring and follow-up. In addition, the results of the modified Delphi survey process will also serve to inform this section supported by evidence-based examples in practice and evidence-informed solutions. The structure offers an

overview of 1) a patient's perspective, 2) the setting for care (primary care, secondary care, community care), 3) the most reported roadblocks and a review of evidence, 4) an integrated and strategic approach to specific solutions based on collective action areas, and 5) examples of initiatives that have been implemented, where feasible.

Reflection before action

Perhaps the greatest challenge in creating this document has been how to present roadblocks and solutions as an evidence-informed framework to support implementation. As a first-line approach, it is essential to assess and identify whether presented roadblocks to care are in fact barriers within context. Careful consideration of the perspective of patients, the health care team, and decision makers is needed before embarking on planning and implementing interventions. A situational analysis can offer useful information and feedback from different perspectives and an overview of the true gap in care [53].

Prevention of CVD among people living with diabetes

The target setting is relevant for the general public and those living with with type 2 diabetes mellitus.

Roadblock: Low awareness of the link between CVD and diabetes.

“People are eating so much sugar without even realising. People in my country just don't know the effects sugar[s] have on our health. Not just sugar that we add ourselves, but sugar already added to food that we eat every single day.”

Although this entire Roadmap is focused on prevention, the prescribed pathway of care focuses on the prevention of onset CVD among people living with type 2 diabetes mellitus. Despite the proven connection between type 2 diabetes mellitus and CVD, general awareness among the public remains low [54]. Approximately one-quarter of people with diabetes in the United States and nearly one-half of Asian and Hispanic Americans with diabetes are undiagnosed [55]. In Sub-Saharan Africa, this number has been reported as high as 80% [56]. People with metabolic syndrome are also at increased risk of CVD. Increased vigilance is warranted to identify and treat them and their associated cardiovascular risk factors [57].

Prevention is particularly important in countries and regions treating type 2 diabetes mellitus as a new disease area, where awareness, health literacy, and education are particularly low among those newly diagnosed. Low awareness among those living with type 2 diabetes mellitus of the elevated risks of CVD is a well-reported barrier to best patient care, notably in the prevention of heart disease or stroke. Within the survey sent to WHF and IDF Members, a “lack of patient awareness of the risks of CVD” was the highest ranked roadblock with over 94% and 95%,



FIGURE 7. A framework for collective action. The framework includes health systems: Leadership and Agency; health policy and political agendas: Advocacy; strengthening collaboration across all sectors: Collaboration; raising awareness and prevention: Communication; the role of education in type 2 diabetes mellitus and cardiovascular disease: Education; the role of evidence-based interventions in solution pathways: Research (implementation science).

respectively, of respondents agreeing or strongly agreeing across both survey rounds.

In a U.S. survey conducted in 2016, 52% of respondents with type 2 diabetes mellitus were unaware of their increased risk of CVD while awareness of the microvascular risk was higher [58]. In a survey in Lebanon, the awareness of cardiovascular risk factors was highest for smoking and lowest for diabetes [59]. U.S. adults had a low awareness of cardiovascular risk factors and correlates of awareness included older age, insurance status, family income above the poverty line, U.S. origin, having a usual source of health care, and the presence of comorbid conditions [60]. In a study of the general population in 4 cities in Argentina, Chile, and Uruguay, the prevalence of diabetes varied between 8.4% and 14.3% but only 80% of those with diabetes were aware of their condition [61]. In a prevalence study among Latin Americans living in the United States, 37% of those with diabetes were undiagnosed. Individuals with higher odds of being undiagnosed were women, those with no health insurance, individuals who received no health care in the past year, those who were overweight, and those with dyslipidemia. Individuals with lower likelihood of being undiagnosed were those with a family history of diabetes and those with hypertension [62].

By increasing global understanding of the link between CVD and diabetes, there is hope that we can reduce the

TABLE 2. Roadblocks and possible solutions on the prevention of CVD among people living with diabetes

Action Needed by Target Group	Roadblock	Survey Responses	Possible Solutions	Key Action Area
Patients, carers and families, patient organizations, and civil societies	Lack of awareness of the risks of CVD among diabetes patients	97% agreement	Clear campaigns to inform the general public Strengthen patient information and patient awareness campaigns, for example, AHA Take Diabetes to Heart	Communication Advocacy
	Difficulty in changing attitudes and behavior to adhere to a new lifestyle to avoid later risks	85% agreement	Direct patients to national and local support programs that may exist	Education Communication
	Lack of understanding of risk perception of CVD among diabetes patients	Survey round 2: 97% agreement	A module-based education program covering key components that may include disease risks, health management, avoiding complications, importance of medication adherence, lifestyle, and nutrition	
	Difficulty in changing attitudes and behavior to adhere to a new lifestyle	85% agreement	Strengthen evidence on effective interventions for behavior change in people living with diabetes across contexts, cultures, and socioeconomic classes Implement support interventions that have proven success at improving education in those living with type 2 diabetes mellitus	Research Education
Health systems and health care professionals	Lack of awareness of health care professionals of risk, assessment, and overall importance of CVD and diabetes	85% agreement	Design medical education curricula with more focus on prevention Strengthen multidisciplinary education models Design care systems to facilitate collaboration with health care professionals across setting using integrated care models	Education Collaboration Agency and Leadership
	Medical education is not focused on prevention	New	Build into continuing medical education— and	
	Perception of diabetes as a glucose-centric, misperceived focus	Survey round 2: 79% agreement	continuous professional development—specific modules on disease burden and public health	
	Lack of focus on teaching on disease burden and public health	90% agreement		
Health policy and leaders in cardiovascular health	Lack of investment in public health	94% agreement	Make diabetes and CVD a priority on national agendas and assign funding Simple and strong awareness campaigns supported at national level Coordinate efforts to inform and educate decision and policy makers of the overall burden	Leadership and Agency Communication Advocacy
	Payment structures that do not allow for sufficient allocation of resources to prevention	Not included in survey round	Increase high-quality evidence on effectiveness of interventions across settings Use evidence to inform policy, health agendas, and allocation of resources	Leadership and Agency Research

Abbreviations as in Table 1.

incidence of CVD through patient engagement and behavior change [63]. This will represent the first steps in reducing the burden of diabetes, simultaneously helping people with the disease to control their diabetes. Awareness campaigns focused on making the link between CVD and type 2 diabetes mellitus are the first step to better general public understanding and appreciation of this growing burden and the actionable steps that can be taken to reduce

it (see Table 2) [64]. CVD and type 2 diabetes mellitus are invariably linked with poor diet, lack of physical activity, smoking, and obesity among lower socioeconomic classes, a trend widely reported at the global level [65]. Therefore the public must be made aware of the benefits of healthy lifestyle choices, but these must be made accessible and affordable. This requires a collaborative effort across leaders and decision makers of education systems, the food

TABLE 3. Evidence-based examples from the Montana DPP

Intervention	Results
Telehealth delivery of the DPP to rural communities	Participants receiving the Montana DPP through telehealth have similar rates of participation and achieve similar weight loss as participants attending the program on site
Intensive lifestyle intervention goals can be achieved as effectively with large groups as with small groups	Findings indicate that intensive lifestyle intervention goals can be achieved as effectively with large or small groups

DPP, Diabetes Prevention Program.

industry, media, urban planning, and nongovernmental organizations [66]. Actively promoting diabetes awareness and supporting healthy decision making for people living with diabetes and those at risk is key. By increasing access to healthier options, key stakeholders in cities will effectively make healthier choices easier. A large number of stakeholders and sectors should be involved at all levels of society [67,68].

For the primary and secondary prevention of CVD among people living with type 2 diabetes mellitus, the management of type 2 diabetes mellitus must shift from the management of glycemia to the management of cardiovascular risk. This is supported by 77% of survey respondents in the second survey round. Yet first-line treatment approaches have traditionally relied on the evidence of therapeutic strategies for the control of hyperglycemia [69], with little understanding on the effects of these treatments on cardiovascular risk [70].

Evidence based solution and an example from the Montana Diabetes Prevention Program. The United States currently ranks the third highest in adult diabetes worldwide [9]. The published data clearly outline that there are specific risk factors that may increase the likelihood of developing CVD among those living with type 2 diabetes mellitus. Yet there are few examples of programs that have directed sufficient resources toward prevention. The Montana Diabetes Prevention Program (DPP) delivers interventions for healthy lifestyle changes to those at risk of developing CVD and diabetes in Montana, through awareness and education interventions. Publications from the Montana DPP have shown the effectiveness of lifestyle intervention programs [71], of a telehealth model to deliver prevention initiatives to rural communities [72], and of setting lifestyle goals with large and small groups [73].

See Table 3 for evidence-based examples from the Montana DPP.

Screening for CVD among people living with diabetes

The target setting is particularly relevant for primary care and specialist centres.

Roadblock: Adherence to clinical practice guidelines.

“Before my diagnosis I visited my physician twice and was sent away with misinformation.”

“There is a long family history of diabetes so as a routine check my doctor would often screen for diabetes and take my blood pressure.”

Turning to populations at higher risk, such as women with previous gestational diabetes, and those with atherosclerotic vascular disease including coronary, peripheral, and cerebrovascular, screening needs to be performed by blood tests following best-reported practice within clinical guidelines [74]. A respondent noted that “guidelines on screening for CVD in diabetes patients has failed to be established” (from Japan). This statement reflects that clinical practice based on evidence is commonly not implemented as recommended [75] and contrasts with the development of new pharmacological possibilities that have made a timely identification of dysglycemia, particularly in patients with coronary artery disease (see Table 4).

One reason for this may be that the association between dysglycemia and CVD is considered unclear [75]. New drugs, originally launched as glucose-lowering but also with mortality- and morbidity-reducing effects, make such a position unacceptable as a reason for abstaining from dysglycemia screening [58]. Another reason may be lack of understanding of which tests should be used. Data favor the use of an OGTT if the ambition is to disclose as many people living with dysglycemia as possible. Although this may be logistically challenging, particularly in low-resource settings or in care settings not accustomed to administration of the OGTT, it is an aim well supported for screening for CVD among people living with diabetes. According to recent reports by Shahim et al. [31] in patients with stable coronary artery disease and by Chattopadhyay et al. [76] in patients with acute coronary syndromes, OGTT is the test that provides the best prognostic information.

Roadblock: Fragmented care—a health care worker—led roadblock. It is clear that national and local communication of, and adherence to, specific guidelines for screening of CVD in those living with type 2

TABLE 4. Roadblocks and possible solutions to screening for CVD among people living with diabetes

Action Needed by Target Group	Roadblock	Survey Responses	Key Action Area and Possible Solution	Key Action Area
Patients, carers and families, patient organizations, and civil societies	Absence of symptoms and perception of diabetes as a silent disease deters those living with diabetes from seeking appropriate follow-up including screening	Survey round 2: 92% agreement	Work collaboratively with patients in a shared decision making process	Education
	Socioeconomic and psychosocial barriers to screening, particularly in low-income and low-education populations (e.g., negative attitude toward screening)	New	Provide clear information on the risks of living with type 2 diabetes mellitus using targeted individual approaches based on patient needs	Communication Advocacy
Health care professionals	As patients are already diagnosed with diabetes, there may be the assumption that other specialists or members of the health care team would address screening for risk factors. This is linked to the barrier that patient care is delivered by a health care team across settings that may lead to fragmented, episodic, and catastrophic care	Survey round 2: 88% agreement	Define clear roles and responsibilities and task allocation of the health care team across settings Consider approaches to link specialist clinics with community-based programs in an integrated approach to care Design care systems that facilitate and support collaboration across settings	Collaboration Leadership and Agency
	No readiness or commitment to keep updated with specific education linked to CVD and diabetes, which leads to a lack of adherence to the implementation of best-practice guidelines	New	Continue the development and update of high-quality national and international guidelines Ensure communication across national and local health care centers on specific guidelines to follow	Research Education
	Lack of coordination of health records systems	Survey round 2: 85% Survey 2: 96%	Adhere to relevant up-to-date guidelines and local protocols for screening	Research Education
	No resources or coordinated efforts to measure and analyze big data		Use registries that can provide specific information about patients and patient populations that support the delivery of optimal care across settings	Leadership and Agency
Health policy and leaders in cardiovascular health	Lack of screening, suboptimal screening, or low uptake of screening for CVD risk in those living with diabetes	(Modified based on feedback in Delphi process)	Evaluate, modify, and redesign care models based on needs Point-of-care testing hemoglobin AMC, and lipids, and gather large database of patient information to better understand the disease	Leadership and Agency
	No access or long waiting times to access general practitioners or specialist clinics especially in LMIC, particularly for the follow-up of those living with diabetes for cardiovascular risks.	Survey round 1 and round 2: 92% and 85%, respectively	Consider successful care models (e.g., HIV in Africa) Consider different models of improved access to care (e.g., considering subsidized or free transport, decentralizing follow-up care programs, opening times of clinics)	Leadership and Agency
	This has been also linked to socioeconomic status and health inequality in developed countries			

AMC, amplitude of muscular contradiction; CVD, cardiovascular disease; HIV, human immunodeficiency virus; LMIC, low- and middle-income countries.

diabetes mellitus can effectively recommend and disseminate the best available evidence to guide practice [77]. The organization of health care services can further improve patient care by strengthening collaboration and integration across care settings [78].

A number of barriers to this were identified in the WHF and IDF surveys including a “fragmented, episodic, and catastrophic” care (receiving 88% agreement) and to

those living with type 2 diabetes mellitus where health care teams “fail to work together” (93% agreement) across primary, community, and specialist care settings. Whereas integrated care is embedded as a best-practice approach across the complex pathway of diabetes and CVD care, it is worthy of specific mention in addressing screening for CVD among those living with type 2 diabetes mellitus [79,80].

TABLE 5. Evidence-based examples of integrated care screening programs in the United States and China

Intervention	Results
A randomized trial of an intervention to improve self-care behaviors of African American women with type 2 diabetes: impact on physical activity [90]	The intervention showed modest enhancement
Effects of a structured health education program by a diabetic education nurse on cardiovascular risk factors in Chinese type 2 diabetic patients: a 1-yr prospective randomized study [91]	Regular structure reinforcement with health education is useful and can help to control CVD risk factors

CVD, cardiovascular disease.

Integrated care describes a partnership across a team of health care practitioners who work collaboratively with those living with type 2 diabetes mellitus and CVD, in a coordinated effort to make decisions for the best possible health and social outcomes [81]. Care models supporting integrated care have a reported positive impact on perceived quality of care [82], cost effectiveness for hypertension screening and therapy [79], patient safety [83], and increased access [84], and these models continue to build on evidence-based support for this approach in practice [85].

For screening of CVD among those living with type 2 diabetes mellitus, integrated care within the community and primary care settings is essential to the timely diagnosis of CVD. Within current health systems, integrated care remains the exception rather than the rule, perhaps most notably due to reported challenges with implementation such as insufficient integration between patient databases [86], lack of targeted remuneration or financial incentives [87], lack of collaboration across settings and between professionals [87], closed communication channels across settings [88], to name a few, yet evidence and support for

TABLE 6. Roadblocks and possible solutions on assessment of CVD risk and diagnosis of CVD among people living with diabetes

Action Needed by Target Group	Roadblock	Survey Responses	Key Action Area and Possible Solution	Key Action Area
Patients, carers and families, patient organizations, and civil societies	Once diagnosed with diabetes it may be difficult for patients to accept their diagnosis (78%)	Survey round 2: 78% agreement	Support patients on where to find accurate and up-to-date information on their disease Direct patients to national or local support groups that might exist	Communication Education
	Lack of belief or capacity to change behavior	Survey round 2: 92% agreement	Support and invest in health behavior change initiatives and adapt programs to differences across socioeconomic status	Communication Advocacy
	Lack of patient awareness on the risks of CVD among people living with diabetes and the importance of lifestyle management	Survey round 2: 97% agreement	Partner with affected communities with high numbers of people living with diabetes to build strong targeted awareness campaigns	
Health care professionals	Lack of education of health care professionals across settings and overall importance of the link between CVD and diabetes	Survey Round 2: 88%	Provide clinical decision support offered through mHealth models Offer the possibility for real-time feedback on dashboards	Education Collaboration Leadership and Agency
	Insufficient numbers of trained specialists particularly diabetologists, leading to delayed diagnosis	New	Plan and innovate for new care models	
Systems and policy and leaders in cardiovascular health	Infrequent access to follow-up management programs to support patients	71% agreement	Support community-based programs to harness the voices of those affected. Raise awareness, in line with global or national information packages with a specific target for diabetes patients with a higher risk of CVD	Communication Advocacy

CVD, cardiovascular disease.

TABLE 7. Evidence-based examples of programs for the assessment of CVD risk and diagnosis of CVD among people living with diabetes

Intervention	Results
Effectiveness of pharmacist's intervention in the management of CVD	A greater involvement of pharmacists in activities directed to the patients and collaboration with other health care professionals in a team may provide an enhanced effect on various outcomes and may ultimately positively affect public health [98]
Effectiveness of a multidisciplinary intervention to improve hypertension control in an urban underserved practice	A multidisciplinary team approach involving registered nurses, pharmacists, and physicians resulted in substantial improvements in hypertension control in a real-world underserved setting [99]

CVD, cardiovascular disease.

this approach to strengthen screening processes among those living with diabetes is gaining attention both within the published reports and in practice examples.

Evidence based solution and an example from an integrated care screening program in the Philippines. Through the modified Delphi process and as part of the development of this Roadmap, one such example offered through WHF and IDF Members tells the compelling story of a joint effort with the World Diabetes Foundation and primary health care facilities in the Philippines. The purpose of this initiative was to increase and improve access to multidisciplinary diabetes and CVD care in the Davao and Western Visayas regions, the only large-scale effort to locate integrated services for CVD and diabetes prevention and screening within existing primary health care systems. This project involved specific interventions including establishing registries, records, and screening forms for health care professionals across settings and coordinated training programs that were delivered by specialist teams. Results of the program reported the local screening of 57,242 people for diabetes and hypertension at primary care clinics, the results of which were registered in a large database. Evidence-based examples of the benefits of different models of integrated care, across settings as well as across specialty areas continue to support this model as a best-care approach for chronic disease [89].

Table 5 presents evidence-based examples of integrated care screening programs in the United States and China [90,91].

Assessment of CVD risk and diagnosis of CVD among people living with diabetes

The target setting is particularly relevant for primary care and specialist centers.

Roadblock: Access to endocrinologists.

“My dad lived for many, many years with undiagnosed type 2 diabetes mellitus. When he was eventually diagnosed with type 2 diabetes, he also had very high blood pressure and heart disease.”

A multitude of roadblocks exist around limited screening and optimal diagnosis of type 2 diabetes mellitus. There is also a need to remove all the barriers for access to health care: accessibility (geographical); acceptability (social and cultural); affordability (financial for patients); and availability (of health services and resources) (see Table 6). The limited number of diabetologists and endocrinologists providing timely diagnosis of type 2 diabetes mellitus has a direct and measurable impact on detection of cardio-metabolic risk in this ‘at risk’ population. Among endocrinologists, factors preventing optimal management may include sheer numbers, given the high incidence of type 2 diabetes mellitus and relatively limited numbers of endocrinologists. According to the Center for Disease Control 2015, the most recent estimates in the United States indicate 30.3 million individuals with diabetes and only ~8,000 endocrinologists [92]. It has been reported that those countries with the highest numbers of undiagnosed type 2 diabetes are China, India, and the United States [9]. New emerging studies link increasingly higher CVD risk with each increasing decade at diagnostic age. Age at diagnosis of type 2 diabetes mellitus is essential for prognosis of survival and cardiovascular risks [93].

Beyond this, endocrinologists, like any other specialty, can experience a lag time until full familiarity with new data for more novel agents such as SGLT-2 inhibitors and GLP-1RA. Particularly worrisome is the notion that these agents with cardiovascular benefit may fall between specialties in higher risk patients, in a situation where endocrinologists defer to cardiologists in prescribing them given their action on parameters such as heart failure, volume status, and atherosclerotic complications and cardiologists defer to endocrinologists (and internists) given that these are glucose-lowering agents.

Health system planning to reflect trends in health care are essential if we are to meet the demands of this rising epidemic and to ensure that health systems have the possibility to deliver quality care required for those living with diabetes. This approach requires active participation of leaders in health systems as well as policy and decision makers at the national level. Patients and patient organizations are increasingly playing a greater role in more innovative planning, designing, and implementing of care models [94]. Foresight in education planning, for medical specialist training as well as training for health care professionals to ensure a skilled care team, can meet the needs of complex patient profiles. The World Health Organization and European Observatory on Health Systems and Policies offer best-practice examples of innovation across

TABLE 8. Roadblocks and possible solutions on treatment and approaches to care

Action Needed by Target Group	Roadblock	Survey Responses	Key Action Area and Possible Solution	Key Action Area
Patients, carers and families, patient organizations, and civil societies	Patients unnecessary fear of the side effects of treatment or feeling that medication is not needed	Survey rounds 1 and 2: 76% and 87%	Support and invest in infrastructure to create “expert patients” particularly in treatment of CVD	Education
	Difficulty in changing attitudes and behaviors to adhere to a new lifestyle to reduce risk factors	Survey round 2: 94%	Education and active interventions as an approach to care to supporting behavior change	
Health systems and health care professionals	Lack of support and full understanding in the difficulties faced to modify behaviors among those living with diabetes and CVD	New		
	Lack of appropriate time and system support in delivery of care teams	Survey round 2: 88%	Support collaboration and teamwork. Follow an integrated education approach across specialty areas and with the entire care team	Strengthening collaboration
	Lack of consistency in the approach to care particularly for first-line treatment	New	Improve health care systems for the systematic delivery of high-quality care following evidence-based guidelines	Education
	Lack of supporting evidence on combination therapy approaches	New		
Policy and leaders in cardiovascular health	Changing demographics of diabetes as a disease across the life span, especially with raising numbers of diagnosis of children and adolescents with type 2 diabetes and those living long with type 2 diabetes, where evidence from clinical trials to guide therapy is still being built	New	New research is needed Improve coordination and efforts across clinical trial teams	Research
	Lack of clear, concise, targeted information to patients on the importance of adherence to treatment of CVD	Survey rounds 1 and 2: 97% and 92%	Improve early intervention programs following initial first-line treatment	Communication
	Lack of adherence to medication due to affordability	Survey rounds 1 and 2: 87% and 78%	Investigate national initiatives and strategies to improve access to quality affordable evidence-based medicines and treatment programs (free or subsidized medicines)	Leadership and Agency
	Lack of adherence to medication due to accessibility	Survey round 2: 89%		
	Avoid stock outages through long-term planning and a mix of private and public medicine storage and distribution	Survey rounds 1 and 2: 94% and 84%		

CVD, cardiovascular disease.

countries within the European Observatory Policy Brief Series [95].

Roadblock: Lack of multidisciplinary education. For nonendocrinologists, multiple overlapping as well as distinct barriers may exist regarding optimal care of diabetes. Cardiologists may feel this is outside the realm of what they have traditionally cared for. They may also feel uneasy about participating in the management of a disease they did not train in, exacerbated by a lack of resources for either doing the teaching required in terms of diabetes or new medication use and/or the requisite follow-up. Importantly, for almost a decade, key cardiology groups, such as the ACC, have called for cardiologist involvement in diabetes management in a multidisciplinary approach to care and this has not occurred [96].

A long-held notion among specialists has been a territorial one—concern that physicians referring cases to them for more traditional cardiovascular problems will feel as if the cardiologist is encroaching on their area. Internists and primary care physicians may feel unfamiliar with newer agents and perplexed about their appropriate use and patient selection. Certainly a trickle-down process has been seen with the use of other agents over time, including ones that are well tolerated such as statins. As is relevant for all caregivers, a tremendous focus has existed around notions of “do no harm,” with physicians concerned about potential side effects or untoward responses to newer agents and being unfamiliar with patients who might not be appropriate for a given drug. The results of the WHF and IDF surveys echo this reported barrier with 97% of survey respondents agreeing

TABLE 9. Implementation examples with published outcomes

Intervention	Results
Strategies for guideline implementation in primary care focusing on patients with CVD: a systematic review	The use of implementation strategies for the distribution of guidelines on CVD can be convincingly effective on physician adherence, regardless of whether it is based on a unimodal or multimodal design [108]
Nurse care manager collaboration with community-based physicians providing diabetes care: a randomized controlled trial	A nurse care manager collaborating at the office level with community-based primary care physicians can enhance the care provided to adult patients with type 2 diabetes [109]

CVD, cardiovascular disease.

that there is a “lack of education of health care professionals across settings.”

The most fundamental intervention related to improving diabetes care involves education regarding new insights into the nature of diabetes, its associated pathological drivers and complications, and the impact of glucose control on cardiovascular outcomes, including newer glucose-lowering agents. Ongoing and more rapid integration of clinical trial data into guideline-directed care can help in this regard. The education provided to those in

practice should be both broad and practical, including prior authorization strategies and key patient characteristics that might lead to the exclusion of specific agents given risk for adverse outcomes. This approach helps address physicians’ fears regarding causing harm, which also include concerns over liability.

Evidence based solutions and an example from the ACC Expert Consensus Decision Pathway. Regional societies are well placed to deliver the educational tools to

TABLE 10. Roadblocks and possible solutions on monitoring and follow up

Action Needed by Target Group	Roadblock	Survey Responses	Key Action Area and Possible Solution	Key Action Area
Patients, carers and families, patient organizations, and civil societies	Patient-centered and partnered initiatives that move toward more united recommendations and guidelines for patient monitoring and follow-up	Survey round 2: 97%	Include patient representatives in the development of guidelines particularly for monitoring and follow-up	Research
Health systems and health care professionals	Failure to work together across a multidisciplinary team with community workers, pharmacists, and nutritionists	Survey round 2: 93%	Improve an integrated care approach across community, primary, and specialist and collaboration care settings, strengthening communication, interprofessional education and Appropriately equip health care workers with the skills for accurate screening and patient follow-up Strengthen skills profiles and promote task shifting with certified education programs for community-based workers	Leadership and Agency Communication Education Collaboration
	Lack of education that is socially, demographically, and culturally aware	Survey round 2: 95% agreement	Multidisciplinary and training of the care team to work collaboratively, to set targets, and overcome demographic and cultural challenges	
Health policy and leaders in cardiovascular health	Lack of or poorly delivered community-based programs designed to reach the patient Monitoring and follow-up of CVD and diabetes care must not only focus on patient care initiatives but to incorporate cross-sectional policy planning and environmental engineering	Survey round 2: 87% New	Develop and evaluate new care models and invest in implementation of new approaches to care Large-scale urban planning initiatives to address today’s problems but also to plan for tomorrow’s determining factors of population health	Leadership and Agency

CVD, cardiovascular disease.

TABLE 11. Evidence-based examples of monitoring and follow-up

Study	Results
Urban green space interventions and health: a review of impacts and effectiveness	Urban green space is a necessary component for delivering healthy sustainable and livable cities that deliver positive health and social and environment outcomes for all population groups [122]
The influence of local food environments on adolescents' food purchasing behaviors	High fast-food outlet density in both home and school neighborhoods was associated with increased fast-food purchasing by adolescents. Macrolevel regulations and policies are required to amend the health-detracting neighborhood food environment surrounding children and youth's home and school [123]

support clinical decision making in practice. The ACC Expert Consensus Decision Pathway is one such example to disseminate the knowledge required particularly on new areas where evidence may be limited or evolving to enable the care team to make evidence informed decisions [97].

Table 7 provides evidence-based examples of programs for the assessment of CVD risk and diagnosis of CVD among people living with diabetes [98,99].

Successful interventions using an integrated care approach have been repeatedly shown within the published data across specialties and settings.

Treatment and approaches to care

The target setting is particularly relevant for specialist centers, primary and community care, and care at home.

Roadblock: Evidence practice gaps in treatment of diabetes and CVD.

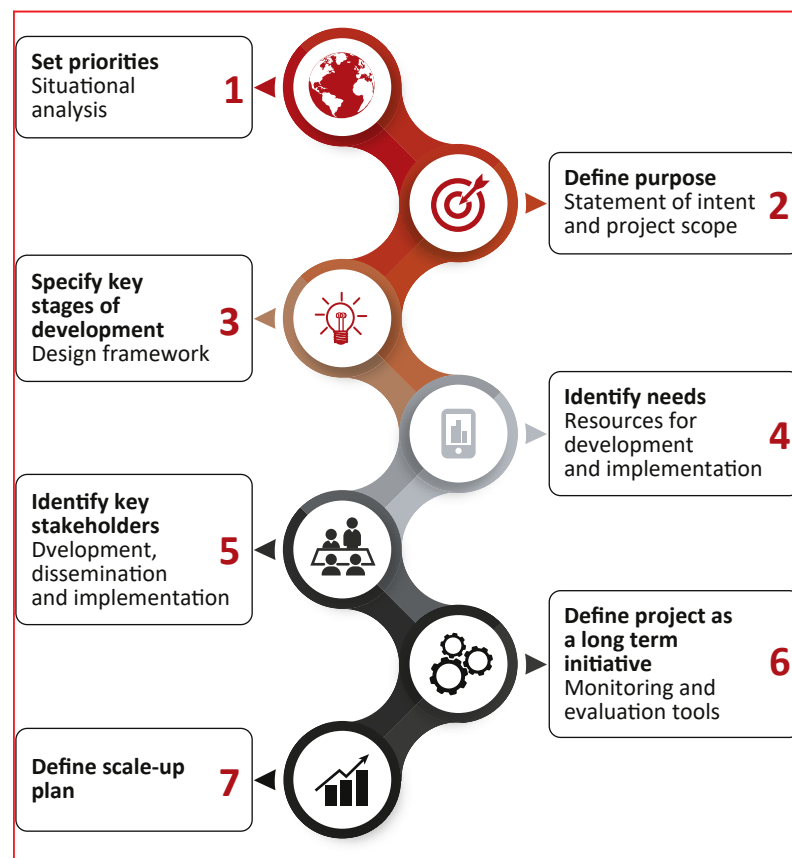
"I was living with type 2 diabetes and given metformin to take daily. I have a sweet tooth and loved bread.

I decided on no more than 35 g of carbohydrates every day and I check my levels before and after every meal. Within 1 week, my levels were great and with my GP's support I did not take the additional metformin he advised and just stayed on 1 a day.

I went for regular HbA_{1c} check-ups and I was told to eat starchy carbohydrates with every meal. But through the online support groups I checked this advice as it did not make any sense to me when my goal was to reduce sugar intake. I ignored it and followed the information offered by other diabetics who were sharing their great results (diabetes.co.uk)."

There is substantial variation in the treatment of type 2 diabetes mellitus worldwide. Recently, the global DISCOVER (A Global, Prospective, Observational Study of Patients With Type 2 Diabetes Who Are Starting Second-Line Glucose-Lowering Therapy) study observed type 2 diabetes mellitus treatment and clinical outcomes in 38 countries across 6 continents [100]. Investigators observed significant variation in treatment across countries, reflecting barriers refined and gathered through feedback from WHF and IDF Members during the Delphi survey process.

Although clinical guidelines recommend monitoring HbA_{1c} to support treatment decisions, approximately 1 in 5 patients did not have an HbA_{1c} measurement recorded when initiating second-line treatment, suggesting that HbA_{1c} is not routinely measured in some clinical settings and geographic regions [100]. There is well reported underutilization of comprehensive medical prescriptions and lipids to test blood pressure [101]. The median time from diagnosis of type 2 diabetes mellitus to initiation of second-line therapy was 4.1 years, with the lowest time found in Southeast Asia and the Western Pacific region (3.4 years) and the highest amount of time in Africa (5.7 years)

**FIGURE 8.** An implementation toolkit.

[100]. Even within regions, there was significant variability in median time from diagnosis of diabetes between countries [100]. Similarly, the use of first- and second-line therapies varied greatly across regions [100]. The most frequently prescribed first-line therapies were metformin monotherapy and combinations of metformin and a sulfonylurea [100]. The greatest proportion of patients receiving combinations of metformin and a sulfonylurea as first-line therapies were found in Southeast Asia and the Eastern Mediterranean region [100]. The most prescribed second-line therapies were combinations of metformin and a DPP-4 inhibitor and combinations of metformin and a sulfonylurea. The most common second-line therapies prescribed in Africa and Southeast Asia were combinations of metformin and a sulfonylurea, which differed from the Eastern Mediterranean region, the Americas, Europe, and the Western Pacific region, where combinations of metformin and a DPP-4 inhibitor were more frequently prescribed as second-line therapies [100].

These differences in treatment triggered mainly by cost-related and drug availability problems—especially the access to insulin, which is defective in some regions—could be solved through appropriate leadership and national programs that would improve health care systems for consistent delivery of high-quality and evidence-based care (see Table 8).

Roadblock: A lack of collaboration across the healthcare team. Type 2 diabetes mellitus doubles or even triples the risk of developing ASCVD [102] and therefore an integrated approach is mandatory [20]. This cardiology-diabetology collaboration has been highlighted since 2013 in the European Society of Cardiology Guidelines on diabetes, pre-diabetes, and CVD developed in collaboration with the European Association for the Study of Diabetes. Delivery of best-practice care is not implemented due to insufficient collaboration between different specialties or due to a lack of diverse health care professionals. For it to become reality, an integrated approach to care is needed, including not only diabetologists and cardiologists, but also internal medicine specialists and general practitioners, alongside nurses and other caregivers. This would provide clear and targeted information about the array of cardioprotective drug regimens for patients with type 2 diabetes mellitus. Education is also among the key solutions in avoiding clinical inertia with recent and ongoing research proving that several antidiabetic drugs reduce cardiovascular events and even cardiovascular and general mortality.

Another roadblock that must be addressed is the difficulty of changing attitudes and behaviors in regard to attaining a healthy lifestyle. To achieve a best-practice approach to deliver the highest quality care to those living with type 2 diabetes mellitus and CVD, the following are essential: 1) educational programs; 2) a multidisciplinary team—including a psychologist, a registered dietitian, and, if possible, a physical therapist; and 3) specific

and coherent policies, campaigns, and activities (national, nongovernmental, community, workplace, industry) [103] that would promote beneficial lifestyle changes are needed to achieve a best-practice approach to deliver the highest quality care to those living with type 2 diabetes mellitus and CVD.

Evidence based solutions and an example of integrated patient care with improved outcomes. An integrated approach to health care delivery is not new to health care systems and evidence clearly links this to improved patient outcomes [104,105]. Yet interprofessional practice remains among the greatest reported barriers to patient care [106]. Placing the patient at the very center of the organization of care, this research project investigates 2 specific action areas: 1) communication to investigate integration of better communication channels to share information on patients and patient outcomes across settings; and 2) education tools to support skill development that could be delivered at work sites.

Health care professionals including physicians, nurses, and multiprofessional staff were all invited to take part. Whereas the results of this study are not yet published, this initiative offers an example of the importance of supporting integrated models of care that have a marked impact on improved patient outcomes generally and has been shown specifically for the delivery of care to those living with diabetes [99,107].

Table 9 provides implementation examples with published outcomes [108,109].

Monitoring and follow-up

The target setting is particularly relevant for specialist centers, primary and community care and at home care

Roadblocks: Personal and social barriers to the management of diabetes and CVD.

“Changing your lifestyle is huge, it means changing everything that you do and incorporating it daily. But I am a new person, I love to work out and I do this 7 days a week.

I am an emotional eater so when I am stressed, I eat. There is no support system to help you overcome this.

Educating yourself is the most important thing. I know I must manage my lifestyle which has had a direct impact on my blood pressure, reducing weight, and I feel healthier.

There is no easy way to ‘fix’ diabetes. It takes time and energy and effort. You have to want to do this (Patient story from Nebraska Medical Centre <https://www.youtube.com/watch?v=Eup7mjvMxcvM>).”

Healthy lifestyle choices are not only based on individual attitudes and subsequent behaviors but are also built

on the foundations of our environment and social determinants that may predict health outcomes.

Whereas individual behaviors and social determinants of health were not presented as specific barriers to care within the modified Delphi process, a number of comments from respondents referred to this as a specific barrier. To ensure a successful approach to the monitoring and follow-up of those living with type 2 diabetes mellitus and CVD, a systematic approach to support and induce change of lifestyle is essential and is reported in 3 specific steps to 1) follow a healthy lifestyle including addressing obesity and healthy eating, exercise, and tobacco cessation; 2) self-management including adherence to medication and where possible self-monitoring of glucose and blood pressure; and 3) awareness of microvascular-diabetes complications including eye, foot, and renal complications [110] (see Table 10). The risk of the development of any complications is greatly reduced by monitoring and appropriate correction of blood glucose and blood pressure, following a healthy dietary pattern, and performing regular physical activity.

Supporting patients to meet these health demands is not an easy feat and requires health systems to be adaptable and flexible to individual patient needs. Strategies that work for 1 patient will not be the same strategies that work for others; therefore, different options must be offered to those living with type 2 diabetes mellitus and CVD. Creating a health system that is adaptable to the needs of individual patients and their families or support network can be the determining success factor for behavior change [111] and a critical component to improved and optimal health outcomes [112,113]. Health systems with routine surveillance mechanisms are needed to better manage type 2 diabetes mellitus and CVD. Lastly, health care systems and clinicians can leverage mHealth interventions to not only improve diabetes control, but also to control various cardiovascular risk factors commonly present in people with diabetes such as physical inactivity, hypertension, hyperlipidemia, and smoking. Early studies (including those performed in low- and middle-income countries) appear promising, but long-term studies are urgently needed [114,115].

Roadblock: Social determinants of health. Overall improvement of outcomes for the vast numbers of people with type 2 diabetes mellitus and CVD is not only dependent on long-term personal lifestyle modification but is also determined by the social environment we are born into, including the built environment, pollution, environmental noise, and socioeconomic status [41]. Although circumstances may change over time, social constructivist theory notes that we are bound by our environment, our situation, and the network of people who influence our behavior.

The global and growing epidemic of type 2 diabetes mellitus is vast, placing an enormous burden on individuals and on society, and the magnitude of this disease

continues to grow with a global cost of US\$1.3 trillion estimated to almost double by 2030 to US\$2.2 trillion [17]. Access to quality housing [116], healthy food [117], green spaces [118,119], and air pollution [120] have all been directly linked to higher incidence of type 2 diabetes mellitus and consequently to macrovascular complications. Therefore, it is clear that tailored interventions at an individual level are not enough to dramatically reduce the burden of this disease on the overall economy, health systems, and the individual heartfelt burden of patients and families. In the second survey round to WHF and IDF Members, only 38% of respondents reported having taxation on sugary foods, 0% of respondents were aware of any incentives either at the national level or through insurance for sport membership, and 78% of respondents reported that there were no incentives for reduced costs of healthy foods. Large-scale urban and environmental engineering is needed if we are to make a real and significant positive impact on societies as a direct result of the growing epidemic of type 2 diabetes mellitus.

Evidence based solutions and an example of urban transformation from India. The Atal Mission for Rejuvenation and Urban Transformation (<http://cpheeo.gov.in/cms/amrut.php>) has been supported by the Government of India since 2015. It is a program that plans, designs, and implements national coordinated interventions across 500 cities with the aim of providing safe water and sanitation, reducing air pollution through improved public transport, and developing well-maintained open or “green” spaces. Large-scale environmental engineering requires balancing continuing basic needs of safe water and sanitation to many cities (which many cities still lack) with the more recent and growing hazard of air pollution [121].

To truly plan for and implement precision public health, a coordinated government and policy change effort is needed to reinvest in agriculture and provide new streams of healthy food, upskill a new workforce to generate new needed skills, improve infrastructure including roads and public transport, and implement health initiatives for prevention in schools and universities.

Table 11 provides evidence-based examples of monitoring and follow-up [122,123].

IMPLEMENTING THE ROADMAP AND MAKING A DIFFERENCE—FROM PRESCRIBED RECOMMENDATIONS TO IMPLEMENTATION

Successful Roadmap implementation requires committed global action that starts at the local level with all key stakeholders. Those living with diabetes are as important in this process as their families and caregivers; patient advocacy groups; health care professionals; health care systems; public health officials; and policy makers at the local, national, and global levels. The roadblocks and solutions tables in each section highlight the barriers that must be addressed at multiple levels as well as facilitators of successful engagement

that must be promoted. Fortunately, we have evidence from implementation science theories, frameworks, models, and research findings to provide guidance for Roadmap implementation as well as rigorous evaluation of its impact on clinical and implementation outcomes [124,125].

For example, the practical, robust implementation and sustainability model for integrating evidence-based best practices into routine health care provides a framework that builds on evidence for diffusion of innovations, quality improvement, and chronic care, with a strong emphasis on the perspectives and characteristics of patients as well as those of health care providers and health systems [126]. Issues of Roadmap adoption and intervention acceptability and affordability at the local level are heavily influenced by patient-related factors including program reach, level of awareness, health literacy, and self-efficacy related to Roadmap implementation. At all levels including prevention, screening, diagnosis, treatment, and monitoring, effective communication is needed to address the major roadblocks such as lack of awareness of cardiovascular risks in type 2 diabetes mellitus and difficulties in lifestyle choices and behavior change [126]. Early active engagement of patients, their families and caregivers, patient advocacy groups, and civil societies is essential for successful Roadmap implementation.

The practical, robust implementation and sustainability model also highlights the crucial role that health care providers, health systems, and health professional organizations play in successful implementation [126]. Challenges of behavior change that are well recognized for patients are also relevant for providers, health systems, and organizations and must be addressed for successful Roadmap implementation. Behavior change at the organizational level and readiness to do so are complex and require early engagement of cardiovascular and type 2 diabetes mellitus thought-leaders and attention to attitudes and current efforts toward prevention, as well as commitment and capacity to implement change [127,128]. A unique opportunity for this Roadmap is to highlight the crucial role that CVD plays in type 2 diabetes mellitus and the potential lives saved from effective preventive strategies. The use of strategies such as audit and feedback as well as educational outreach visits for health providers can be instrumental for sustained guideline adherence and Roadmap implementation [129].

The important role of strategic partnership cannot be overemphasized. It will be essential to engage public and private sector partners, civil societies, patients and patient advocacy groups, governmental and nongovernmental organizations, and health professional organizations in advancing this effort. Additionally, the Achilles heel of Roadmap implementation is successful local adoption, adaptation, dissemination, and effective convening of key stakeholders to align on a plan of action. A unique resource to leverage is the WHF's practical toolkits for conducting situation analyses, policy dialogues, and sharing lessons learned in Roadmap implementation [130].

ADAPTING GLOBAL ROADMAPS TO NATIONAL CONTEXTS

Just as many barriers exist in terms of suboptimal diabetes care, a host of solutions have also been proposed and are being undertaken, including solutions targeting specific physician groups. It is unlikely that 1 approach will fit all physicians caring for diabetes, supporting the need for a delineation of options across a spectrum of intensity, cost, resource requirements, and specific physician groups. Importantly, such solutions are not mutually exclusive. Furthermore, the extent to which data exists as to which strategies may be the most effective, especially when it comes to measures targeting specific physician groups, is limited.

The purpose of this Roadmap is to offer a framework to plan, design, and implement change interventions based on a pathway of care for type 2 diabetes mellitus and CVD. Too often when presented with the burden of a disease, the growing numbers and predicted future, it is difficult to know where to begin, what to look at in terms of every day management, and with already overstretched resources how to address increasing numbers of diagnoses in the future. This framework will support national and local initiatives to 1) identify and bring together key decision makers; 2b) investigate the gap in care for those living with diabetes mellitus and CVD with possible use of a situational analysis, considering all perspectives; 3) prioritize specific barriers or gaps along the pathway of care for those living with diabetes mellitus and CVD; 4) consider the key action areas required following a best-practice approach; 5) develop and plan interventions using an implementation toolkit (Figure 8).

This Roadmap has adapted the notion of "precision medicine" to a new concept of "precision public health" that requires an integrated approach to care and that underlines key action areas across multiple care settings. Most importantly, this framework is context-specific.

Moving from a global Roadmap to a national call for action through to carefully planned interventions for implementation requires strong leadership and an integrated approach. This must involve ministries of health, education, labor, finance, transportation, and urban planning, as well as representation from patients, caregivers and civil societies, health care professionals and leaders, and industry. Bringing together key leaders and stakeholders for national Roundtable discussions to consider a diabetes and CVD agenda based on local needs is a first-line approach.

At a global level, WHF and IDF continue to support national and regional societies and Members to raise awareness of CVD and diabetes as a priority area. Global implementation is supported through a number of activities that facilitate and support national efforts to reduce the growing burden of CVD and type 2 diabetes mellitus, including 1) national Roundtable stakeholder discussions, 2) creation of national scorecards, 3) planning and research projects with a global network of researchers as part of the Emerging Leaders program, supporting toolkits for implementation, and 4) World Heart Day.

FINAL CONSIDERATIONS FOR THE FUTURE OF CVD AND DIABETES PATIENTS

This global effort brings together the IDF and WHF to look toward the future, not in terms of continued upward predictions but with determination and promise to work together to reduce the overwhelming burden caused by type 2 diabetes mellitus and CVD. This new chapter begins with planning for the future, while managing the present, considering new interventions that will increase awareness, improve diagnosis, and maximize adherence in treatment and management. It is an exciting time where health care professionals and health care systems now have therapies that do not only target hyperglycemia in those living with type 2 diabetes mellitus, but that can also reduce future risk of atherosclerotic CVD outcomes, and heart failure–related outcomes, as well as renal outcomes in those living with diabetes. As such, these therapies will only see their full impact if the gap between new knowledge and its implementation in routine clinical practice can be shortened. Creating the need for this change in how evidence is implemented in routine practice will require action from patients, clinicians, health care systems, health policy makers informed by evidence from implementation science, health promotion, and environmental engineering.

ACKNOWLEDGMENTS

The authors would like to thank all those who played a role in bringing this Roadmap to publication. There are a number of persons and institutions needing mention: Emory University, where the face-to-face expert writing group meeting took place; to the local experts who actively contributed to the meeting including Dr. Mehta Anurag, Dr. Devinder Dhindsa, Ty Kraniak, and Dr. Amy Scheel; and to Dr. Laura Gaita, diabetologist, who substantially contributed to the “Treatment and approaches to care” section. The authors also thank DiaTribe, who have engaged in numerous discussions about the role of patients and patient perspectives in this Roadmap.

The modified Delphi process involved 2 rounds of surveys sent to all WHF and IDF Members with responses of 161 and 66 responses, respectively. Information gathered was essential to the development of the Roadmap, and we thank all those who took the time to complete the survey and send their feedback. A number of Members were actively involved in providing feedback, and specifically the authors would like to thank the Fondation H tienne de Diab te et de Maladies Cardio-vasculaires, the Swaziland Ministry of Health, and the Japan Diabetes Society. The authors would also like to thank WHF through the development of this roadmap.

REFERENCES

1. Perel P, Avezum A, Huffman M, et al. Reducing premature cardiovascular morbidity and mortality in people with atherosclerotic vascular disease: the World Heart Federation Roadmap for secondary prevention of cardiovascular disease. *Glob Heart* 2015; 10:99–110.
2. Grainger Gasser A, Welch C, Arora M, et al. Reducing cardiovascular mortality through tobacco control: a World Heart Federation Roadmap. *Glob Heart* 2015;10:123–33.
3. Adler AJ, Prabhakaran D, Bovet P, et al. Reducing cardiovascular mortality through prevention and management of raised blood pressure: a World Heart Federation Roadmap. *Glob Heart* 2015;10: 111–22.
4. Palafox B, Mocumbi AO, Kumar RK, et al. The WHF Roadmap for reducing CV morbidity and mortality through prevention and control of RHD. *Glob Heart* 2017;12:47–62.
5. Murphy A, Banerjee A, Breithardt G, et al. A World Heart Federation Roadmap for nonvalvular atrial fibrillation. *Glob Heart* 2017;12: 273–84.
6. Murphy A, Faria-Neto JR, Al-Rasadi K, et al. A World Heart Federation Roadmap on cholesterol. *Glob Heart* 2017;12:179–97.
7. Kengne AP, Kruger HS, Schutte AE, Bentham J, Zhou B. Trends in obesity and diabetes across Africa from 1980 to 2014: an analysis of pooled population-based studies. *Int J Epidemiol* 2017;46:1421–32.
8. Manne-Goehler J, Atun R, Stokes A, et al. Diabetes diagnosis and care in sub-Saharan Africa: pooled analysis of individual data from 12 countries. *Lancet Diabetes Endocrinol* 2016;4:903–12.
9. IDF. IDF Diabetes Atlas. 8th edition. Brussels, Belgium: International Diabetes Federation, 2017. Available at: <https://www.idf.org/component/attachments/attachments.html?id=1405&task=download>. Accessed July 15, 2019.
10. Global Burden of Disease Study 2016. Global Burden of Disease Study 2016 (GBD 2016) Results. Seattle, WA: Institute for Health Metrics and Evaluation, University of Washington, 2016. Available at: <https://gbd2016.healthdata.org/gbd-search/>. Accessed April 2, 2019.
11. Ogurtsova K, da Rocha Fernandes JD, Huang Y, et al. IDF Diabetes Atlas: global estimates for the prevalence of diabetes for 2015 and 2040. *Diabetes Res Clin Pract* 2017;128:40–50.
12. Benjamin EJ, Muntner P, Alonso A, et al., for the American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. Heart Disease and Stroke Statistics—2019 Update: a report from the American Heart Association. *Circulation* 2019;139:e56–66.
13. Laakso M. Cardiovascular disease in type 2 diabetes from population to man to mechanisms: the Kelly West Award Lecture 2008. *Diabetes Care* 2010;33:442–9.
14. The Emerging Risk Factors Collaboration. Diabetes mellitus, fasting blood concentration, and risk of vascular disease: a collaborative meta-analysis of 102 prospective studies. *Lancet* 2010;375:2215–22 [Published correction appears in *Lancet* 2010;376:958].
15. IDF Diabetes Atlas Group. Update of mortality attributable to diabetes for the IDF Diabetes Atlas: estimates for the year 2013. *Diabetes Res Clin Pract* 2015;109:461–5.
16. Bommer C, Heesemann E, Sagalova V, et al. The global economic burden of diabetes in adults aged 20–79 years: a cost-of-illness study. *Lancet Diabetes Endocrinol* 2017;5:423–30.
17. Bommer C, Sagalova V, Heesemann E, et al. Global economic burden of diabetes in adults: projections from 2015 to 2030. *Diabetes Care* 2018;41:963–70.
18. Wang H, Naghavi M, Allen C, et al. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* 2016;388:1459–544.
19. Chawla A, Chawla R, Jaggi S. Microvascular and macrovascular complications in diabetes mellitus: distinct or continuum? *Indian J Endocrinol Metab* 2016;20:546–51.
20. Cosentino F, et al. ESC guidelines on diabetes, pre-diabetes and cardiovascular diseases developed in collaboration with EASD 2019. *Eur Heart J* 2019. In press.
21. Libby P, Plutzky J. Diabetic macrovascular disease: the glucose paradox? *Circulation* 2002;106:2760–3.
22. IDF. Taking Diabetes to Heart Survey Results; September 2018. Available at: Accessed June 15, 2019.

23. Newman JD, Schwartzbard AZ, Weintraub HS, Goldberg IJ, Berger JS. Primary prevention of cardiovascular disease in diabetes mellitus. *J Am Coll Cardiol* 2017;70:883–93.
24. American Diabetes Association. 10. Cardiovascular disease and risk management: Standards of Medical Care in Diabetes—2019. *Diabetes Care* 2019;42(Suppl 1):S103–23.
25. Fox CS, Golden SH, Anderson C, et al. Update on prevention of cardiovascular disease in adults with type 2 diabetes mellitus in light of recent evidence: a scientific statement from the American Heart Association and the American Diabetes Association. *Circulation* 2015;132:691–718.
26. Arnett DK, Blumenthal RS, Albert MA, et al. 2019 ACC/AHA guideline on the primary prevention of cardiovascular disease: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol* 2019 Mar 17 [E-pub ahead of print].
27. Organisation mondiale de la santé. Prevention of cardiovascular disease: guidelines for assessment and management of cardiovascular risk. Geneva, Switzerland: World Health Organization, 2007. Available at: https://www.who.int/cardiovascular_diseases/publications/Prevention_of_Cardiovascular_Disease/en/. Accessed May 25, 2019.
28. World Health Organization. Obesity and Overweight Fact Sheet []. Available at: http://www.who.int/dietphysicalactivity/media/en/gsf_s_obesity.pdf. Accessed June 15, 2019.
29. Echouffo-Tcheugui JB, Ali MK, Griffin SJ, Narayan KV. Screening for type 2 diabetes and dysglycemia. *Epidemiol Rev* 2011;33:63–87.
30. Ritsinger V, Tanoglidis E, Malmberg K, et al. Sustained prognostic implications of newly detected glucose abnormalities in patients with acute myocardial infarction: long-term follow-up of the GAMI cohort. *Diab Vasc Dis Res* 2015;12:23–32.
31. Shahim B, De Bacquer D, De Backer G, et al. The prognostic value of fasting plasma glucose, two-hour post load glucose and HbA1c in patients with coronary artery disease: a report from EUROASPIRE IV, a survey from the European Society of Cardiology. *Diabetes Care* 2017;40:1233–40.
32. George A, Bhatia RT, Buchanan GL, et al. Impaired glucose tolerance or newly diagnosed diabetes mellitus diagnosed during admission adversely affects prognosis after myocardial infarction: an observational study. *PLoS One* 2015;10:e0142045.
33. Alberti KG, Eckel RH, Grundy SM, et al. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. *Circulation* 2009;120:1640–5.
34. Rydén L, Shahim B, Standl E. On the prognostic value of post-load glucose in patients with coronary artery disease. *Eur Heart J* 2018;39:2746–8.
35. Ismail-Beigi F, Moghissi E, Kosiborod M, Inzucchi SE. Shifting paradigms in the medical management of type 2 diabetes: reflections on recent cardiovascular outcome trials. *J Gen Intern Med* 2017;32:1044–51.
36. DeFilippis AP, Larned JM, Cole JH, Nell-Dybdahl C, Miller JI 3rd, Sperling LS. Clues to cardiovascular risk: an office-based approach. *Prev Cardiol* 2007;10:36–41.
37. Das SR, Everett BM, Birtcher KK, et al. 2018 ACC expert consensus decision pathway on novel therapies for cardiovascular risk reduction in patients with type 2 diabetes and atherosclerotic cardiovascular disease: a report of the American College of Cardiology Task Force on Expert Consensus Decision Pathways. *J Am Coll Cardiol* 2018;72:3200–23.
38. de Jong M, van der Worp HB, van der Graaf Y, Visseren FL, Westerink J. Pioglitazone and the secondary prevention of cardiovascular disease: a meta-analysis of randomized-controlled trials. *Cardiovasc Diabetol* 2017;16:134.
39. Davies MJ, D'Alessio DA, Fradkin K, et al. Management of hyperglycemia in type 2 diabetes, 2018: a consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care* 2018;41:2669–701.
40. Gebreab SY, Diez Roux AV, Brenner AB, et al. The Impact of Life-course Socioeconomic Position on Cardiovascular Disease Events in African Americans: The Jackson Heart Study. *J Am Heart Assoc* 2015; 4:e001553.
41. Bhatnagar A. Environmental determinants of cardiovascular disease. *Circ Res* 2017;121:162–80.
42. Cesaroni G, Forastiere F, Stafoggia M, et al. Long term exposure to ambient air pollution and incidence of acute coronary events: prospective cohort study and meta-analysis in 11 European cohorts from the ESCAPE Project. *BMJ* 2014;348:f7412.
43. Wilker EH, Wu CD, McNeely E, et al. Green space and mortality following ischemic stroke. *Environ Res* 2014;133:42–8.
44. Chaix B, Bean K, Leal C, et al. Individual/neighborhood social factors and blood pressure in the RECORD cohort study: which risk factors explain the associations? *Hypertension* 2010;55:769–75.
45. Doekhie KD, Strating MM, Buljac-Samardzic M, van de Bovenkamp HM, Pauwe J. The different perspectives of patients, informal caregivers and professionals on patient involvement in primary care teams: a qualitative study. *Health Expect* 2018;21: 1171–82.
46. Frimpong JA, Myers CG, Sutcliffe KM, Lu-Myers Y. When health care providers look at problems from multiple perspectives, patients benefit. June 23, 2017. Harvard Business Review. Available at: <https://hbr.org/2017/06/when-health-care-providers-look-at-problems-from-multiple-perspectives-patients-benefit>. Accessed August 5, 2019.
47. Ouwens M, Wollersheim H, Hermens R, Hulscher M, Grol R. Integrated care programmes for chronically ill patients: a review of systematic reviews. *Int J Qual Health Care* 2005;17:141–6.
48. Goodwin N, Smith J, Davies A, et al. Integrated Care for Patients and Populations: Improving Outcomes by Working Together. London, UK: King's Fund; 2012.
49. Flanagan S, Damery S, Combes G. The effectiveness of integrated care interventions in improving patient quality of life (QoL) for patients with chronic conditions: an overview of the systematic review evidence. *Health Qual Life Outcomes* 2017;15:188.
50. Flynn M, Walsh M, Hegarty I, Shea BO, Rourke M. National Clinical Programme in Surgery GP Integrated Care ENT Education Programme. *Int J Integr Care* 2017;17:A180.
51. Kinnerley P, Stott N, Peters TJ, Harvey I. The patient-centredness of consultations and outcome in primary care. *Br J Gen Pract* 1999;49: 711–6.
52. Beaglehole R, Bonita R, Horton R, Adams O, McKee M. Public health in the new era: improving health through collective action. *Lancet* 2004;363:2084–6.
53. Rajan D. Situational Analysis of the Health Sector: Strategizing National Health in the 21st Century: A Handbook. Chapter 3. Available at: <https://apps.who.int/iris/bitstream/handle/10665/250221/9789241549745-chapter3-eng.pdf>. Accessed April 24, 2019.
54. Merz CN, Buse JB, Tuncer D, Twillman GB. Physician attitudes and practices and patient awareness of the cardiovascular complications of diabetes. *J Am Coll Cardiol* 2002;40:1877–81.
55. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care* 2011;34(Suppl 1):S62–9.
56. Silva-Matos C, Gomes A, Azevedo A, Damasceno A, Prista A, Lunet N. Diabetes in Mozambique: prevalence, management and healthcare challenges. *Diabetes Metab* 2011;37:237–44.
57. Huang Y, Cai X, Mai W, Li M, Hu Y. Association between prediabetes and risk of cardiovascular disease and all-cause mortality: systematic review and meta-analysis. *BMJ* 2016;355:i5953.
58. Perreault L, Boardman MK, Pak J. The association between type 2 diabetes and cardiovascular disease: the “For Your SweetHeart™” survey. *Adv Ther* 2019;36:746–55.
59. Fahs I, Khalife Z, Malaeb D, Iskandarani M, Salameh P. The prevalence and awareness of cardiovascular diseases risk factors among the Lebanese population: a prospective study comparing urban to rural populations. *Cardiol Res Pract* 2017;2017:3530902.

60. Buchholz EM, Gooding HC, de Ferranti SD. Awareness of cardiovascular risk factors in US young adults aged 18–39 years. *Am J Prev Med* 2018;54:e67–77.
61. Irazola V, Rubinstein A, Bazzano L, et al. Prevalence, awareness, treatment and control of diabetes and impaired fasting glucose in the Southern Cone of Latin America. *PLoS One* 2017;12:e0183953.
62. Casagrande SS, Menke A, Aviles-Santa L, et al. Factors associated with undiagnosed diabetes among adults with diabetes: results from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). *Diabetes Res Clin Pract* 2018;146:258–66.
63. Koniak-Griffin D, Brecht ML. Awareness of cardiovascular disease and preventive behaviors among overweight immigrant Latinas. *J Cardiovasc Nurs* 2015;30:447.
64. Wikstrom K, Lindstrom J, Tuomilehto J, et al. National diabetes prevention program (DEHKO): awareness and self-reported lifestyle changes in Finnish middle-aged population. *Public Health* 2015;129:210–7.
65. Méjean C, Droomers M, van der Schouw YT, et al. The contribution of diet and lifestyle to socioeconomic inequalities in cardiovascular morbidity and mortality. *Int J Cardiol* 2013;168:5190–5.
66. Lindstrom J, Uusitupa M, Tuomilehto J, Peltonen M. Following in the footsteps of the North Karelia Project: prevention of type 2 diabetes. *Glob Heart* 2016;11:223–8.
67. Balakumar P, Maung UK, Jagadeesh G. Prevalence and prevention of cardiovascular disease and diabetes mellitus. *Pharmacol Res* 2016;113:600–9.
68. Fuster V, Kelly BB, Vedanthan R. Promoting global cardiovascular health: moving forward. *Circulation* 2011;123:1671–8.
69. Gæde P, Lund-Andersen H, Parving HH, Pedersen O. Effect of a multifactorial intervention on mortality in type 2 diabetes. *N Engl J Med* 2008;358:580–91.
70. Younk LM, Lamos EM, Davis SN. Cardiovascular effects of anti-diabetes drugs. *Expert Opin Drug Saf* 2016;15:1239–57.
71. Brokaw SM, Carpenedo D, Campbell P, et al., for the Montana Cardiovascular Disease and Diabetes Prevention Workgroup. Effectiveness of an adapted Diabetes Prevention Program lifestyle intervention in older and younger adults. *J Am Geriatr Soc* 2015;63:1067–74.
72. Vadheim L, Patch K, Brokaw SM, et al. Telehealth delivery of the diabetes prevention program to rural communities. *Transl Behav Med* 2017;7:286–91.
73. Brokaw SM, Arave D, Emerson DN, et al., for the Montana Cardiovascular Disease and Diabetes Prevention Workgroup. Intensive lifestyle intervention goals can be achieved as effectively with large groups as with small groups. *Prim Care Diabetes* 2014;8:295–300.
74. Low Wang CC, Hess CN, Hiatt WR, Goldfine AB. Clinical update: cardiovascular disease in diabetes mellitus: atherosclerotic cardiovascular disease and heart failure in type 2 diabetes mellitus—mechanisms, management, and clinical considerations. *Circulation* 2016;133:2459–502.
75. Gyberg V, De Bacquer D, Kotseva K, et al., for the EUROASPIRE IV Investigators. Screening for dysglycaemia in patients with coronary artery disease as reflected by fasting glucose, oral glucose tolerance test and HbA1c: a report from EUROASPIRE IV, a survey from the European Society of Cardiology. *Eur Heart J* 2015;36:1171–7.
76. Chattopadhyay S, George A, John J, Sathyapalan T. Adjustment of the GRACE score by 2-hour post-load glucose improves prediction of long-term major adverse cardiac events in acute coronary syndrome in patients without known diabetes. *Eur Heart J* 2018;39:2740–5.
77. Ryan MA. Adherence to clinical practice guidelines. *Otolaryngol Head Neck Surg* 2017;157:548–50.
78. Gucciardi E, Espin S, Morganti A, Dorado L. Exploring interprofessional collaboration during the integration of diabetes teams into primary care. *BMC Fam Pract* 2016;17:12.
79. Schouten LM, Niessen LW, Van De Pas JW, Grol RP, Hulscher ME. Cost-effectiveness of a quality improvement collaborative focusing on patients with diabetes. *Med Care* 2010;48:884–91.
80. Rawaf S, Allen L, Dubois E, et al. Primary health care: closing the gap between public health and primary care through integration. 2018. Available at: <https://spiral.imperial.ac.uk/bitstream/10044/1/65203/2/WHO%20Integrating%20PH%20to%20PC%202024th%20October%202018.pdf>. Accessed July 3, 2019.
81. Kuluski K, Ho JW, Hans PK, Nelson ML. What are the facilitators and barriers to integrated health and social care in the community? Insights from care providers. *Int J Integr Care* 2017;17:A36.
82. Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. *Cochrane Database Syst Rev* 2013;(9):CD000197.
83. Donaldson MS, Corrigan JM, Kohn LT, editors. *To Err Is Human: Building a Safer Health System*. Washington, DC: National Academies Press; 2000.
84. Baxter S, Johnson M, Chambers D, Sutton A, Goyder E, Booth A. Understanding new models of integrated care in developed countries: a systematic review. *Health Serv Deliv Res* 2018;6:6–29.
85. Kaiser L, Bartz S, Neugebauer EA, Pietsch B, Pieper D. Interprofessional collaboration and patient-reported outcomes in inpatient care: protocol for a systematic review. *Syst Rev* 2018;7:126.
86. Busetto L, Lujckx K, Huizing A, Vrijhoef B. Implementation of integrated care for diabetes mellitus type 2 by two Dutch care groups: a case study. *BMC Fam Pract* 2015;16:105.
87. Mc Hugh S, O'Mullane M, Perry IJ, Bradley C. Barriers to, and facilitators in, introducing integrated diabetes care in Ireland: a qualitative study of views in general practice. *BMJ Open* 2013;3:e003217.
88. Ling T, Brereton L, Conklin A, Newbould J, Roland M. Barriers and facilitators to integrating care: experiences from the English Integrated Care Pilots. *Int J Integr Care* 2012;12:e129.
89. Szymanski BR, Bohnert KM, Zivin K, McCarthy JF. Integrated care: treatment initiation following positive depression screens. *J Gen Intern Med* 2013;28:346–52.
90. Keyserling TC, Samuel-Hodge CD, Ammerman AS, et al. A randomized trial of an intervention to improve self-care behaviors of African-American women with type 2 diabetes: impact on physical activity. *Diabetes Care* 2002;25:1576–83.
91. Ko GT, Li JK, Kan EC, Lo MK. Effects of a structured health education programme by a diabetic education nurse on cardiovascular risk factors in Chinese type 2 diabetic patients: a 1-year prospective randomized study. *Diabet Med* 2004;21:1274–9.
92. Elfein J. Number of active physicians in the U.S. 2019 by specialty area. Available at: <https://www.statista.com/statistics/209424/number-of-active-physicians-by-specialty-area/>. Accessed July 10, 2019.
93. Sattar N, Rawshani A, Franzén S, et al. Age at diagnosis of type 2 diabetes mellitus and associations with cardiovascular and mortality risks: findings from the Swedish National Diabetes Registry. *Circulation* 2019;139:2228–37.
94. Khodyakov D, Stockdale SE, Smith N, Booth M, Altman L, Rubenstein LV. Patient engagement in the process of planning and designing outpatient care improvements at the Veterans Administration Health-care System: findings from an online expert panel. *Health Expect* 2017;20:130–45.
95. World Health Organization. *European Observatory Policy Brief Series*. Copenhagen, Denmark: European Observatory on Health Systems and Policies; 2013.
96. White CJ. A call to arms ... legs, brains, and kidneys! *JACC Cardiovasc Interv* 2009;2:476–7.
97. ACC. *Expert Consensus Decision Pathways*. Available at: <https://www.acc.org/tools-and-practice-support/expert-consensus-decision-pathways>. Accessed July 4, 2019.
98. Omboni S, Caserini M. Effectiveness of pharmacist's intervention in the management of cardiovascular diseases. *Open Heart* 2018;5:e000687.
99. Fortuna RJ, Nagel AK, Rose E, et al. Effectiveness of a multidisciplinary intervention to improve hypertension control in an urban underserved practice. *J Am Soc Hypertens* 2015;9:966–74.
100. Gomes MB, Rathmann W, Charbonnel B, et al. Treatment of type 2 diabetes mellitus worldwide: baseline patient characteristics in the global DISCOVER study. *Diabetes Res Clin Pract* 2019;151:20–32.

101. Wong ND, Young D, Zhao Y, et al. Prevalence of the American College of Cardiology/American Heart Association statin eligibility groups, statin use, and low-density lipoprotein cholesterol control in US adults using the National Health and Nutrition Examination Survey 2011–2012. *J Clin Lipid* 2016;10:1109–18.
102. Emerging Risk Factors Collaboration, Sarwar N, Gao P, et al. Diabetes mellitus, fasting blood glucose concentration, and risk of vascular disease: a collaborative meta-analysis of 102 prospective studies. *Lancet* 2010;375:2215–22.
103. Piepoli MF, Hoes AW, Agewall S, et al. 2016 European Guidelines on cardiovascular disease prevention in clinical practice: the Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts). Developed with the special contribution of the European Association for Cardiovascular Prevention and Rehabilitation (EACPR). *Eur Heart J* 2016;37:2315–81.
104. Bracco MM, Mafra AC, Abdo AH, et al. Implementation of integration strategies between primary care units and a regional general hospital in Brazil to update and connect health care professionals: a quasi-experimental study protocol. *BMC Health Serv Res* 2016;16:380.
105. Vázquez ML, Vargas I, Unger JP, et al. Evaluating the effectiveness of care integration strategies in different healthcare systems in Latin America: the EQUITY-LA II quasi-experimental study protocol. *BMJ Open* 2015;5:e007037.
106. Auschra C. Barriers to the integration of care in inter-organisational settings: a literature review. *Int J Integr Care* 2018;18:5.
107. McDonald KM, Sundaram V, Bravata DM, et al. Closing the quality gap: a critical analysis of quality improvement strategies (Vol. 7: Care Coordination). *AHRQ Techn Rev* 2007;14. 07-0054.
108. Unverzagt S, Oemler M, Braun K, Klement A. Strategies for guideline implementation in primary care focusing on patients with cardiovascular disease: a systematic review. *Fam Pract* 2013;31:247–66.
109. Hiss RG, Armbruster BA, Gillard ML, McClure LA. Nurse care manager collaboration with community-based physicians providing diabetes care a randomized controlled trial. *Diabetes Educ* 2007;33:493–502.
110. American Diabetes Association. 1. Strategies for improving care. *Diabetes Care* 2016;39(Suppl 1):S6–12.
111. Hood KK, Hilliard M, Piatt G, Ievers-Landis CE. Effective strategies for encouraging behavior change in people with diabetes. *Diabetes Manag (Lond)* 2015;5:499–510.
112. McAndrew LM, Napolitano MA, Pogach LM, et al. The impact of self-monitoring of blood glucose on a behavioral weight loss intervention for patients with type 2 diabetes. *Diabetes Educ* 2013;39:397–405.
113. Renders CM, Valk GD, Griffin SJ, Wagner EH, Assendelft WJ. Interventions to improve the management of diabetes in primary care, outpatient, and community settings: a systematic review. *Diabetes Care* 2001;24:1821–33.
114. Rehman H, Kamal AK, Sayani S, Morris PB, Merchant AT, Virani SS. Using mobile health (mHealth) technology in the management of diabetes mellitus, physical inactivity, and smoking. *Curr Atheroscler Rep* 2017;19:16.
115. Rehman H, Kamal AK, Morris PB, Sayani S, Merchant AT, Virani SS. Mobile health (mHealth) technology for the management of hypertension and hyperlipidemia: slow start but loads of potential. *Curr Atheroscler Rep* 2017;19:12.
116. Hill J, Nielsen M, Fox MH. Understanding the social factors that contribute to diabetes: a means to informing health care and social policies for the chronically ill. *Perm J* 2013;17:67–72.
117. Breland JY, McAndrew LM, Gross RL, Leventhal H, Horowitz CR. Challenges to healthy eating for people with diabetes in a low-income, minority neighborhood. *Diabetes Care* 2013;36:2895–901.
118. Dadvand P, Bartoll X, Basagaña X, et al. Green spaces and general health: roles of mental health status, social support, and physical activity. *Environ Int* 2016;91:161–7.
119. Markevych I, Thiering E, Fuertes E, et al. A cross-sectional analysis of the effects of residential greenness on blood pressure in 10-year old children: results from the GINIplus and LISAplus studies. *BMC Public Health* 2014;14:477.
120. Alderete TL, Habre R, Toledo-Corral CM, et al. Longitudinal associations between ambient air pollution with insulin sensitivity, β -cell function, and adiposity in Los Angeles Latino children. *Diabetes* 2017;66:1789–96.
121. Ahluwalia IJ. Environment urban governance in India. *J Urban Aff* 2019;41:83–102.
122. WHO. European and Health Process: Urban Green Space Interventions and Health: A Review of Impacts and Effectiveness. Available at: <https://www.cbd.int/health/who-euro-green-spaces-urbanhealth.pdf>. Accessed July 13, 2019.
123. He M, Tucker P, Gilliland J, Irwin JD, Larsen K, Hess P. The influence of local food environments on adolescents' food purchasing behaviors. *Int J Environ Res Public Health* 2012;9:1458–71.
124. Smith JD, Polaha J. Using implementation science to guide the integration of evidence-based family interventions into primary care. *Fam Syst Health* 2017;35:125–35.
125. Tabak RG, Khoon EC, Chambers DA, Brownson RC. Bridging research and practice: models for dissemination and implementation research. *Am J Prev Med* 2012;43:337–50.
126. Feldstein AC, Glasgow RE. A practical, robust implementation and sustainability model (PRISM) for integrating research findings into practice. *Jt Comm J Qual Patient Saf* 2008;34:228–43.
127. Weiner BJ. A theory of organizational readiness for change. *Implement Sci* 2009;4:67.
128. Castaneda SF, Holscher J, Mumman MK, et al. Dimensions of community and organizational readiness for change. *Prog Community Health Partnersh* 2012;6:219–26.
129. Chan WV, Pearson TA, Bennett GC, et al. ACC/AHA special report: clinical practice guideline implementation strategies: a summary of systematic reviews by the NHLBI Implementation Science Work Group: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol* 2017;69:1076–92.
130. Perel P, Bianco E, Poulter N, et al. Adapting the World Heart Federation Roadmaps at the national level: next steps and conclusions. *Glob Heart* 2015;10:135–6.

ABOUT THE WHF

WHF is the only CVD nongovernmental organization in official relations with the World Health Organization and is a member of the NCD Alliance.

WHF works at the international and national levels through our own activities and those of our 200-plus Members. Together, we are working to end needless deaths from exposure to tobacco and other risk factors, lack of access to treatment, and neglected conditions such as rheumatic heart disease, which kills hundreds of thousands of children each year.

Across 100 countries, we are acting now to build global commitment to address cardiovascular health at the policy level, generate and exchange ideas, share best practices, advance scientific knowledge, and promote knowledge transfer to tackle CVD. We are at the heart of driving the CVD agenda and advocating for better heart health, enabling people to live longer, better, and more heart-healthy lives, whoever and wherever they are.