Published in connection with

cities changing diabetes | summit 2017

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- University of Copenhagen
- Danish Diabetes Association
- Steno Diabetes Center Copenhagen

Houston, USA
- American Diabetes Association, Houston
- Asian American Health Coalition
- City of Houston Human Resources Department
- Clinton Health Matters Initiative
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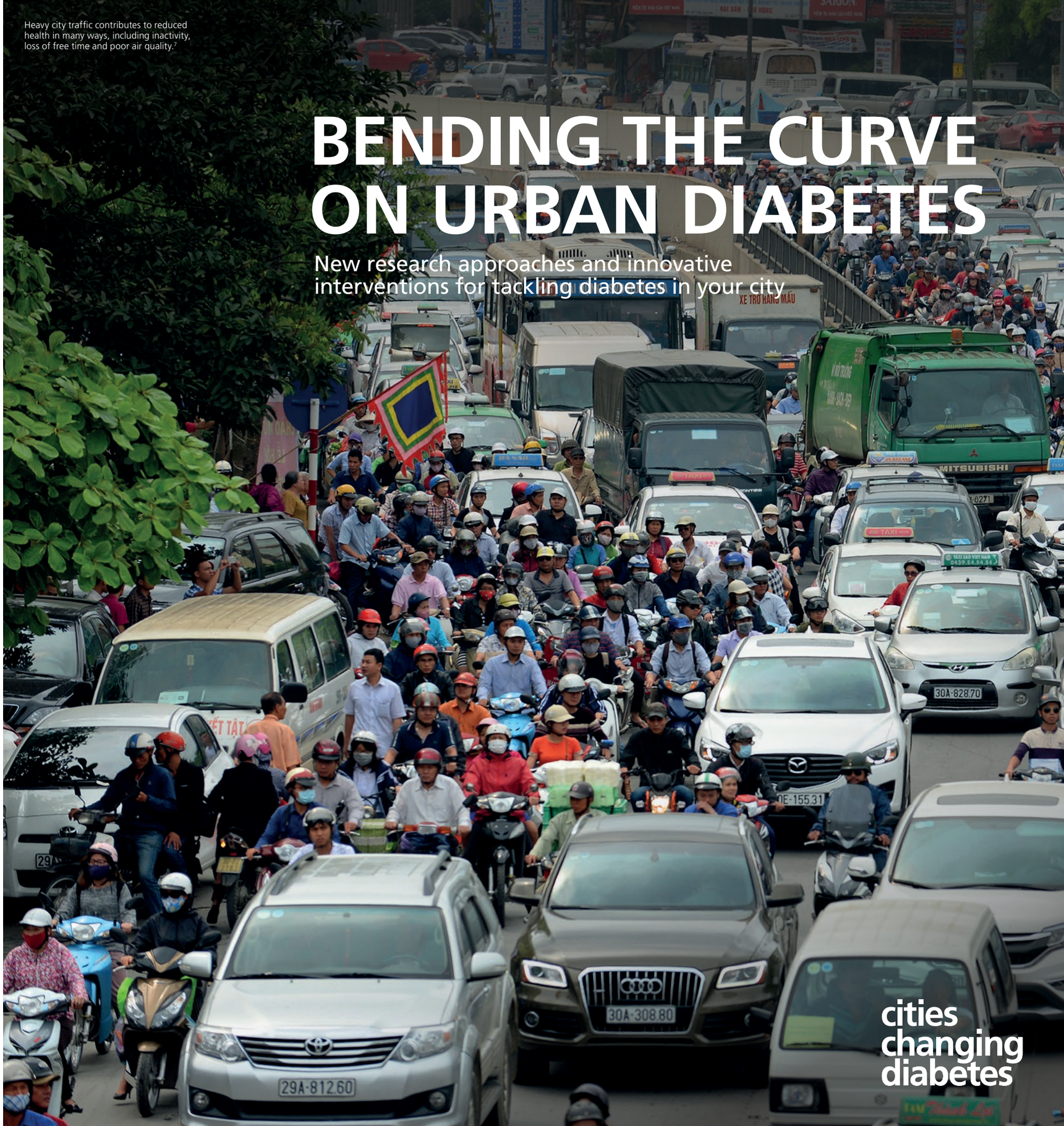

Heavy city traffic contributes to reduced health in many ways, including inactivity, loss of free time and poor air quality.[7]

BENDING THE CURVE ON URBAN DIABETES

New research approaches and innovative interventions for tackling diabetes in your city

cities changing diabetes

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FOREWORD

The world is rapidly urbanising, changing not just where we live, but the way we live. Today, the way cities are designed, built and run risks fuelling the health challenges of their citizens.

Following calls from many leading stakeholders, health formed a growing part of the discussion on the future of urban development at the United Nations Habitat III Conference in 2016. But there is unfinished business. Described by the World Health Organization as a "new urban epidemic", the risks for non-communicable diseases (NCDs) are exacerbated in cities. NCDs already shorten millions of people's lives, cost national health systems billions of dollars and undermine economic growth. We must focus on slowing their prevalence in cities.

Urban environments are already home to two-thirds of people with diabetes. This makes cities the front line in the fight against diabetes – and where we must take action to hold back the alarming rise of the condition.

We launched Cities Changing Diabetes in 2014 with the conviction that the rise of diabetes is not inevitable. Our aim is clear: to accelerate the global fight against urban diabetes. Working with eight cities, we have established new approaches to map the challenge, understand the areas of greatest risk and vulnerability and design interventions that can begin to deliver real impact. Our research confirms that we must address the sociocultural factors that heighten diabetes vulnerability among certain people living in cities. That means taking action beyond the health system and building health into the DNA of cities.

To hope to push back the disease, we need to focus on the most significant modifiable drivers of the condition. That puts the spotlight on the single biggest of these: obesity. We have modelled what it will take to hold the rise of diabetes prevalence at 10.0% globally, and what this model shows is that we must set ourselves a target of reducing obesity by 25.0% globally by 2045.

The nature and scale of the challenge require that we work together across sectors and disciplines. Cities Changing Diabetes has demonstrated the power of new forms of public–private partnership, bringing together a wide range of stakeholders behind a common cause.

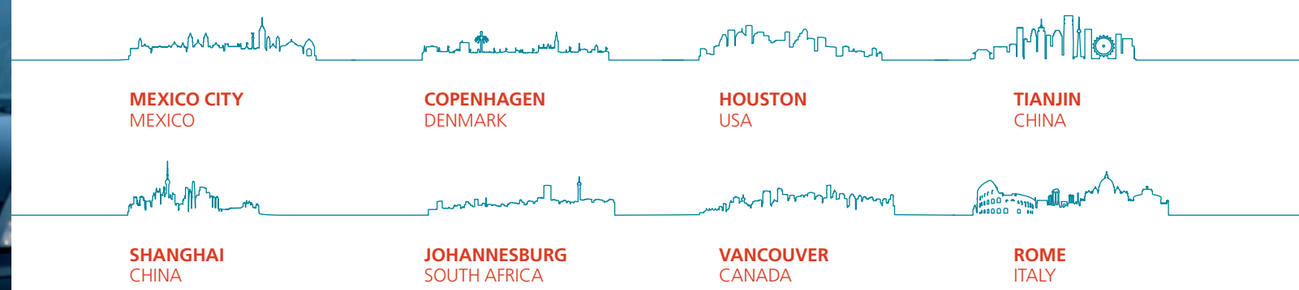
The methods and tools we have collectively forged are brought together in the Urban Diabetes Toolbox. We are sharing the toolbox so that city and health leaders in any city can set goals and establish an action plan for what it will take to respond to this public health emergency.

So now we call on every city to ask itself: **what will it take to bend the curve on diabetes in our city?**

LARS FRUERGAARD JØRGENSEN
President and chief executive officer, Novo Nordisk

PROF ALLAN FLYVBJERG
Chief executive officer, Steno Diabetes Center Copenhagen

PROF DAVID NAPIER
Director, Science, Medicine and Society Network, University College London



BENDING THE CURVE ON DIABETES

For too long, the growing burden of diabetes has continued along a steady upward trajectory, but this can and must be changed.

Diabetes is rising at an alarming rate. The global prevalence of diabetes has almost doubled in the past 16 years – from 4.6% in 2000[1] to 9.1% in 2017[2]. If we do nothing, the prevalence of diabetes is projected to continue rising to 11.7% – an astounding 736 million people – by 2045.[2] Given the devastating human and economic cost that diabetes and its complications have on individuals, their families, communities and society, this growth is simply unsustainable.[3]

Established drivers of the rising trajectory include a growing ageing population and global trends such as urbanisation, unhealthy diet and reduced physical activity.[4] Although factors such as an ageing population are non-modifiable, it is vital that we do not treat the scale of the rise as inevitable. In order to bend the curve on diabetes, we must commit ourselves to addressing the most significant modifiable cause – obesity.

The **Diabetes Projection Model** plots the trajectory of diabetes prevalence over time and illustrates how reducing the prevalence of obesity would reduce the burden of diabetes (Figure 1). Two global scenarios illustrate that inaction is not an option and what it will take to hold back the rise.

SCENARIO 1: WHAT WOULD BE THE CONSEQUENCE OF INACTION?[2]

Today, 9.1% and 14.0% of adults aged 20–79 have diabetes and obesity respectively. If we do nothing, the global diabetes prevalence will continue to rise, reaching 11.7% in 2045. Inaction would result in:

- **1.4 billion adults** (22.4% of adults) living with obesity
- **736 million adults living with diabetes** – a staggering 300 million more people with diabetes than today
- **1,076 billion US dollars** in global annual diabetes-related health expenditure by 2045.

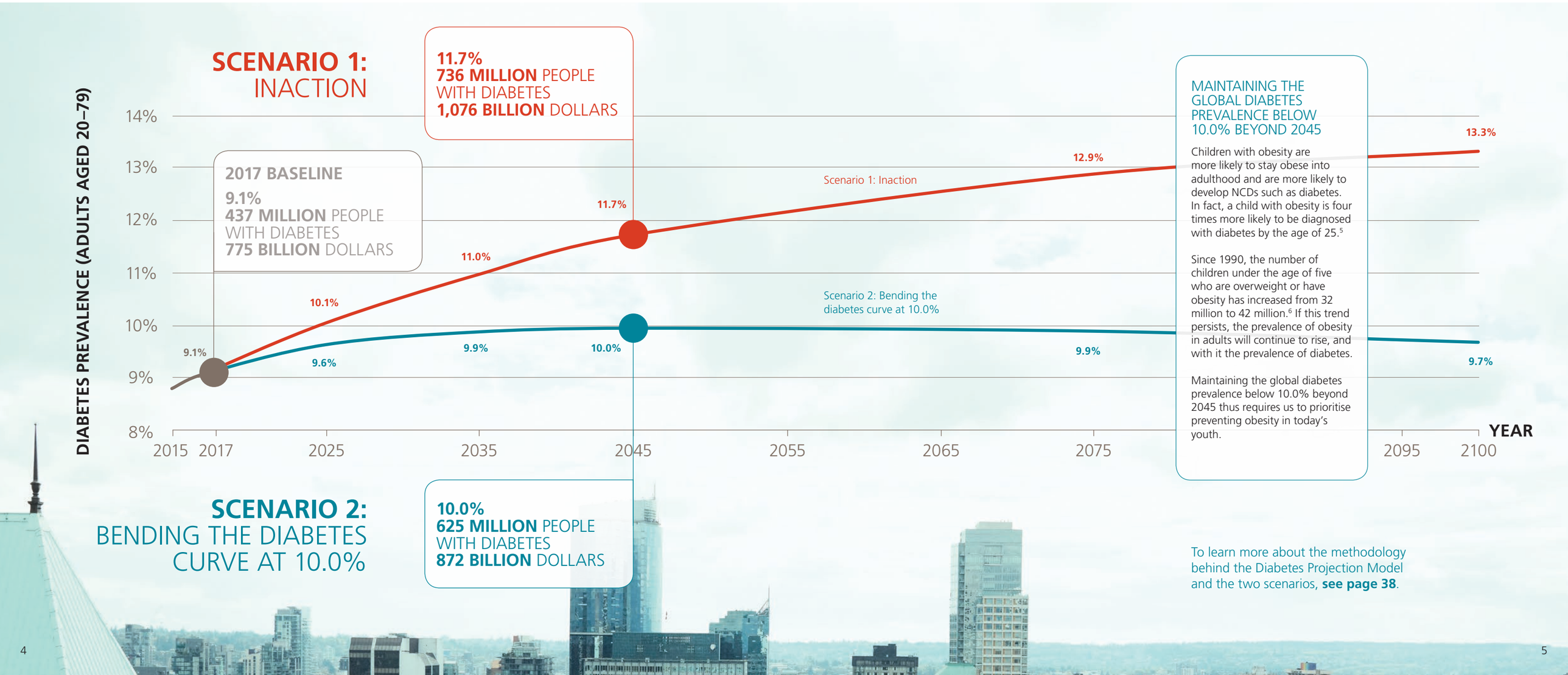
SCENARIO 2: BENDING THE GLOBAL DIABETES CURVE AT 10.0%.[2]

Bending the curve on the global diabetes prevalence at 10.0% would require the global prevalence of obesity to be reduced by 25.0% by 2045 compared with 2017 levels. Compared to a scenario of inaction, this would result in:

- **111 million fewer cases of diabetes globally** in 2045
- **204 billion dollars** saved in global diabetes-related health expenditure in 2045.

Holding diabetes prevalence at or below 10.0% globally would be a significant achievement, impacting the health and well-being of more than 100 million people and relieving pressure on already overburdened healthcare systems.

FIGURE 1: PROJECTED DIABETES PREVALENCE SCENARIOS (2017–2100)



MAINTAINING THE GLOBAL DIABETES PREVALENCE BELOW 10.0% BEYOND 2045

Children with obesity are more likely to stay obese into adulthood and are more likely to develop NCDs such as diabetes. In fact, a child with obesity is four times more likely to be diagnosed with diabetes by the age of 25.[5]

Since 1990, the number of children under the age of five who are overweight or have obesity has increased from 32 million to 42 million.[6] If this trend persists, the prevalence of obesity in adults will continue to rise, and with it the prevalence of diabetes.

Maintaining the global diabetes prevalence below 10.0% beyond 2045 thus requires us to prioritise preventing obesity in today's youth.

To learn more about the methodology behind the Diabetes Projection Model and the two scenarios, **see page 38**.

Shanghai, China

"If we are to have any hope of bending the trajectory of the potentially catastrophic rise in diabetes, we have to work together to grapple with the factors that put people at risk in the first place – and cities are the front line for doing so. That's why we're calling on every city to set a goal for what it'll take to bend the curve on the disease in their city."

LARS FRUERGAARD JØRGENSEN, PRESIDENT AND CHIEF EXECUTIVE OFFICER, NOVO NORDISK

"Decisions related to urban planning, finance and governance can create or exacerbate major health risks – or they can foster healthier environments and lifestyles that in turn reduce the risks of both communicable and non-communicable diseases."

EXTRACT FROM 'HEALTH AS THE PULSE OF THE NEW URBAN AGENDA: UNITED NATIONS CONFERENCE ON HOUSING AND SUSTAINABLE URBAN DEVELOPMENT', 2016[7]

OUR CALL TO CITIES

WE ARE CALLING ON EVERY CITY TO ASK ITSELF: "WHAT WILL IT TAKE TO BEND THE RISE OF DIABETES IN OUR CITY?"

There is a lot at stake. The diabetes pandemic is already shortening the lives of millions of people and creating an unsustainable burden for individuals and society.

As more cities recognise the urgency of the challenge of urban diabetes and take action to push it back, together we can play our part in bending the curve on diabetes globally.

That is why we are putting the call out to all mayors, health ministers, city planners and the many others who are shaping cities to accelerate action against diabetes, to:

1. **Define a city goal** to help everyone working on the challenge of diabetes in your city see what it will take to bend the curve on diabetes.
2. **Create an action plan** by mapping the challenge, understanding the areas of greatest risk and vulnerability, and designing interventions that work in your city context.
3. **Establish new and innovative partnerships** to work together with the leading actors in urban management and health, and community groups which have the power to tackle urban diabetes in your city, and to bring together the public and private sectors.
4. **Build health into every aspect of urban strategy** so that health is not left behind as cities act on the related challenges of transport, housing, food, climate change and inequality – and so that mutual benefits can be realised.
5. **Contribute your learning to the global effort** so that more cities around the world can optimise the health of urban citizens, and can join the fight against urban diabetes.

THE URBAN DIABETES CHALLENGE

Cities concentrate opportunities, jobs and services, but they also concentrate risks and hazards that can promote the development of diabetes.

Today, more than half the world's population (3.9 billion people) are city dwellers, and it is projected that almost 6.3 billion people will live in urban areas by 2050.[8] Consequently, urban areas will absorb practically all of the world's population growth by the middle of this century.

For both rich and poor in developed and developing countries, cities offer unique opportunities for citizens to increase their income and benefit from education as well as health and social services. Despite these opportunities and benefits, cities can also negatively impact the health of their citizens by exacerbating the very factors that lead to NCDs such as diabetes.[9]

Worldwide, the number of people with diabetes has dramatically increased over the past 15 years. In 2000, the International Diabetes Federation (IDF) estimated that there were 151 million people with diabetes.[1] As of 2015, IDF puts this number at 415 million, of which almost two-thirds live in urban environments.[4]

WHAT IS BEHIND THE RISE OF DIABETES?

The rise of diabetes is driven by an increase in type 2 diabetes, which accounts for up to 91.0% of all cases.[4] It generally occurs in middle-aged and older people, but the age of diagnosis is decreasing, and it is becoming increasingly common in children, adolescents and young adults.[4]

Although there are several well-defined biological and behavioural risk factors for type 2 diabetes, the most significant is excess body weight.[3] In 2014, the most recent year for which global estimates are available, approximately one in three adults over the age of 18 were overweight and more than one in 10 had obesity.[10] Overweight and obesity account for 44.0% of the total diabetes burden.[11] The growing prevalence of overweight and obesity plays a significant role in driving the rising prevalence of diabetes.[3]

Economic development and its associated mechanisation, urbanisation and the way cities are organised, have altered how we live our lives. Changes in the type of work we do and the way we work, along with changes in the way we produce, process and consume our food, have led to a surge in the common risk factors for both obesity and type 2 diabetes.[12] As environments become more urbanised, so they become more 'obesogenic' too, promoting the consumption of more energy-dense foods and leading to lower levels of physical activity.[12]

Economic development has also driven demographic and epidemiological transitions whereby reduced mortality rates, particularly in infants and children, along with reduced fertility rates, have resulted in an ageing population.[13] Ageing of the population will, in itself, increase the prevalence of type 2 diabetes and other age-related diseases.[4]

Why are some people more vulnerable to diabetes?
The best way to contain the impact of diabetes is to manage its risk factors and prevent it from occurring altogether. However, while biomedical approaches to treating diabetes have contributed to vast reductions in mortality and morbidity worldwide, the continuing rise in the prevalence of both obesity and diabetes indicates a need to look at the drivers that underlie these conditions.

Only by getting to grips with what makes some people more vulnerable to diabetes can we begin to effectively solve the challenge of diabetes. Sociocultural factors, which describe the social, economic and cultural context of people's lives, are known to impact people's vulnerability to diabetes.[14] Understanding these allows us to act on the negative influence of sociocultural factors as well as harness their positive influence in order to build resilience.

In 2014, Cities Changing Diabetes established a global research programme to drive pioneering research into the sociocultural causes of type 2 diabetes in urban environments. The research, led by University College London, was conducted using a specially adapted Vulnerability Assessment,[15] which was originally developed by University College London in collaboration with the United Nations.

Over the course of one year, research was conducted by a total of 75 specially trained local field workers in five major cities* across three continents. All in all, 746 individual interviews were carried out, transcribed and analysed to identify the sociocultural factors behind urban diabetes.[16]

The study confirmed that diabetes vulnerability in cities is linked to a complex mix of sociocultural factors responsible for both putting certain groups of people at greater initial risk for type 2 diabetes and for making them less likely to be diagnosed, receive treatment and maintain good health.[16]

A total of eight locally expressed, but universally applicable, themes were identified that together influence an individual's vulnerability to urban diabetes (Infobox 1).[16]

CITIES ARE THE FRONT LINE FOR ACTION

With compelling evidence linking the quality of urban environments with lifestyle and behavioural factors,[3,4,7,9,17] cities are the front line for tackling diabetes.

Those who design, plan, build and govern cities exercise great influence over the basic ingredients of a healthy life. Cities are able to offer health-enabling environments and coordinated support for healthy lifestyles and, in so doing, ensure that their citizens are not only healthier and happier, but more economically productive, resulting in far lower costs to both families and society. Prioritising health as a central component of urban development and governance makes sense and is key to ensuring sustainable development for all.

Cities that place health at the forefront – by integrating health into urban planning, investments and policy decisions – can bend the curve on diabetes and reap significant opportunities for improving the overall health, well-being and economic productivity of their citizens.[7]

Integrating health into all aspects of city-level policy, including urban planning, can mitigate the influence of sociocultural factors and promote resilience.

* Copenhagen, Houston, Mexico City, Tianjin and Shanghai.

INFOBOX 1: SOCIOCULTURAL FACTORS OF URBAN DIABETES[16]

SOCIAL FACTORS

- **Financial constraints:** Limited financial resources may become a barrier to accessing health-promoting resources, such as paying for healthy food, healthcare, health insurance and exercise. Financial constraints can also lead to stress and despondency.
- **Time constraints:** Time-consuming family and work obligations and long commutes may become barriers to leading a healthy lifestyle, which includes seeking healthcare, exercising and sourcing healthy food. Time constraints can also lead to stress and social isolation.
- **Resource constraints:** Low level of education, poor knowledge of existing health resources, and scarcity of healthcare provision, medicine, healthy foods and exercise opportunities may be barriers to health-enhancing decision-making and self-care.
- **Geographical constraints:** Unfavourable climate, pollution, high crime levels and/or lack of infrastructure (eg basic roads or access to water) may become barriers to health-promoting activities such as walking and outdoor exercise. They may also lead to isolation and loneliness.

CULTURAL FACTORS

- **Traditions and conventions:** Traditions and conventions have direct consequences on health and well-being. Traditional gender roles, unhealthy food traditions and use of healthcare only in emergency situations may become barriers to effective self-care, healthy eating and optimal healthcare.
- **Perceptions of health and illness:** The way health and illness are understood shapes the perception of health and well-being. Perception of diabetes as less serious than other social and health issues, misconception of own health and disease, mistrust of healthcare providers and feeling of stigma may be barriers to optimal care-seeking behaviour and lifestyle modification.
- **Self and others:** A person's understanding of self in relation to others contributes to health and well-being. Environments, where large body size is accepted as normal, may create a scenario where slimming is perceived as unnecessary. In contrast, when normal body size is favourable, obesity may become a barrier to, for instance, going to the gym.
- **Change and transition:** Experiencing change and transition may have physical and psychological consequences. Living in rapidly growing cities or neighbourhoods that undergo constant changes and migrating from rural to urban settings are often worrying and stressful, and may become barriers to optimal health outcomes. The memory of hunger and resource shortage, in particular, can create an obesogenic environment.

THE URBAN DIABETES TOOLBOX

Since Cities Changing Diabetes was launched, we have been carrying out research and piloting actions to fight diabetes. This journey and the individual city approaches have been documented to inform a toolbox that any city can use to address the growing diabetes challenge.

The Urban Diabetes Toolbox enables city and health leaders around the world to create their own action plan for tackling diabetes in their city. It provides new ways to map the challenge, understand the areas of greatest risk and vulnerability, and design interventions to halt the rise of diabetes.

The Toolbox has been developed through the Cities Changing Diabetes partnership, built on the experience of eight cities around the world. The stories of their research and actions are a resource for any city to draw on. Over time, the Toolbox will collect the experiences of more cities, offering encouragement and inspiration to everyone joining the fight against urban diabetes.

The Toolbox and manuals for implementation are available at citieschangingdiabetes.com.

INFOBOX 2: FOUR ACTION ARENAS FOR ENGAGEMENT

HEALTH-PROMOTING POLICY entails increasing awareness and understanding of urban diabetes, and getting these insights incorporated into local policy. Insights gained from the Cities Changing Diabetes research provide the opportunity to develop concrete and evidence-based solutions to address the urban obesity and diabetes challenge and improve overall health.

COMMUNITY INVOLVEMENT IN HEALTH strives to strengthen communities around vulnerable citizens who have diabetes or increased risk of developing diabetes, so that they can build resilience and improve their quality of life, diabetes care and treatment outcomes.

URBAN PLANNING focuses on obesity and diabetes prevention by showing the importance of health-promoting aspects, such as walkability and bikeability in urban planning. Research shows that the built environment in cities plays a key role in the ability to live a healthy life, for example, access to green spaces and facilities for physical activity.[7]

HEALTH SYSTEM STRENGTHENING engages stakeholders at all levels to build capacity into the local healthcare system. Cities Changing Diabetes research shows that vulnerable citizens sometimes struggle to access a city's formal health systems or get the support they need to live a healthy life with diabetes.[16] This can happen despite living in relative proximity to healthcare facilities.

SETTING THE GOAL

Diabetes Projection Model enables cities to set a goal
The Diabetes Projection Model is a tool that plots the trajectory of diabetes in any city over time. It allows cities to forecast the impact that reducing obesity could have on both the prevalence and cost of diabetes. Using the model, it is possible to understand the scale of the challenge and set a goal for what it will take to bend the curve in their city.

MAPPING THE CHALLENGE

Risk Monitor quantifies the population at risk for diabetes
The Risk Monitor is a framework for quantifying and visualising the populations at highest risk of developing diabetes. By quantifying the number of people at highest risk of developing type 2 diabetes, cities can prioritise where action needs to be taken to push back the condition.

Rule of Halves highlights gaps in diabetes care
The Rule of Halves analysis is a framework that shows where gaps need to be closed to ensure that everyone with diabetes is diagnosed, everyone diagnosed gets treated and everyone treated has better health outcomes. In the treatment of diabetes, this is critical in order to avoid complications, improve quality of life and reduce treatment costs for the health system.

UNDERSTANDING RISK AND VULNERABILITY

Diabetes Vulnerability Assessment identifies sociocultural factors to be addressed
The Diabetes Vulnerability Assessment is a research tool for identifying city-level factors that make certain groups of people vulnerable or, conversely, resilient to diabetes and its complications. The Diabetes Vulnerability Assessment is an innovative approach for establishing a local evidence base with a special focus on the sociocultural factors that impact the health and well-being of citizens.

Urban Diabetes Risk Assessment engages citizens to prioritise vulnerabilities and co-create interventions
The Urban Diabetes Risk Assessment builds on the findings of the Diabetes Vulnerability Assessments conducted in 2015. It generates valuable information about population sub-groups and their specific needs, priorities and barriers to care and health. It allows for the design of tailored city-level interventions and policies that are more effective in preventing and managing diabetes than those targeted at general populations. The approach facilitates city leaders to engage citizens around their experiences of vulnerability and shape interventions according to what will be most relevant locally.

Read more about the Urban Diabetes Risk Assessment on page 36.

DESIGNING INTERVENTIONS

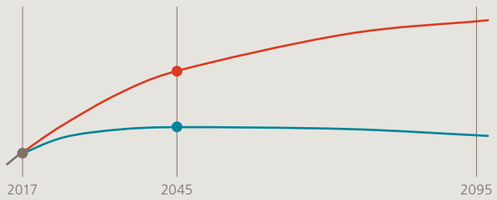
Collaborative working supports cities to act in partnership to deliver interventions
The collaborative working approach brings together people across sectors and disciplines who have the power to tackle urban diabetes in their city: leaders in urban planning and management, health policy and practice, and community groups. It is an opportunity to establish the new public–private partnerships needed to design interventions that really work. At a global level, Cities Changing Diabetes has established three new global networks to support knowledge sharing and cross-collaboration within Peer support, Community action research and Urban planning for partners engaged in the programme.

Learn more about the global networks at citieschangingdiabetes.com.

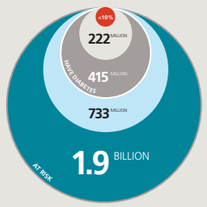
Four Action Arenas draw on real-world examples to provide a set of cases for building city-level action plans
The Action Arenas are a set of live examples of what has been found to be effective in cities around the world in four main areas: health-promoting policy; urban planning; community involvement in health; and health system strengthening (Infobox 2). Examples of how cities, including Cities Changing Diabetes cities, have developed initiatives across these Action Arenas are made available to inspire other cities. The learnings from these actions can then be applied by any city to build an urban diabetes action plan that is relevant to the local context and diabetes goals.

FIGURE 2: THE URBAN DIABETES TOOLBOX

Diabetes Projection Model
enables cities to set a goal.



Risk Monitor
quantifies the population at risk of diabetes.



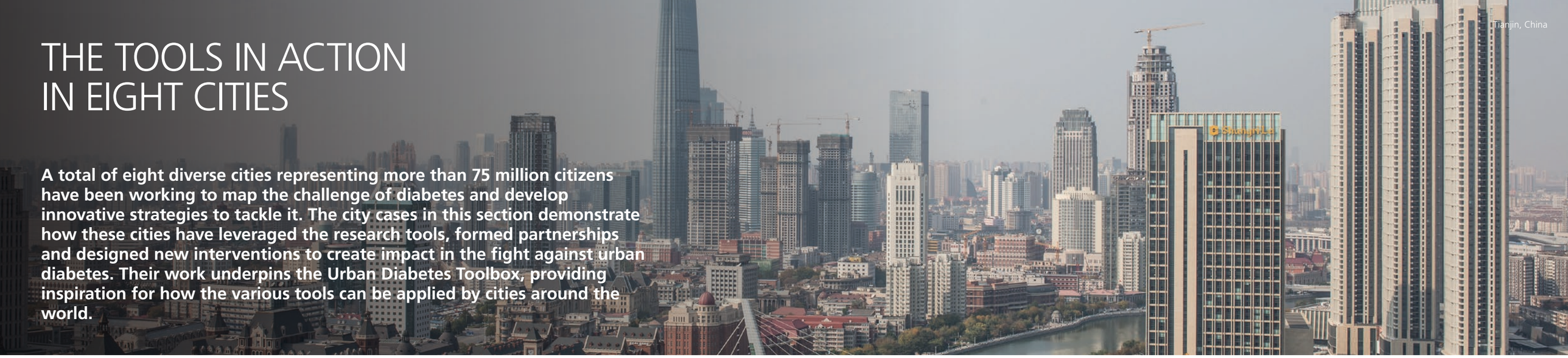
Rule of Halves
highlights gaps in diabetes care.

Diabetes Vulnerability Assessment
identifies sociocultural factors to be addressed.

Urban Diabetes Risk Assessment
engages citizens to prioritise vulnerabilities and co-create interventions.

Action Arenas
provide a set of inspirational cases for building city-level action plans.

THE TOOLS IN ACTION IN EIGHT CITIES


Tianjin, China

A total of eight diverse cities representing more than 75 million citizens have been working to map the challenge of diabetes and develop innovative strategies to tackle it. The city cases in this section demonstrate how these cities have leveraged the research tools, formed partnerships and designed new interventions to create impact in the fight against urban diabetes. Their work underpins the Urban Diabetes Toolbox, providing inspiration for how the various tools can be applied by cities around the world.

MEXICO CITY
MEXICO

In Mexico City, the local partnership established a specialised diabetes clinic in a particularly underserved area of the city and expanded an existing maternal health programme to reach individuals who are either at risk for or who have diabetes. These efforts seek to improve the quality of care by tackling the vulnerabilities identified in the research, focusing efforts on health-promoting policy and health system strengthening.

Read the full case on page 14

COPENHAGEN
DENMARK

In Copenhagen, programme research informed the adoption of a city action plan for type 2 diabetes that sets out policy responses to address inequalities in diabetes management. The plan has led to the establishment of a specialised diabetes centre, a community-based mentor programme and a community action research initiative focused on the most vulnerable populations.

Read the full case on page 16

HOUSTON
USA

The programme research in Houston identified the need to improve community involvement and engage local citizens in positive health behaviours. As a result, the Cities Changing Diabetes partnership launched the Faith and Diabetes Initiative, which uses the reach and influence of faith-based organisations to reach the most vulnerable people. These organisations deliver support and education to drive prevention, detection and management of diabetes.

Read the full case on page 18

TIANJIN
CHINA

In Tianjin, research established that cultural belief, along with barriers to accessing the health system, significantly impact people's ability to manage their condition. A train-the-trainer approach was established to build diabetes capacity and specialist skills among a group of primary healthcare providers, enabling them to reach more people earlier in the course of the condition. These 'Chief GPs of Diabetes' are part of an effort by the partners to support the city government in strengthening the city health system.

Read the full case on page 20

SHANGHAI
CHINA

Cities Changing Diabetes research in Shanghai revealed a high prevalence of diabetes and indicated that one-third of people with diabetes are undiagnosed. Therefore, the programme is supporting a three-year diabetes intervention programme, which is focused on strengthening the city's health system for diabetes care.

Read the full case on page 22

JOHANNESBURG
SOUTH AFRICA

Johannesburg used experienced, retired nurses to conduct research on the burden of diabetes as well as its comorbidities, such as obesity, high blood pressure and dyslipidaemia, in the public health sector. This research will be used to inform health-promoting policies and a range of on-the-ground actions.

Read the full case on page 24

VANCOUVER
CANADA

In Vancouver, the programme is leveraging findings from other Cities Changing Diabetes cities, and Vancouver is the first city to pilot research with the Urban Diabetes Risk Assessment. The research will explore how residents of Vancouver prioritise the impact of sociocultural factors in their lives.

Read the full case on page 26

ROME
ITALY

Rome conducted research to understand the burden of diabetes in the city. The research formed the basis of a large-scale effort to elevate the challenge of urban diabetes to the top of the health agenda, with the release of the Rome Cities Changing Diabetes Atlas, a manifesto and activities related to health-promoting policy, urban planning and community involvement in health.

Read the full case on page 28

MEXICO CITY


Mexico City, Mexico

RESEARCH, ACTION AND POLICY CHANGE IN A MEGACITY GRAPPLING WITH A PUBLIC HEALTH EMERGENCY

As one of the great megacities of the world, with more than 20 million citizens,[8] Mexico City finds itself in the clutches of a diabetes epidemic. A major cause of this healthcare emergency, which affects almost 16.0% of adults (2.3 million people) in the city,[18] is the increasing challenge of overweight and obesity. With 34.7% of the city's adult population considered to have obesity, the prevalence of diabetes can only be expected to grow.[19] The Diabetes Projection Model forecasts that 22.8% of the adult population (aged 20–79) will have diabetes by 2045 if action is not taken (Figure 3).[18] This is an additional 2 million people with diabetes compared with today.

The challenge is not confined to Mexico City. In fact, as many as 14.7% of Mexico's adult population already has diabetes, and it is estimated that the prevalence could rise to 18.5% by 2040.[4] The toll from diabetes-related deaths in Mexico is immense. More than 76,000 people died from diabetes-related causes in 2015[4] – an 8.0% increase on 2013[20]. This sharp rise in such a short period has led the Federal State's Ministry of Health to declare a public health emergency and call on local, state and federal governments to work to design and launch effective solutions to tackle the challenge.[21]

EXPLORING THE SOCIOCULTURAL FACTORS OF DIABETES

Taking on the important challenge of addressing diabetes, Mexico City was the first city to sign up to the Cities Changing Diabetes programme in 2014, and the first step was to establish a baseline for the challenge. Under the leadership of Dr Armando Ahued Ortega, secretary of health of Mexico City, with the academic support of Dr Simón Barquera, executive director, Nutrition and Health Research Centre, National Institute of Public Health, a massive data collection process was initiated in Mexico City. Data regarding the characteristics of housing, demography, health information, food consumption and levels of physical activity were collected from 2,500 people aged 20 to 69, along with information about anthropometry and biomarkers for diabetes and lipidaemia. In addition, blood samples were collected from half of the participants surveyed.[19]

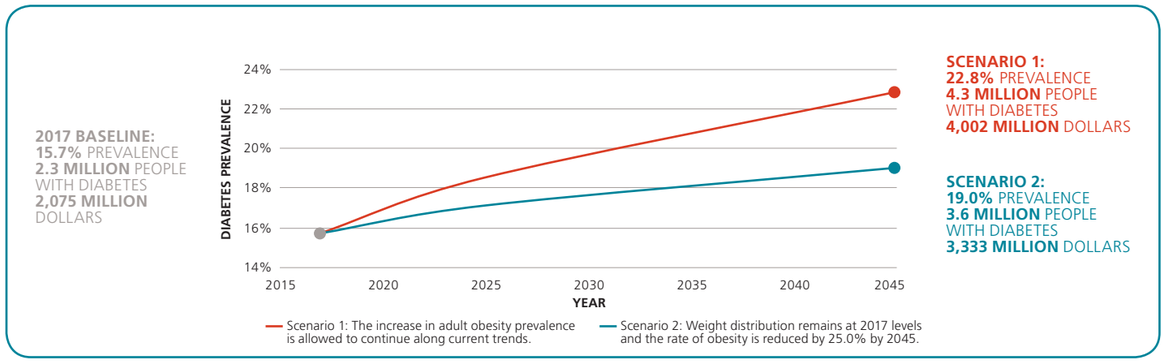
Following this, a Diabetes Vulnerability Assessment was conducted, involving 220 individual interviews with people with type 2 diabetes.[16] The assessment revealed that socioeconomic vulnerabilities are exacerbated when people cannot engage with healthcare services. It also highlighted several barriers to care, including lack of resources, lack of understanding and lack of trust in institutions.[16]

A turning point for tackling the burden of diabetes

The outcome of this research has enabled local policymakers to respond to the crisis with concrete interventions. Two such interventions are *El Médico en Tu Casa* (the doctor in your home) and the establishment of a specialised diabetes centre in Iztapalapa.

FIGURE 3: DIABETES PREVALENCE IN MEXICO CITY, 2017–2045 (ADULTS AGED 20–79)[18]

If we reduce obesity by 25.0% by 2045, 700,000 cases of type 2 diabetes can be avoided and 669 million dollars in healthcare expenditure saved



NOTE: The baseline prevalence of 15.7% among adults (aged 20–79) in 2017 is a projection based on Rule of Halves research conducted in Mexico City in 2015, which showed a prevalence of 13.9% among adults (aged 20–69).[19]

> *"The insights we've gained from the Cities Changing Diabetes research have fundamentally changed the way we think about diabetes in our city."*
>
> **DR ARMANDO AHUED ORTEGA, SECRETARY OF HEALTH, MEXICO CITY**

Diabetes screening and care integrated into existing health services

El Médico en Tu Casa is an example of how diabetes can be integrated into existing interventions. The programme, introduced in 2014, mobilised approximately 3,000 doctors and nurses to knock on doors in the most marginalised areas of the city to look for pregnant women who were vulnerable, without access to healthcare and potentially at risk for poor pregnancy outcomes. Now, influenced by Cities Changing Diabetes research, the scope of the programme has been expanded to address vulnerability among other populations (including people with disabilities and chronic illnesses, people in a state of neglect and people who are terminally ill).

The programme has a special focus on type 2 diabetes. By bringing diabetes screening into people's homes, *El Médico en Tu Casa* works to improve type 2 diabetes diagnosis rates, and identify and assist people at high risk of developing type 2 diabetes. It also works to reduce the impact of vulnerability among people already diagnosed with diabetes. As highlighted in the research, many senior citizens find it difficult or even impossible to get to a doctor or healthcare centre because of the transportation and appointment costs, and because of distances to the primary healthcare centres. Through this consolidated programme, these challenges are being circumvented.

Comprehensive diabetes care in an underserved part of the city

The specialised diabetes clinic in Iztapalapa is another example of how vulnerability in diabetes care is being addressed. The clinic, established in December 2016, has introduced vital diabetes services in the heart of one of Mexico City's most vulnerable communities. The centre is one of the only truly integrated diabetes care centres in Mexico City serving as a one-stop-shop for a range of medical services. Services including internal medicine, psychology, nephrology, cardiology, dentistry, ophthalmology, podology, diabetes education, nutrition and clinical laboratory tests are all provided under one roof, thus reducing the number of clinics patients need to visit. The clinic, which serves 8,000 patients and their families annually, is the result of a collaboration between the World Diabetes Foundation and Mexico City's Ministry of Health.

These two programmes mark a turning point in Mexico City's approach to tackling the rising burden of diabetes and its impact on vulnerable communities. Due to its success, the local congress granted *El Médico en Tu Casa* legal status, meaning that it is no longer a pilot programme, but instead a permanent part of Mexico City's healthcare service offering. Two more clinics following a similar model to the clinic in Iztapalapa are set to open in the district of Mexico City.

LOCAL PROGRAMME PARTNERS

- **Government of Mexico City**
- **Ministry of Health, Government of Mexico City**
- **National Institute of Public Health of Mexico**

IN MEXICO CITY, **28.8% OF PEOPLE WITH TYPE 2 DIABETES ARE UNDIAGNOSED**, PUTTING THEM AT GREATER RISK OF DEVELOPING SERIOUS HEALTH COMPLICATIONS.[19]

MEET CAMILO[16]

- **50-year-old man**
- **Poor socioeconomic circumstances and sedentary job as a taxi driver**
- **Type 2 diabetes.**

Camilo, a taxi-driver from Mexico City, was diagnosed with diabetes after an episode of exhaustion. The diagnosis did not come as a surprise to him as his mother and three brothers already have diabetes. Still, it made him feel depressed and he delayed going for treatment until his health began to get worse. Without the support of the public healthcare system, he could not have afforded the medical consultations and medicines that he needs for his diabetes. Camilo sees himself as fortunate because the endocrinologist who treated him provided a lot of information about diabetes. Even with a sedentary job as a taxi driver, he sticks to his eating habits and his treatment. He has realised that Mexican society "eats to get full, not to get nutrients". Camilo furthermore thinks that there are not sufficient clinics to take care of all the people with diabetes.

COPENHAGEN


Copenhagen, Denmark

ADDRESSING HEALTH INEQUALITY IN AN ALREADY HEALTHY CITY

Copenhagen frequently finds itself topping lists of the world's greenest,[22] healthiest[23] and most liveable[24] cities. Therefore, it is unquestionably synonymous with healthy and sustainable living today. However, these accolades are by no means a matter of chance. The fact that half of all commutes are made by bicycle[25] and 96.0% of citizens can walk to parks or beaches in less than 15 minutes[26] is a result of continued collaborative efforts across the city's various departments to make health part of the city's DNA.

'Enjoy life, Copenhageners!' is the title of the city's latest 10-year health plan, which aims to ensure that all Copenhageners have an equal opportunity to live longer and enjoy a better quality of life.[27] While this may sound like a relatively easy task in a country with free universal healthcare and a city built for healthy living, Copenhagen is still challenged by the fact that its citizens' life expectancy lags behind the national average[27] and almost half of adult residents have at least one chronic disease.[28]

ENSURING NO-ONE IS LEFT BEHIND

Copenhagen is especially focused on addressing inequalities in the prevalence of diabetes which, by international standards, is relatively low at 5.1%.[29] However, its prevalence among citizens not employed is 10.2%.[29] Furthermore, research shows that the risk of developing diabetes is especially high in Valby and Brønshøj/Husum (15–18.0%), two less affluent neighbourhoods in the city.[29]

The Diabetes Projection Model for Copenhagen shows that the prevalence of diabetes among adults (aged 20–79) could climb from 5.1% today to 6.0% in 2045 if action is not taken (Figure 4).[30]

While many of the city-level initiatives help to enable healthy living for the general population, there is evidence of inequalities in health, especially among those with a low level of education, without employment or living alone.[31]

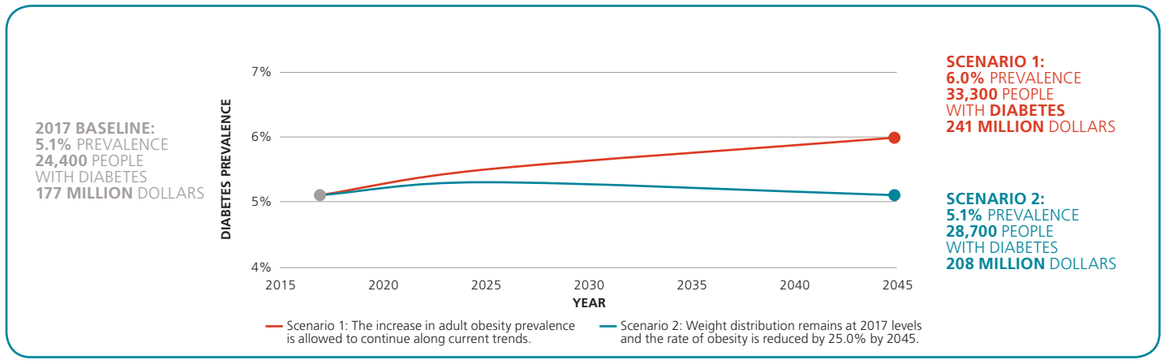
Despite few barriers to accessing healthcare services, primary care is often not proactive and cohesive enough to reach and retain some citizens who have type 2 diabetes. Cities Changing Diabetes research from Copenhagen shows that citizens – especially the most vulnerable – do not feel capable of navigating 'the system' (healthcare, social services and institutions in general) and need support in living with diabetes, including finding the energy to prioritise diabetes self-management.[31]

Policy and action informed by research

Since the research was published in 2015, the findings have been applied to inform the City of Copenhagen's health policies relating to diabetes, in the form of a Copenhagen Diabetes Action Plan.[32] In addition, the research findings have laid the foundation for developing targeted interventions aimed at helping vulnerable populations and thus addressing inequalities in the prevalence of diabetes.

FIGURE 4: DIABETES PREVALENCE IN COPENHAGEN, 2017–2045 (ADULTS AGED 20–79)[30]

If we reduce obesity by 25.0% by 2045, 4,600 cases of type 2 diabetes can be avoided, and 33 million dollars in healthcare expenditure saved



NOTE: The baseline prevalence of 5.1% among adults (20–79 years) in 2017 is based on Rule of Halves research conducted in Copenhagen in 2015.[29]

"Through this programme, the City of Copenhagen wants to take concrete action to increase health equality for its citizens."

NINNA THOMSEN, HEALTH AND CARE MAYOR OF COPENHAGEN

Supporting programmes for vulnerable populations

The Center for Diabetes opened in Copenhagen in 2016 and is available to people with diabetes in the city via a referral from their general practitioner. Upon entering its doors, patients are welcomed with a range of support activities, including group and individual education, indoor and outdoor fitness classes, and a team of nurses, physiotherapists and dieticians who are committed to helping them improve their health. In addition, a comprehensive health promotion initiative has been implemented in the socially disadvantaged neighbourhood of Tingbjerg. The initiative includes community action research that is being implemented with the assistance of vulnerable youth groups. The young people are engaged in the research process, which includes conducting surveys in their own neighbourhoods. The goal of these programmes is to establish sustained lifestyle changes among vulnerable populations and, thus, minimise health inequality.

Peer mentoring to support lasting lifestyle changes

Despite the Center for Diabetes' central location and availability of programmes, certain vulnerable populations are less likely to join or are difficult to keep engaged in its programmes. According to the Cities Changing Diabetes research, this is especially true for men over the age of 45 who are not employed and have a limited social network.

Thus, one of the key interventions that have evolved from the Cities Changing Diabetes research is a peer mentor programme. The one-year pilot programme is an essential step in helping to build a peer-to-peer social network for vulnerable men, so that they feel motivated to make lasting lifestyle changes.

The pilot launched in May 2017 in collaboration with the City of Copenhagen, the Danish Diabetes Association and the University of Copenhagen. It aims to reduce inequality in the development of diabetes and its complications among the most vulnerable people with type 2 diabetes.

The programme will be based in the newly established Center for Diabetes and will recruit and connect mentors and mentees based on their proximity to one another. Approximately 100 people with diabetes will participate in the pilot programme, which will be evaluated by the University of Copenhagen. The vision is to ultimately scale up the project to reach more people and integrate it into Copenhagen's standard health offerings.

LOCAL PROGRAMME PARTNERS

- **City of Copenhagen**
- **University of Copenhagen**
- **Danish Diabetes Association**
- **Steno Diabetes Center Copenhagen**

10.0% OF ADULTS LIVING IN THE GREATER COPENHAGEN AREA HAVE OBESITY.[33]

MEET MICHAEL[16]

- **51-year-old man**
- **Unemployed and lives with his girlfriend**
- **Overweight and is at high risk of type 2 diabetes.**

Michael lives with his girlfriend Anna who was recently diagnosed with type 2 diabetes, and he believes the diagnosis will have a positive and healthy effect on them, as they now have a reason to make healthier choices. However, being unemployed is a great stress in his life. Sometimes being unemployed gets too much for him. When this happens, Michael's motivation with regard to eating healthier weakens, and he ends up using food as a comfort: "If you're having an emotional downturn because you have difficulties finding a job, then somehow you eat more compulsively, and maybe you eat more than what's good for you." Being overweight makes Michael feel at risk of developing diabetes. However, he does not give it any thought during his everyday life, as thinking about it makes it unbearable on top of all his other issues.

HOUSTON

EMPOWERING COMMUNITIES AT GRASSROOTS LEVEL

Up until recently, Houston was one of the fastest-growing cities in America,[34] expanding on average by 20.0% every decade and surging to the fourth largest metropolitan area in the United States, trailing only New York, Los Angeles and Chicago.[35] By 2025 it is predicted to overtake Chicago.[36] The dramatic population growth in Houston has also altered the city's ethnic make-up, making it the single most ethnically diverse population in the US.[37] Today, Houston is home to many different ethnic groups speaking more than 145 different languages.[38]

Unrestrained by formal zoning requirements and major geographic barriers, Houston has accommodated its rapid population growth through a sprawling urban landscape tied together with miles of concrete highways. The result is a car-centric metropolitan area where 57.0% of commuters drive alone to work and only 1.5% of the population uses active transport (ie walking or cycling).[39] However, within the city limits, Houston has 9.4 hectares of total parkland per 1,000 residents, which is well above the median of 5.4 hectares for cities with a similar density.[40]

Poor health behaviours, such as inactive lifestyles and unhealthy diets, often coupled with urban living, have resulted in one of the highest obesity rates in the country.[41] In Houston, 28.9% of adults are sedentary,[42] and obesity is the most common chronic condition, affecting 31.4% of adults[43]. The Diabetes Projection Model shows that today 15.6% of the adult population (aged 20–79) in Houston has diabetes. By 2045 this number could reach 21.1% if no action is taken (Figure 5).[44]

IDENTIFYING THE UPSTREAM DRIVERS OF VULNERABILITY

Understanding the upstream drivers of obesity and diabetes is a critical step in developing targeted diabetes prevention measures in Houston. Therefore, University College London and University of Texas, School of Public Health, as part of Cities Changing Diabetes in Houston, conducted a Diabetes Vulnerability Assessment which involved a comprehensive analysis of the sociocultural factors that underpin vulnerability to type 2 diabetes among residents from three different city areas of Houston. The research revealed several vulnerabilities among Houstonians, including low health literacy, long commutes, unhealthy food traditions and living in neighbourhoods undergoing constant change. Researchers were also surprised to learn that the risk of diabetes transcends economic lines. They found that some young professionals were especially vulnerable to diabetes because they were too busy to make time for a healthy diet and exercise.

ENGAGING THE COMMUNITY IN HEALTH

For many Houstonians, their house of faith is their primary community, and according to a 2016 survey, almost half of them had attended a religious service in the previous month.[45] Therefore empowering congregational health leaders or ministers within houses of faith is a logical place to start to engage with members of the community and, hopefully, reach populations vulnerable to diabetes. The Faith and Diabetes Initiative was voted on as a priority initiative by Cities Changing Diabetes Houston stakeholders, thus signifying an opportunity to move forward with this initiative, which is truly driven by members of the Houston community.

Leveraging the reach and influence of faith-based organisations

Through both the Cities Changing Diabetes research on vulnerabilities in Houston and the formation of the Faith and Diabetes Action Work Group, Cities Changing Diabetes has engaged with members of Houston's faith community on the local challenge of diabetes. The commitment of this Action Work Group has been inspiring for all those involved with the programme, with many of them taking time outside of their busy schedules to collaborate on the best solutions to help people with diabetes in their communities. The aim of the Faith and Diabetes Initiative is to assist houses of faith across Greater Houston in strengthening or building a Congregational Health Ministry by developing a range of diabetes prevention and awareness tools that they can share with their congregations. At the heart of the initiative is the development of a Congregational Health Leadership Programme, which is a diabetes-focused training programme for congregational leaders that addresses faith and community dynamics, communications and community health improvement.

One of the programme's first major milestones was the October 2016 Faith and Diabetes Summit, which brought together leaders from houses of faith across the city. The discussions primarily focused on better understanding members' need for support on diabetes prevention and management, and awareness and education. The conference was hosted by Cities Changing Diabetes, the Institute for Spirituality and Health, and Interfaith Ministries, and included more than 100 participants representing multiple faith groups, including Buddhists, Muslims, Hindus, Jews and Christians.

Empowering community leaders to engage on diabetes

On 8 September 2017, Cities Changing Diabetes Houston kicked off the Congregational Health Leadership Programme. This programme consists of a six-week train-the-trainer course that prepares two congregational members from each house of faith to implement evidence-based primary prevention programmes, and a 10-week lifestyle change programme for congregational members already diagnosed with diabetes. The curriculum was developed in collaboration with the Action Work Group, TMF Health Quality Institute, Houston Health Department, Harris County Public Health, Institute for Spirituality and Health and The University of Texas Health Science Center at Houston School of Public Health. The curriculum consists of five components which are delivered at no cost to the Faith and Diabetes Initiative: Diabetes self-management and treatment; Diabetes prevention and awareness; Religious belief, practice and health; Leadership and communication; and Evaluation techniques and principles.

> *"Cities Changing Diabetes opened up a whole new world, that we needed to look at people from vulnerable populations versus poor populations. When we looked at vulnerable populations, that gave us the opportunity to serve more of our congregation than just a very small segment of the congregation."*
>
> **GEORGE ANDERSON, CHIEF OPERATING OFFICER, THE FOUNTAIN OF PRAISE, HOUSTON**

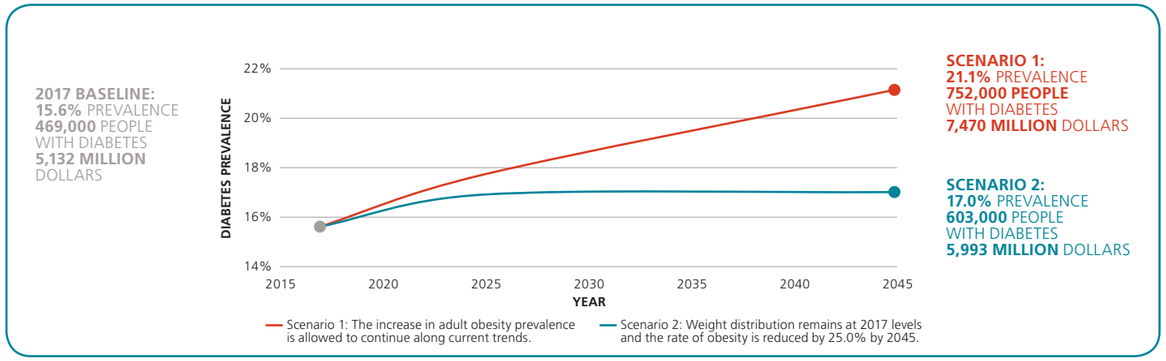
The participating houses of faith are part of a learning collaborative that seeks to facilitate knowledge exchange and collaboration among the participants during the training and throughout the implementation phase. This learning collaborative is supported by the Institute for Spirituality and Health at the Texas Medical Center, the Cities Changing Diabetes Houston project team and volunteers from the different organisations who developed the curriculum.

Collaborating across partners for better public health in cities

Looking forward, Houston will collaborate with programme partners in Mexico City and Vancouver in an initiative called the Healthy Cities Research Hub. The initiative will facilitate knowledge exchange, drive action-orientated research and evaluate community-based interventions. It is focused on the social and environmental conditions that impact health in urban settings throughout North America. The Healthy Cities Research Hub is funded through a three-year 2.4 million dollar grant, which has been awarded by the Robert Wood Johnson Foundation.[46]

FIGURE 5: DIABETES PREVALENCE IN HARRIS COUNTY, HOUSTON, 2017–2045 (ADULTS AGED 20–79)[44]

If we reduce obesity by 25.0% by 2045, 149,000 cases of type 2 diabetes can be avoided, and almost 1.5 billion dollars in healthcare expenditure saved



NOTE: The baseline prevalence of 15.6% among adults (aged 20–79) in 2017 uses published data from 2012 for Harris County, Houston, which states that 11.3% of the adult population has diagnosed diabetes.[47] Assuming that 27.0% of people with diabetes are undiagnosed, as indicated by Rule of Halves research in Houston in 2015, provides a total prevalence of 15.6%.[16]

LOCAL PROGRAMME PARTNERS

- **American Diabetes Association, Houston**
- **Asian American Health Coalition**
- **City of Houston Human Resources Department**
- **Clinton Health Matters Initiative**
- **Gateway to Care**
- **Harris County Medical Society**
- **Harris County Public Health**
- **Hispanic Health Coalition**
- **Houston Business Coalition on Health**
- **Houston Health Department**
- **Institute for Spirituality and Health at the Texas Medical Center**
- **The Fountain of Praise**
- **The University of Texas Health Science Center at Houston School of Public Health**

IN HOUSTON, **47.0%** OF CHILDREN WERE **OVERWEIGHT** OR **HAD OBESITY** IN 2012.[48]

MEET EVE[16]

- **50-year-old woman**
- **Married housewife with two teenage children**
- **Overweight with high blood pressure.**

Eve lives in a middle-class residential suburb of Houston with her family. Through the church, Eve and her family are part of a 'tight-knit' and socially active community. During the week, they often have friends over for dinner. When Eve cooks for her family, her focus is on convenience and ease. A meal typically consists of "some meat, some kind of starch, and one or two vegetables". Eve is clearly knowledgeable about her health. She has also taken up running regularly for exercise, and thus considers herself healthy. But, she is not risk-aware. She is, for example, not aware that her BMI approaches the category of obesity and strongly doubts the validity of the measurements. Diabetes-risk, in her opinion, is linked to a sedentary lifestyle and because she is active, Eve is sure that diabetes does not pose a significant risk to her.

TIANJIN


Tianjin, China

LAYING THE FOUNDATION FOR DIABETES PREVENTION AND CONTROL IN A RAPIDLY EXPANDING CITY

Located just 30 minutes southeast of Beijing by high-speed rail, Tianjin is among the fastest-growing cities in China in terms of population and economy.[49] It is already the fourth most populous city in China, with approximately 16 million inhabitants,[50] and is expected to continue significant population growth for many years to come. Tianjin's robust economy, as a major port and manufacturing hub in China, drives this trend.[49] Emulating the momentous social transformations in China, Tianjin has invested significantly in local and regional infrastructure, economic development, job creation and expanding health infrastructure.

The rapid growth has also led to a turning point – NCDs have quickly become the number one health threat. Out of every 100 deaths in China, 85 are now caused by NCDs.[51] Several high-risk health behaviours have accompanied the rapid growth. Powerful underlying forces often associated with urban living, such as poor diets, sedentary lifestyles, smoking and alcohol consumption as well as environmental factors, have resulted in the emergence of a diabetes epidemic in Tianjin. Already, an estimated 9.7% of the adult population (aged 20–79) has diabetes,[52] and it is expected that, without action, the prevalence of diabetes will almost reach 15.0% by 2045 (Figure 6).[52]

UNDERSTANDING VULNERABILITY IN TIANJIN

Research conducted by the Tianjin Medical University as part of Cities Changing Diabetes in Tianjin revealed that vulnerability to diabetes is embedded in cultural beliefs impacting perceptions of risk and management. Low diabetes literacy, low patient education levels and socioeconomic challenges also significantly impact people's access to information about diabetes and their ability to manage the condition.[16] This is emphasised by the fact that almost 45.0% of people with diabetes remain undiagnosed.[53]

SUPPORTING A NATIONAL STRATEGY

Until recently, most people in China sought medical care in hospitals, especially the large hospitals in major cities, partly due to lack of trust in primary care physicians.[51] However, staff capacity at hospitals has been markedly overstretched, and many patients struggle to gain access to treatment.[51] The central government has therefore made strengthening the tiered medical system and integrated prevention of NCDs a priority of its 'Healthy China 2030' strategy.[54] The healthcare reform will involve establishing a referral system and improving the capacity of general practitioners (GPs).

Strengthening diabetes capacity among primary healthcare providers

A key focus of the programme in Tianjin has been to improve the level of diabetes diagnosis and treatment at primary care level in community health centres (CHCs), and, in so doing, lay the foundation for a referral system for the treatment of diabetes. The programme is training GPs in the diagnosis and management of diabetes in partnership with the Tianjin Health and Family Planning Commission, Tianjin Human Resource and Social Security Bureau and Tianjin Medical Association. The training programme is based in 30 training centres and led by 70 specialists. The aim is to train one or two Chief GPs for each primary health institution in the city.

Enabling Chief GPs to play a lead role in improving the diagnosis, treatment and management of diabetes will provide urban residents with access to high-quality and professional medical services, and lay the foundation for a tiered medical system. By the end of 2016, 300 GPs had received training, including theoretical training, clinical hands-on practice and sessions with mentors, and were granted the title of Chief GPs of Diabetes by the Tianjin Health and Family Planning Commission. Indications are that this effort has already resulted in improved levels of diagnosis and treatment of diabetes at CHCs, and will improve trust in the primary health system.

Furthermore, an evaluation of the training programme shows that GPs not only perceive that their knowledge of diabetes has improved, but that so too has their self-confidence and motivation to help patients manage their diabetes. This is beneficial in order to create a good medical atmosphere and promote efficient medical treatment.

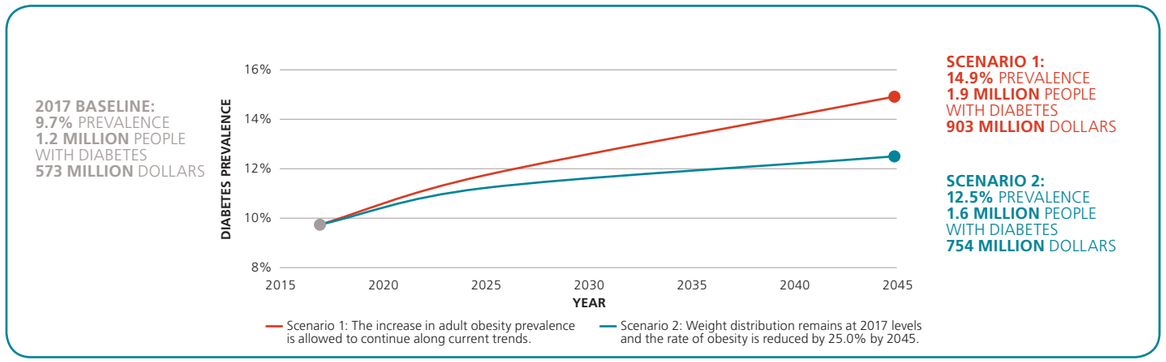
Going forward, the training efforts will continue to grow to meet the needs of a growing diabetes population. The programme will provide centralised training for GPs twice a year, online supplemental tutorials twice a month and a three-week mentor training programme where Chief GPs receive hands-on diabetes training at a clinic. In addition, patient education is being made available in order to improve self-management.

Ensuring capacity for the diagnosis and management of diabetes at CHC level in Tianjin is a critical step in improving diabetes care in this rapidly expanding city.

> *"Through initiatives like the Chief GP of Diabetes in Tianjin, Cities Changing Diabetes is laying the foundation for diabetes control in primary health centres in Tianjin."*
>
> **ZHANG FUXIA, DEPUTY DIRECTOR OF TIANJIN HEALTH AND FAMILY PLANNING COMMISSION**

FIGURE 6: PROJECTED DIABETES PREVALENCE IN TIANJIN, 2017–2045 (ADULTS AGED 20–79)[52]

If we reduce obesity by 25.0% by 2045, 300,000 cases of type 2 diabetes can be avoided and 149 million dollars in healthcare expenditure saved



NOTE: The baseline prevalence of 9.7% among adults (aged 20–79) in 2017 uses published data from 2010.[53] For China, the model uses different BMI cut-off points for overweight and obesity because, in Asian populations, there is a risk of developing type 2 diabetes at a BMI lower than the existing WHO cut-off point for overweight.[55]

LOCAL PROGRAMME PARTNERS

- **Tianjin Human Resource and Social Security Bureau**
- **Tianjin Medical Association**
- **Tianjin Medical University**
- **Tianjin Municipal Commission of Health and Family Planning**

8.7% OF ADULTS IN TIANJIN HAVE PREDIABETES.[53]

MEET XIA[16]

- **55-year-old woman**
- **Married and works as full-time labourer**
- **Slightly overweight and has type 2 diabetes.**

Xia lives in an apartment with her husband. Daily, she cycles from the city to the countryside, where she spends several hours doing farm work, and therefore feels that she is in good physical condition for her age. Xia also has many household chores; this keeps her busy and she often skips meals during the day. She says: "I think I get the diabetes because I eat too much this time and too little next [time]." In principle, Xia trusts doctors, but is unsure as to what help they can give her and avoids seeking medical attention, even when necessary. At the same time, she is very concerned about the complications of diabetes, which could prevent her from working and caring for her family. Her knowledge about diabetes is very limited, though she knows she can get information from the local hospital.

SHANGHAI


Shanghai, China

STRENGTHENING LOCAL CAPACITY FOR DIABETES CARE IN CHINA'S FASTEST-GROWING CITY

Shanghai is a coastal megacity in eastern China, spanning an area of 6,341 km² and with a resident population of about 25 million people.[50,56] Since China's economic reform in the late 1970s, Shanghai has experienced rapid expansion and urbanisation, making it into one of the world's largest and fastest-growing urban areas.[57]

In the past decade, rapid development has changed the face of Shanghai as the thriving population has driven the city to expand upwards, with 150 skyscrapers,[58] and more recently underground, with the building of the first and largest super underground city.[59]

Moreover, the population of Shanghai has also undergone a demographic transition. Life expectancy has more than doubled since 1949, with people now living to an average age of 83, a statistic which exceeds that of many Western industrialised countries.[60] This has resulted in Shanghai becoming the first city in China categorised as an ageing society.[60] Consistent with the profile of an ageing population, there has also been a shift in the pattern of disease away from infectious diseases and infant health problems to NCDs such as diabetes.

ESTABLISHING A FOUNDATION FOR ACTION

The Diabetes Projection Model shows that 11.3% of the adult population (aged 20–79) in Shanghai has diabetes, and the prevalence is projected to reach 18.2% in 2045 if action is not taken (Figure 7).[61] This would increase the number of people with diabetes from 2.3 million today to 4.3 million in 2045.

Cities Changing Diabetes research from 2015 highlighted several diabetes vulnerabilities in the city. The research revealed how diabetes impacts families, and how family behaviour and perceptions impact an individual's ability to manage their diabetes. Knowledge about social transition and its relationship with urban diabetes was also revealed.[16]

> *"We all have more to learn, and do more. Through in-depth learning and connecting our knowledge, Cities Changing Diabetes can help us to improve even further the effectiveness of taking on diabetes in our city."*
>
> **PROF JIA WEIPING, DIRECTOR, SHANGHAI DIABETES INSTITUTE**

Transforming diabetes care in Shanghai

The Shanghai Municipal Government developed and launched a new three-year action plan on diabetes, the 2015–2017 Diabetes Intervention Programme. The programme provides well-organised specialised diabetes care along with primary care through Community Health Centres (CHCs) in the neighbourhoods in which people with diabetes live.

The working strategy emphasises community-based health promotion for controlling risk factors, early detection of diabetes and health management, and screening for complications and disease/case management.

Strengthening screening capacity at the primary care level

The City of Shanghai has initiated a project to organise screening for both people at high risk for diabetes and people with diagnosed diabetes at risk for diabetes-related complications. According to the plan, this will cover 300,000 individuals at high risk for diabetes and 250,000 people with diagnosed diabetes. For those with diabetes, the programme will screen for neuropathy, cardiovascular disease, nephropathy and retinopathy. To date, 195 of the 241 participating CHCs have implemented screening to detect people at high risk for diabetes. More than 150,000 individuals have already been screened for diabetes and, of these, almost 17,000 were identified as having diabetes and another 20,000 as having prediabetes. Six CHCs have started screening for complications among people with diabetes and have already screened more than 7,000 people.[62]

Supporting healthcare professionals with standard diabetes treatment and referral guidelines

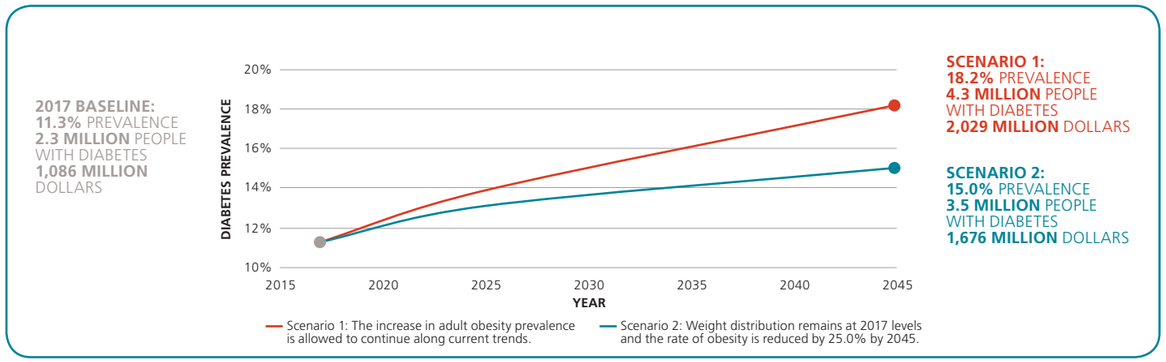
Data from the programme's research indicate that about 60.0% of people with diabetes receive treatment.[16] However, despite having a diagnosis and receiving treatment many do not manage to control their diabetes adequately. Supporting people with diabetes to achieve better outcomes requires the necessary healthcare professional capacity and expertise to be in place and accessible.[3] To improve healthcare capacity, standard diabetes treatment and referral guidelines are being promoted, and knowledge transfer among healthcare professionals in CHCs is being facilitated. To date, 1,531 healthcare professionals, including primary care physicians and nurses, have received training at 241 CHCs.

Lessons for a healthier China

The local partners behind the programme hope that the knowledge and experience gained through Cities Changing Diabetes in Shanghai can contribute to making China healthier. The programme has already improved communication between local policymakers, medical institutions and CHCs.

FIGURE 7: PROJECTED DIABETES PREVALENCE IN SHANGHAI, 2017–2045 (ADULTS AGED 20–79)[61]

If we reduce obesity by 25.0% by 2045, 800,000 cases of type 2 diabetes can be avoided, and 353 million dollars in healthcare expenditure saved



NOTE: The baseline prevalence of 11.3% among adults (aged 20–79) in 2017 uses published data from 2010.[63] For China, the model uses different BMI cut-off points for overweight and obesity because, in Asian populations, there is a risk of developing type 2 diabetes at a BMI lower than the existing WHO cut-off point for overweight.[55]

LOCAL PROGRAMME PARTNERS

Shanghai Diabetes Institute

Shanghai Municipal Centre for Disease Control and Prevention

Shanghai Municipal Commission of Health and Family Planning

IN SHANGHAI, **32.0% OF PEOPLE WITH DIABETES REMAIN UNDIAGNOSED** AND ARE AT RISK OF DEVELOPING SERIOUS COMPLICATIONS BEFORE THEY SEEK TREATMENT.[16]

MEET CAOYANG[16]

- **48-year-old man**
- **Married and has a demanding job**
- **Overweight with type 2 diabetes and high blood pressure**
- **Family history of diabetes.**

Caoyang lives together with his family. He was diagnosed with diabetes by coincidence at a general physical check-up. The stressors of work and the demands of everyday life, mean that he may not focus enough on his own health and does not prioritise monitoring his blood glucose. When he was first diagnosed he did not adhere to dietary restrictions on sweet, salty and fatty foods, often justifying that "it makes no difference to eat occasionally". This changed when he was hospitalised, and since then, he has taken control of his diet and exercises to manage his diabetes. Caoyang usually goes to the hospital to have his blood glucose tested once every six months. Having diabetes does not concern Caoyang as he believes that "diabetes isn't a serious illness…". Ensuring he can provide for his family is a priority; therefore his focus is on work.

JOHANNESBURG

Johannesburg, South Africa

LOCAL PROGRAMME PARTNERS

City of Johannesburg
University of the Witwatersrand
The Johannesburg Junior Council

TAKING THE FIRST STEP TOWARDS ACTION IN A FAST-GROWING CITY

Since the discovery of gold in Johannesburg more than a hundred years ago, it has been a city of immigrants. Mine dumps and gleaming skyscrapers, contrasted with Indian bazaars, African medicine shops and streets thronging with fruit sellers and street vendors, tell the story of Johannesburg's rich and diverse past. Jo'burg, as it is referred to locally, is a single metropolitan municipality of more than 1,645 km^2 connected by vast highways, and is the largest city in South Africa.[64]

Over the past 20 years, Johannesburg has increasingly become an immigrant gateway for people from all over the world, and from other parts of Africa in particular.[65] With approximately 4.9 million people,[66] Johannesburg is one of the most populous cities in Africa.[67]

A NEW HEALTH FOCUS FOR JOHANNESBURG

This fast-paced urbanisation has been a magnet for several challenges, including lack of housing, inner city decay, high unemployment, crime and inadequate healthcare provision, which, in turn, has created an environment conducive to NCDs such as type 2 diabetes. In 2015, NCDs were the leading cause of mortality in the city, with diabetes as the sixth leading cause.[68]

The growing burden of NCDs in Johannesburg is adding to an already high burden of communicable diseases and perinatal, maternal and injury-related disorders.[69] Addressing diabetes provides an opportunity to manage the increasing prevalence of NCDs, and is a paramount step for Johannesburg as it works towards reducing its quadruple burden of disease.

The Diabetes Projection Model shows that 11.0% of the adult population (aged 20–79) in Johannesburg has diabetes. If action is not taken, the prevalence of diabetes could increase to 16.2% by 2045, more than doubling the current number of people with diabetes from 340,000 to approximately 795,000 (Figure 8).[70]

Mapping the burden of diabetes in primary health centres

In 2016, Cities Changing Diabetes initiated quantitative research in Johannesburg to map the burden of diabetes and its comorbid conditions, such as dyslipidaemia, hypertension and obesity, among patients attending public sector primary healthcare facilities in the city. Performed in partnership with the University of the Witwatersrand, Novo Nordisk and the Johannesburg Junior Council, the research is the first step towards action for the programme in Johannesburg and on the African continent.

The research was conducted in 14 primary health centres, which are public sector facilities located in areas with a high population density. The services of retired nurses from the local area were called upon due to their extensive experience of working in these settings.

The research revealed high levels of type 2 diabetes and its comorbidities. Of the sample population, 6.0% had pre-existing diagnosed type 2 diabetes and another 46.0% was not aware they had the condition.[71] High levels of comorbidities such as hypertension and dyslipidaemia were detected.[71] Furthermore, high prevalence of risk factors for type 2 diabetes, such as overweight and obesity, was also observed, with 29.0% of the sample population being overweight and a further 37.0% having obesity.[71]

"Cities Changing Diabetes in Johannesburg provides us with a platform to bring together different players to challenge this epidemic. This is an opportunity to take a multi-faceted integrated approach to tackling diabetes in Johannesburg which has been lacking so far."

PROF DEBASHIS BASU, PUBLIC HEALTH MEDICINE SPECIALIST, UNIVERSITY OF THE WITWATERSRAND

Moving from research to action

The next step for Cities Changing Diabetes in Johannesburg is to use the Urban Diabetes Risk Assessment to unveil the drivers underlying diabetes in the city. The research will facilitate a deeper understanding of how the sociocultural drivers of diabetes play out in a diverse and rapidly growing city.

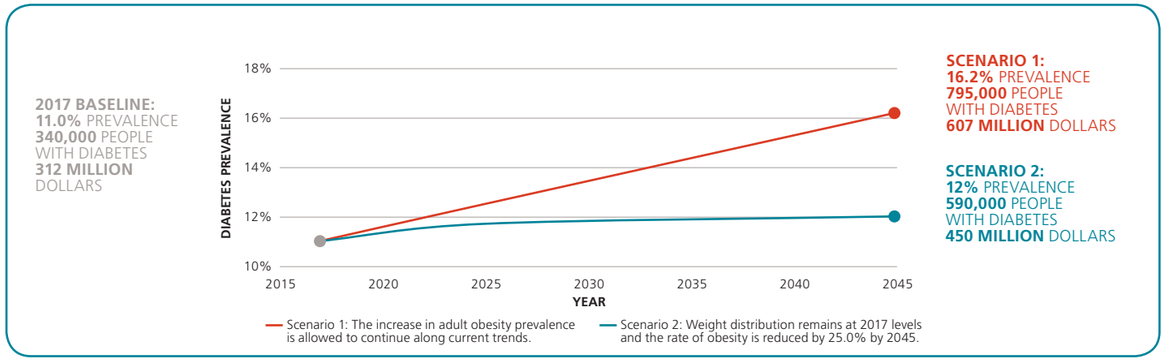
In the meantime, several recommendations and actions based on the quantitative research are already on the table. These include policy recommendations, such as the implementation of risk-based screening for diabetes, hypertension and dyslipidaemia in all health facilities and the development of a cost-effectiveness study to evaluate the sustainability of such an approach.

The local programme partners are planning various stakeholder meetings to present results from the study and discuss primary and secondary prevention of diabetes. In addition, they are planning a school awareness campaign to raise awareness about diabetes and its comorbidities among young people.

IN SOUTH AFRICA, **MORE THAN 47.1%** OF THE ADULT POPULATION **IS PHYSICALLY INACTIVE.**[72]

FIGURE 8: PROJECTED DIABETES PREVALENCE IN JOHANNESBURG, 2017–2045 (ADULTS AGED 20–79)[70]

If we reduce obesity by 25.0% by 2045, 205,000 cases of type 2 diabetes can be avoided and 157 million dollars in healthcare expenditure saved



NOTE: The baseline prevalence of 11.0% among adults (aged 20–79) in 2017 uses Rule of Halves research conducted in Johannesburg in 2016.[71] The model assumes that the age distribution in Johannesburg follows the same pattern as the rest of South Africa.

VANCOUVER

LOCAL PROGRAMME PARTNERS

- City of Vancouver
- Vancouver Coastal Health
- Diabetes Canada
- Simon Fraser University

EXPLORING THE PRIORITIES, CHALLENGES AND UNMET NEEDS IN TYPE 2 DIABETES

When you think of healthy and liveable cities, Vancouver often comes to mind. In fact, it is consistently named as one of the world's top five cities for liveability and quality of life.[73] Along with Copenhagen, it was listed as one of the world's 10 healthiest cities in 2014.[23] You might imagine that Vancouverites stay healthy simply due to the draw of the beautiful outdoors and abundant green spaces. However, the City of Vancouver has also played an important role in building a city that promotes healthy living. Unlike its North American counterparts, Vancouver is the only major city in North America without an interstate running through it. Instead, about one-third of Vancouverites opt to commute by walking, taking public transportation or utilising the miles of bicycle lanes available to them.[74]

Vancouver's focus on healthy living has given the city a head start in addressing the growing burden of diabetes and obesity faced by many cities. In fact, Vancouver's obesity rate, at 15.0%,[75] is one of the lowest rates in Canada[76]. However, even in Vancouver, where physical activity and a healthy outlook are strong components of society, diabetes holds an increasingly strong grip. According to Cities Changing Diabetes research, 9.4% of Vancouver's population is living with diabetes, which is on a par with Canada's national prevalence of diabetes.[77] The Diabetes Projection Model shows that diabetes prevalence among adults could increase to 11.7% if action is not taken (Figure 9).[78]

As in other cities, the diversity of Greater Vancouver's population poses an array of challenges concerning diabetes risk and management. Vancouver is a highly diverse city, with 45.0% of the population speaking a first language other than English.[79] People of Chinese, South Asian and indigenous ethnicity – some of Vancouver's most populous ethnic groups – have a disproportionate level of risk compared to people of European ethnicity with the same BMI.[80] Some neighbourhoods in Vancouver are also disproportionately impacted by type 2 diabetes, with the more affluent Westside of Vancouver having a diabetes prevalence of only 5.0%, whereas the Downtown Eastside and South have a prevalence as high as 8.0% and 11.0% respectively.[77] Preventing, diagnosing and managing diabetes in Vancouver, therefore, requires a more holistic understanding of why certain groups are potentially more vulnerable to developing type 2 diabetes.

PILOTING A NEW RESEARCH TOOL TO ASSESS LOCAL SOCIOCULTURAL FACTORS OF DIABETES

Although there is a substantial knowledge base regarding biomedical and certain socioeconomic factors related to diabetes and its outcomes, sociocultural factors have yet to be comprehensively and systematically explored.

Vancouver is the pilot site for the newly developed Urban Diabetes Risk Assessment. The tool utilises an innovative, mixed-methods approach in order to identify distinct participant sub-groups that share specific priorities and attitudes towards health, well-being and living with diabetes. Building on the Diabetes Vulnerability Assessments carried out by Cities Changing Diabetes in five cities, the research seeks to expand the global evidence base around the sociocultural drivers of urban diabetes.

In Vancouver, the study will recruit 60 people with type 2 diabetes, leveraging two existing population-based studies. A key objective for the researchers is to ensure that the sample represents the diverse population living in Vancouver. This means that participants are purposely recruited from a range of population sub-groups.

A major portion of the data collection happens via an online software application tailored to the needs of Cities Changing Diabetes. In Vancouver, the global and local programme partners have worked to fine-tune the software and ensure ease of use for study participants. This will not only lay the foundation for a successful pilot in Vancouver, but it will also serve as a model for other cities using the tool.

Following the online data collection, the researchers will further explore the findings through citizen engagement. Focus groups or workshops will be used as a unique opportunity for people with type 2 diabetes to play a role in co-creating solutions to address the challenge of diabetes in their city.

Preparing for the pilot has been a highly collaborative process involving University College London and Simon Fraser University as academic leads, along with local partners, including the City of Vancouver, Diabetes Canada and Vancouver Coastal Health.

> *"It definitely has been a real team effort in getting this ready for roll-out, so the most important learning is working in partnership with all players."*
>
> **VERONICA DE JONG, RESEARCH COORDINATOR, SIMON FRASER UNIVERSITY**

Ultimately, the tool is about generating results that can guide a targeted intervention platform around reducing diabetes prevalence and improving management of the condition. In a city such as Vancouver, where there are already several ongoing initiatives, the findings will help to elevate the impact of these initiatives and ensure that they are tailored to the actual needs of various groups of people.

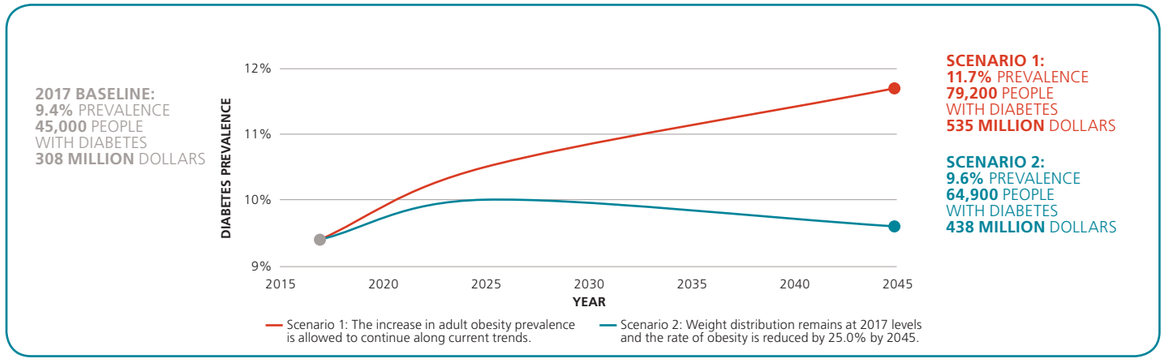
Sharing knowledge between cities

As the seventh city to join Cities Changing Diabetes, Vancouver has the advantage of building on knowledge generated across other cities, specifically on how to engage effectively with stakeholders around research and action. In the spirit of partnership and collaboration, Vancouver will also collaborate with academics in Houston and Mexico City in the Healthy Cities Research Hub.

THE PREVALENCE OF MULTIPLE CHRONIC CONDITIONS IS **FOUR TIMES HIGHER** AMONG PEOPLE WITH LESS THAN A HIGH-SCHOOL DEGREE, AND **THREE TIMES HIGHER** IN HOUSEHOLDS WITH AN ANNUAL INCOME OF BELOW 40,000 CANADIAN DOLLARS PER YEAR.[75]

FIGURE 9: PROJECTED DIABETES PREVALENCE IN VANCOUVER, 2017–2045 (ADULTS AGED 20–79)[78]

If we reduce obesity by 25.0% by 2045, almost 14,300 cases of type 2 diabetes can be avoided and 97 million US dollars in healthcare expenditure saved



NOTE: The baseline prevalence of 9.4% among adults (aged 20–79) in 2017 uses Rule of Halves research conducted in Vancouver in 2017.[77] The model uses the age distribution for British Columbia and published BMI data.

ROME

Rome, Italy

ELEVATING DIABETES TO THE TOP OF THE URBAN AGENDA

Nicknamed the 'eternal city', Rome is situated right on the banks of the River Tiber and was the birthplace and the centre of the Roman Empire. Since 1945, the city has experienced significant demographic development, with a population that has more than doubled,[81] and the city is now the largest in Italy. With more than 4.3 million inhabitants in the metropolitan city, it is the fourth most populated city in the European Union.[82]

Amidst the ancient ruins and monuments there is lively traffic, with more than 68.0% of the population commuting daily.[81] Most people use motor vehicles to get around, contributing to both congestion and pollution problems. Only 15.0% of the population chooses to walk or cycle to their destination.[81] Use of inactive transport along with other factors, such as poor diet, lack of physical exercise and increasing rates of obesity, underlie the rising challenge of urban diabetes in Rome. However, one of the largest contributors to the rise of diabetes is the increasing age of the population in Rome, where the number of citizens over the age of 65 has grown by 136,000 over the last 13 years, reaching a total of 631,000 in 2015.[81]

The number of people diagnosed with diabetes in Rome has increased by 60.0% over the past 15 years alone, and this figure is expected to increase further.[81] Today, 8.3% of the adult population (aged 20–79) has diabetes, and by 2045 the prevalence could reach 10.4% if no action is taken (Figure 10).[83]

Cities Changing Diabetes, in partnership with local researchers, health institutions, scientific societies, patient associations and universities in Rome and other parts of Italy, has leveraged available data to generate a Rule of Halves for the metropolitan city of Rome.[81] This, in turn, has informed the baseline for the Diabetes Projection Model for Rome. There are more than 260,000 adults with diabetes in Rome.[83] One in four remains undiagnosed.[81] Furthermore, of those who are diagnosed and receiving treatment, only half are achieving treatment targets.[81] All in all, nine out of 10 people with diabetes in Rome do not achieve desired health outcomes and are thus at increased risk of developing diabetes-related complications in the near future.[84]

MOVING BEYOND THE NUMBERS

Over the coming months, the findings from the Rule of Halves research will be further enriched with qualitative research, as programme partners investigate local vulnerabilities associated with diabetes using the Urban Diabetes Risk Assessment. The findings will help give a more thorough understanding of how the sociocultural factors of diabetes come into play, and help to identify barriers and opportunities for successful diabetes prevention, care and management in Rome.

MOBILISING FOR ACTION

Even though Cities Changing Diabetes in Rome is still in the early stages, the programme partners are not standing still and waiting to complete research; they are leveraging the existing data and stakeholder enthusiasm and have already undertaken a range of activities and initiatives.

Elevating diabetes on the urban agenda
The Rule of Halves findings have informed a report about diabetes in Rome – the Rome Cities Changing Diabetes Atlas 2017. The report draws attention to the fact that the prevalence of diabetes varies between neighbourhoods and is impacted by socioeconomic factors. It was presented at Rome Metropolitan City Hall meeting and again at the first Rome Cities Changing Diabetes summit in July 2017.[81]

Integrating health into urban planning
Spurred on by the urgency of the urban diabetes challenge, Cities Changing Diabetes has also launched several actions in Rome. These include mapping out 38 walking routes, covering about 261 km, for people with diabetes, and working on the development of a master's degree in global and urban health. The degree stems from a widespread need expressed by various organisations to develop highly qualified minds to govern organisational and strategic processes in the public health sector.

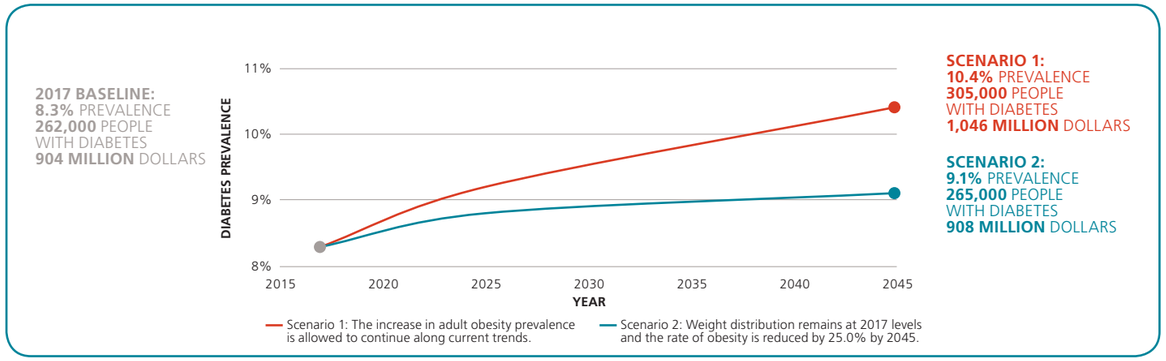
Encouraging broader national action
Another result of Cities Changing Diabetes in Rome is the 'Health in the city: the common good' manifesto. The manifesto seeks to engage all major stakeholders in the city, and to address the issues related to health while promoting the urban diabetes agenda in other Italian cities. The manifesto outlines key points that can guide cities to study and improve the determinants of health in their urban environments, and leverage them to come up with strategies to encourage people to adopt more active lifestyles so that they become less vulnerable to diabetes and obesity.

"Urbanisation and its links with the surrounding territory provide, on the one hand, many risks for public and individual health, and, on the other hand, opportunities that have to be consciously and wisely exploited by an administration. The Cities Changing Diabetes initiative provides an excellent frame to perform an analysis of social determinants and economic and environmental risk factors that impact on health."

ROBERTO PELLA, VICE PRESIDENT VICAR OF ITALIAN MUNICIPALITIES ASSOCIATION (ANCI), PRESIDENT CONFEDERATION OF TOWNS AND MUNICIPALITIES OF THE EUROPEAN UNION, MAYOR OF VALDENGO

FIGURE 10: PROJECTED DIABETES PREVALENCE IN ROME, 2017–2045 (ADULTS AGED 20–79)[83]

If we reduce obesity by 25.0% by 2045, more than 40,000 cases of type 2 diabetes can be avoided, and 138 million dollars in healthcare expenditure saved



NOTE: The baseline prevalence of 8.3% among adults (aged 20–79) in 2017 uses Rule of Halves research conducted in Rome in 2017 and applies to the Rome Metropolitan Area.[81,84]

LOCAL PROGRAMME PARTNERS

- City of Rome
- Health City Institute
- National Institute for Health
- Federsanità ANCI
- Italian Barometer Diabetes Observatory Foundation
- University of Roma Sapienza
- University of Roma Tor Vergata
- National Olympic Committee
- Danish Embassy in Rome, Italy
- Centre for Social Studies and Policies (CENSIS Foundation)
- National Institute of Statistics
- Institute for Competitiveness
- Centre for Outcomes and Research and Clinical Epidemiology
- Italian Diabetes Society
- Italian Diabetologists Association
- Italian Society of General Practitioners
- Active Citizenship Network (Cittadinanzattiva)

ONE IN FOUR CHILDREN LIVING IN ROME ARE OVERWEIGHT OR HAVE OBESITY.[81]

SIX SIGNPOSTS FOR FUTURE FOCUS

As Cities Changing Diabetes progresses and our experience grows, new imperatives for future action emerge. It has become clear that to bend the curve on diabetes, focus is needed in each of the following six areas. The programme has made major steps forward which start to show what is possible. We will continue to work in partnership to explore how best to contribute on these shared challenges – and drive the urban health agenda to the next level.

1 CROSS-CUTTING COLLABORATION

Forging public–private partnerships is essential to achieve the sustainable development agenda successfully.[85] Cities Changing Diabetes has shown what is possible when stakeholders work together on a shared objective – including researchers, businesses, city governments, non-government organisations, faith-based groups, employers and health providers – to share local learnings and insights, and form action plans.

Cities Changing Diabetes has been recognised as an innovative partnership for addressing global challenges and advancing the Sustainable Development Goals. Partnerships reach across various professions and administrations, and between health professionals and city planners and the public and private sectors to transcend traditional transactional partnership models. The programme has been included as an example of good practice in reports by leading organisations, including UN Global Compact,[86] Access to Medicine Foundation[87] and the World Economic Forum[88].

2 HEALTH AND CLIMATE SYNERGIES

Increasingly, people managing cities are seeing the synergies between improving health and tackling the critical challenge of becoming resilient to climate change. At the forefront of this work is a partnership established between C40, a network of the world's megacities committed to addressing climate change, and Novo Nordisk, the global leader in diabetes care, working to establish policies in cities that benefit both the state of the environment and the health of citizens.

"Each week 1.4 million people move into cities. Tackling climate change and reducing cities' greenhouse gas emissions is not just important because of global warming but also for the health and well-being of urban citizens around the world. By more clearly identifying these co-benefits, C40 believes this research will allow mayors and urban policymakers to make an even stronger case for taking climate action in cities around the world."

MARK WATTS, EXECUTIVE DIRECTOR, C40

3 FOOD SYSTEM DYNAMICS

The availability and affordability of healthy food play a critical role for those at risk of diabetes in cities. The Diabetes Vulnerability Assessment conducted by partner cities reinforces this imperative: economic inequality combined with the dynamics of the food system can, in some cases, make it difficult to access healthy food, creating urban food deserts. At the same time, cultural traditions and conventions often mean that foods with a high caloric value play an important part in creating social bonds.[16]

The programme has started to explore potential responses to these challenges through engagement with different organisations. A potential collaboration could be with the EAT Foundation, an NGO with the ambition to reform the global food system to feed a growing global population with healthy food from a healthy planet.

"Behaviours associated with living in poorly planned cities – such as sedentary lifestyles and the overconsumption of ultra-processed foods – contribute to obesity and many non-communicable diseases. Too many marginalised urban populations simply lack access to affordable and nutritious foods."

DR SUDHVIR SINGH, DIRECTOR OF POLICY, EAT FORUM

4 NEW URBAN AGENDA

In 2016, the United Nations Habitat III conference set the agenda for the future of urbanisation. This was an important milestone in putting urban health on the city agenda globally and, as stated in *The Lancet*, in providing the opportunity for the new urban agenda to "draw more upon expertise and stakeholders in the health arena".[89]

In support of the effort to elevate health on the urban agenda, Dr Faith Foreman, assistant director of Houston's Health Department, joined the event as an advocate for collaborating across sectors to achieve better urban health, drawing on her experience from the Cities Changing Diabetes partnership. Partners in the programme also signed an open letter in *The New York Times* calling for health to be central to the discussions:

"Current action does not reflect the scale of the crisis. First-hand experience has shown we need to look afresh at what's driving the epidemic. If we don't find new approaches, the threat of NCDs will overwhelm the health systems we depend on, compromise the quality of life we enjoy and seriously constrain the future economic prosperity that cities have the power to drive."

EXTRACT FROM THE OPEN LETTER ON URBAN DIABETES, THE NEW YORK TIMES, 2016

5 CHILDHOOD OBESITY

The World Health Organization describes childhood obesity as one of the most serious public health challenges of the 21st century.[90] The Diabetes Projection Model shows the significant impact that can be achieved by preventing obesity in future generations. To bend the curve on diabetes for the long term, preventing childhood obesity must be a key part of any city's urban diabetes action plan.

"A child with obesity faces a fourfold greater risk of being diagnosed with diabetes by the age of 25 than their counterpart who is of normal weight."[91]

DR ALI ABBASI, EPIDEMIOLOGIST, KING'S COLLEGE LONDON

6 VULNERABILITY AND RISK

Addressing the sociocultural factors causing disease is now recognised as central to achieving better public health. Doing so helps to focus attention on vulnerability and risk and, therefore, on the opportunity to prevent people developing diabetes. The Healthy Cities Research Hub has been set up to drive this research forward in cities, focusing on the social and environmental conditions that impact health in urban settings throughout North America. Funded by a three-year, 2.4 million US dollar grant from the Robert Wood Johnson Foundation, the hub has been created at the University of Texas, School of Public Health.[46]

"We're excited to draw out specific lessons from Cities Changing Diabetes's global work to inform our efforts to transform United States cities into places that enable everyone in our diverse society to lead healthier lives now and for generations to come."

DR ALONZO PLOUGH, CHIEF SCIENCE OFFICER, ROBERT WOOD JOHNSON FOUNDATION

Rome, Italy

The experience and research tools developed through the Cities Changing Diabetes partnership are now drawn together into the Urban Diabetes Toolbox, making them publicly available so that any city can use them to help set their own goals and create an action plan for their city.

Cities Changing Diabetes is committed to at least doubling the number of cities involved in the fight against urban diabetes. In 2018, the programme will enable at least five new cities to use the Urban Diabetes Risk Assessment to determine the priorities of their citizens and to help shape their action plans.

The partners in Cities Changing Diabetes call on all cities to accelerate action. Working together, we can bend the curve on diabetes globally.

ABOUT DIABETES AND OBESITY

DIABETES

Diabetes is a chronic disease that occurs when the body cannot produce enough insulin or cannot use insulin effectively, which can lead to chronic high blood glucose levels. Consistently high blood glucose levels can lead to serious diabetes-related complications, such as cardiovascular disease, blindness, kidney failure and lower-limb amputation.[4] There are different types of diabetes, but the main types are type 1 and type 2.[4]

Type 1 diabetes is an autoimmune disease where the body's immune system attacks and destroys the insulin-producing cells of the pancreas. It is most common in children and young people but can also develop later in life. Why type 1 diabetes occurs is not entirely understood, nor can it be prevented or cured. People with type 1 diabetes are dependent on daily insulin injections for survival.[4]

Type 2 diabetes is the most common form of diabetes, accounting for about 87–91.0% of all cases in high-income countries.[4] It generally occurs in middle-aged and older people but the age of diagnosis is decreasing, and it is becoming increasingly common in children, adolescents and young adults who are overweight.[4] Type 2 diabetes is often asymptomatic, and between 9–12 years can lapse before any distinct symptoms become apparent.[92] Type 2 diabetes can be prevented or significantly delayed.[3]

Diabetes morbidity and mortality
Due to often delayed diagnosis, diabetes complications are especially common among people with type 2 diabetes, with at least one complication being present at the time of diagnosis.[93] People with diabetes are at high risk of developing many disabling and life-threatening complications.[3,4]

Globally, diabetes is responsible for one death every six seconds.[4] In 2015, diabetes was reported to have caused about 5 million deaths worldwide[4] – and it is the sixth leading cause of disability globally.[94]

The high cost of diabetes and its complications
In 2015, it was estimated that worldwide medical care for diabetes cost 673 billion dollars, accounting for 11.6% of global expenditure on health.[4] This number is predicted to continue rising – estimates for 2040 indicate that it could reach 802 billion dollars.[4] The primary cost driver behind diabetes is its complications, with hospital inpatient care accounting for the greatest portion of diabetes-related health expenditure.[95,96]

DIABETES-RELATED COMPLICATIONS[4]

- CARDIOVASCULAR DISEASE
- BLINDNESS
- KIDNEY FAILURE
- LOWER-LIMB AMPUTATION

OBESITY

At the simplest level, obesity is a disease associated with abnormal or excessive fat accumulation that may impair health.[10] However, it is a complex and multifactorial disease that is influenced by genetic, physiological, environmental and psychological factors.[98]

A reliable way to determine whether a person has too much body fat is to calculate the ratio of their weight to their height squared. This ratio, called the body mass index (BMI), accounts for the fact that taller people have more tissue than shorter people and so tend to weigh more (Table 1).[98]

Overweight and obesity contribute significantly to the rising burden of NCDs
Overweight and obesity may seriously affect a person's health, quality of life and life expectancy.[99,100] Obesity is associated with multiple comorbidities, including prediabetes and type 2 diabetes, cardiovascular disease, osteoarthritis, obstructive sleep apnoea and certain types of cancers.[101–104]

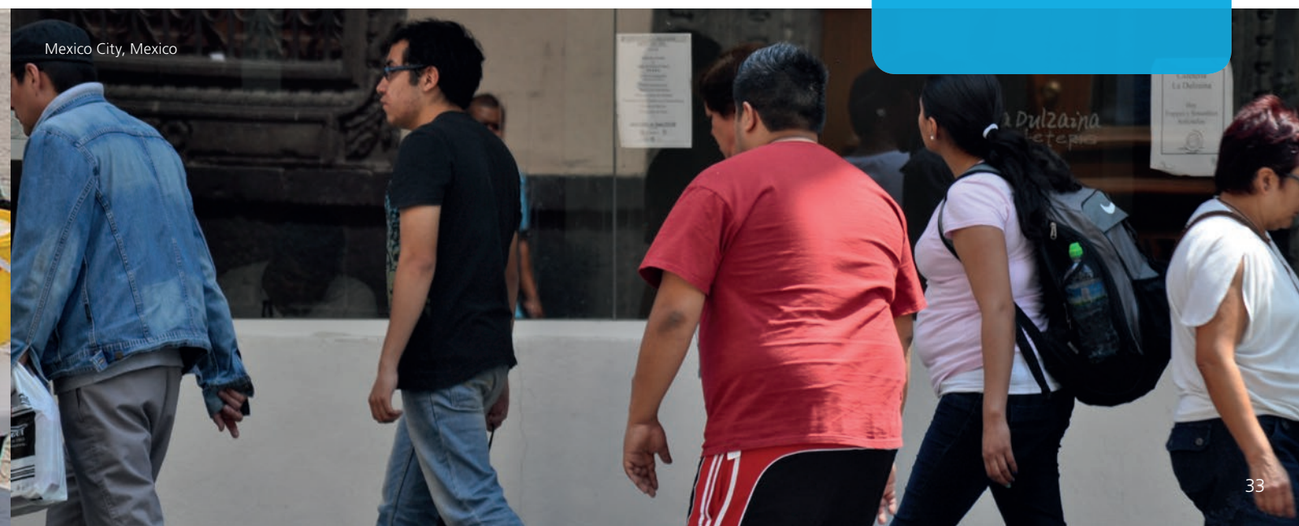
Table 1: Classification based on BMI[98]

Classification	BMI
Underweight	< 18.5
Normal range	≥ 18.5 and < 25
Overweight	≥ 25 and < 30
Obesity	≥ 30
Moderate obesity (class I)	≥ 30 and < 35
Severe obesity (class II)	≥ 35 and < 40
Morbid obesity (class III)	≥ 40

OBESITY ACCOUNTS FOR:[11]

- **44.0%** OF THE GLOBAL DIABETES BURDEN
- **23.0%** OF THE GLOBAL ISCHAEMIC HEART DISEASE BURDEN
- **7–41.0%** OF THE GLOBAL BURDEN OF CERTAIN CANCERS


Johannesburg, South Africa


Mexico City, Mexico


Johannesburg, South Africa

BACKGROUND INFORMATION

CITIES CHANGING DIABETES

The Cities Changing Diabetes programme is a commitment to drive action against type 2 diabetes and obesity in cities on a global scale. Our ambition is to raise the issue on both the global health agenda and the agenda of those shaping cities for the future. We aim to improve understanding of the principal factors behind the rise of diabetes in urban settings, then share and apply that knowledge to real-world solutions for people to live healthier lives.

We believe the best results can be achieved when we work together across sectors and disciplines. This makes public–private partnerships essential to improve health in cities.

A UNIQUE GLOBAL PARTNERSHIP

Cities Changing Diabetes was initiated in 2014 by three global partners: Steno Diabetes Center Copenhagen, University College London and Novo Nordisk. Given the nature and scale of the challenge, we have built a partnership on urban diabetes that extends beyond the three global partners.

We are committed to developing new ways of collaborating with a wide range of stakeholders across the city system: from city governments, academics, businesses, schools and city planners to independent healthcare and patient organisations and other NGOs. This means forging new partnerships and networks that engage all sectors of the community to impact citizens who are often not reached by the formal healthcare system.

THE FOUNDING PARTNERS

Novo Nordisk
Novo Nordisk is at the forefront of one of today's great health challenges: diabetes. As a specialist in diabetes treatment, the company is committed to finding the next generation of medicines through long-term investment in innovation. The company's key contribution is to discover and develop these medicines, manufacture them to scale and make them accessible wherever they are needed. But living with chronic disease is about more than getting the right medicine. That is why Novo Nordisk works on helping people to receive the right treatment and achieve the right outcomes. The company is committed to playing its part in the global fight against diabetes, and Cities Changing Diabetes is at the heart of this commitment.

For more information, visit novonordisk.com.

Steno Diabetes Center Copenhagen
Steno Diabetes Center is a world-leading institution in diabetes care and prevention, with a focus on the early stages of the disease. Established by Novo Nordisk A/S in 1932, the centre is a not-for-profit organisation working in partnership with the Danish healthcare system. The centre was transferred to the Capital Region on 1 January 2017 to become Steno Diabetes Center Copenhagen. As a global partner in Cities Changing Diabetes, Steno Diabetes Center Copenhagen draws on its experience in creating innovative and sustainable approaches to tackling diabetes at community level, and its work on training healthcare professionals in cities across the world and its expertise in providing care in Copenhagen. The centre expects to make a significant contribution to the fight against urban diabetes.

For more information, visit sdcc.dk.

University College London
Over the last few years, University College London has put its weight behind understanding the impacts of urbanisation. Under the banner of its 'Grand Challenge' commitments to global health, sustainable cities, intercultural interaction and human well-being, a cross-disciplinary group has sought to contribute to urban sustainability by identifying health vulnerabilities and addressing the modifiable risk factors that can reduce the impact of NCDs globally. Applied researchers at University College London are delighted to bring their expertise to bear through supporting innovative work with global partners that will underpin Cities Changing Diabetes. More than that, their approach is aimed at making an impact that is sustainable into the future, giving new momentum to this global initiative.

For more information, visit ucl.ac.uk.

novo nordisk®

REGION H Steno Diabetes Center Copenhagen

UCL

FIGURE 11: CITIES CHANGING DIABETES TIMELINE

2014 MARCH
Cities Changing Diabetes programme launched in **Mexico City**

2014 AUGUST
Cities Changing Diabetes launched in **Copenhagen**

2014 NOVEMBER
Cities Changing Diabetes launched in **Houston**

2014 NOVEMBER
Cities Changing Diabetes launched in **Tianjin**

2014 NOVEMBER
Cities Changing Diabetes launched in **Shanghai**

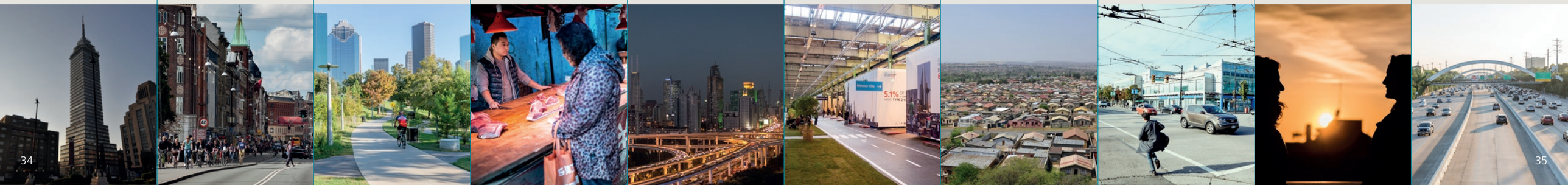
2015 NOVEMBER
The Cities Changing Diabetes summit 2015 held in **Copenhagen**

2016 APRIL
Cities Changing Diabetes launched in **Johannesburg**

2016 NOVEMBER
Cities Changing Diabetes launched in **Vancouver**

2017 JANUARY
Cities Changing Diabetes launched in **Rome**

2017 OCTOBER
The Cities Changing Diabetes summit 2017 held in **Houston**



BACKGROUND INFORMATION

THE URBAN DIABETES RISK ASSESSMENT

Engaging with urban citizens to co-create city-level interventions and policies to prevent and manage diabetes.

The Urban Diabetes Risk Assessment enables researchers to engage with citizens at increased risk for type 2 diabetes or those living with diabetes to explore further how eight predefined social factors and cultural determinants (Infobox 1, page 9) impact capabilities, decisions and behaviours related to health, well-being and diabetes in a given city.

The tool draws on the principles of Q-methodology,[105] which is a technique for the systematic and scientific study of participant subjectivity, or, in other words, a person's subjective viewpoint. The technique is increasingly being used by researchers to explore health-related decision-making and behaviours. Unlike many other qualitative research techniques, the assessment is not purely interview-based, but employs a mixture of data collection and analyses to obtain insights.

Data collection is split into two main phases: the first being self-administered, computer-based data collection and the second consisting of focus group interviews and workshops. The computer-based and focus group data are analysed separately using statistical and content analyses respectively. Results from both phases are synthesised at the end of the study to inform a final analysis. The computer-based component is completed via a web-based data collection tool that has been specially set up for Cities Changing Diabetes by University College London and that can be further customised as needed. In the focus groups and workshops, participants, researchers (and stakeholders, if interested) explore the results from the computer-based data collection, adding depth and detail to the statistical data, following a Cities Changing Diabetes-specific interview protocol.

COMPUTER-BASED DATA COLLECTION

- **Step 1: Demographic data collection**
  First participants complete a demographic survey, which collects basic, up-to-date, self-reported information on socioeconomic status, household and workplace environments, health insurance, chronic disease history, diabetes complications, and height and weight. The input is used to add context and assist in the assessment. It is also used to track the diversity of respondents and identify whether the sampling plan needs to be adjusted.

- **Step 2: Statement sorting activity (Q-sort)**
  After completing the demographic survey, participants conduct a statement sorting task; this is called the Q-sort.[105] Here, participants rank statements about health, well-being and diabetes according to their personal preference. Participants sort the set of 64 statements twice, firstly into three broad fields (agree, neutral, disagree) (Infobox 3).

  After the initial sort, the participants arrange the pre-sorted statements into a specially designed matrix (Figure 12). The layout of the matrix encourages participants to relate the statements to one another and think carefully about which statements should take priority over others. Participants are then given the opportunity to comment on any statements in an open-ended fashion and provide general feedback.

The research team receives the data as a statistically analysable file, which includes all demographic data and the results of the Q-sort. Analyses of the Q-sort data allow researchers to group participating individuals into sub-groups according to what matters most to them regarding their experience of being at increased risk for type 2 diabetes or living with diabetes in a specific community. Each sub-group will be characterised by the demographic data, the priority statements (particularly those at the extreme ends of the sorting matrix, ie those at +6/-6 = strongly agree/disagree with) and the comments left in the open-ended section of the online data collection tool. Those participants whose Q-sorts most closely match a sub-group are invited to participate in the focus groups.

FACE-TO-FACE ENGAGEMENT

Through focus group discussions or workshops, the assessment then provides an opportunity for selected study participants to have their voices heard in the research process. The focus groups are used to enhance the quality and strength of the results of the online data collection. In the focus groups, participants are provided with the opportunity to clarify and comment on the statements, on their individual decisions regarding ranking of the statements as well as on the preliminary results from any analysis completed by the researchers. Participants are also asked to reflect on how various sociocultural factors impact their vulnerability to diabetes and to provide their perspective on diabetes prevention and management interventions.

In addition, the focus groups serve as an opportunity to bring together participants, community leaders and other stakeholders to discuss barriers and opportunities for successful interventions.

A final analysis synthesises all salient data to establish the study findings. These findings can be used to inform diabetes prevention and management interventions by contributing new knowledge about how sociocultural factors create specific barriers to, and opportunities for, successful diabetes prevention and better diabetes care and management in any community.

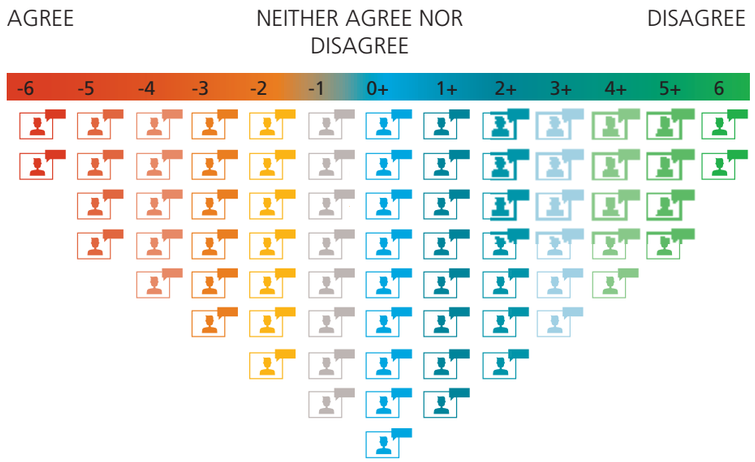
Mexico City, Mexico

INFOBOX 3: SAMPLE OF FIVE STATEMENTS FROM THE Q-SORT

- DIABETES IS THE LEAST OF MY WORRIES.
- WHEN IT COMES TO BUYING FOOD, I THINK THAT QUANTITY IS MORE IMPORTANT THAN QUALITY.
- THE WAY I MAKE DECISIONS ABOUT MY HEALTHCARE IS MOSTLY DEPENDENT ON HOW MUCH MONEY I HAVE.
- LIVING IN THE CITY IS STRESSFUL AND HARMFUL TO MY HEALTH AND WELLBEING.
- EVERYBODY JUST SEEMS TO BE A BIT BIGGER NOWADAYS.

FIGURE 12: THE Q-SORT MATRIX

PARTICIPANTS ARRANGE THE 64 PRE-SORTED STATEMENTS ACROSS THE MATRIX.



BACKGROUND INFORMATION

DIABETES PROJECTION MODEL METHODOLOGY

The Diabetes Projection Model is a tool that plots the trajectory of diabetes in any city over time. It allows cities to forecast the impact that reducing obesity could have on both the prevalence and cost of diabetes. Using the model, it is possible to understand the scale of the challenge and set a goal for what it will take to bend the curve on diabetes in any city.

The model relies on existing data sources and relationships documented in published literature to forecast the prevalence of diabetes, and illustrates how reducing the prevalence of obesity could reduce the burden of diabetes.

As diabetes risk factors vary considerably among individuals, the primary aim of the model is to deliver results that are sufficiently complex to be credible and yet simple enough to be understood by a broad range of stakeholders.

DATA SOURCES

Detailed population data and population projections for the years 1975–2100 were obtained from NCDRisC.org.[106] For each country, the actual and projected population was divided into 15 age groups. For 1975–2014, the population in each age group was also divided into seven weight categories according to WHO BMI classes.[98] For every country and age group, the share of people in each weight sub-group was extrapolated to produce projections for 2015–2100, assuming a linear trend.

Data on diabetes prevalence were pulled from the *2015 IDF Atlas*.[4] The atlas estimates diabetes prevalence (both diagnosed and undiagnosed) in 2014 for most countries in the world and leverages 196 sources from 111 countries.[107]

The Diabetes Projection Model outputs for the eight cities draw on local data collected as part of the individual city research initiatives, such as the Rule of Halves analysis and other published sources.

ASSUMPTIONS

The diabetes prevalence in the model is based on two assumptions, which are documented in the literature:

- There is a significant relationship between diabetes prevalence and age: the higher the age, the greater the diabetes prevalence.[108]
- There is a significant relationship between diabetes prevalence and weight category/BMI: the higher the BMI, the greater the diabetes prevalence.[109]

By applying the diabetes prevalence of each age and BMI group to each country's population, it is possible to estimate the diabetes population, including diagnosed and undiagnosed people (Figure 13).

CALIBRATION

The model was calibrated with regional data from the *2015 IDF Atlas*.[4] Thus, the model takes into account differences in way of life, nutrition and genetic disposition for diabetes.

OUTPUTS

Scenarios

The main output from the model is two scenarios:

- **Scenario 1:** Linear growth in obesity (the increase in adult obesity prevalence is allowed to continue along current trends).
- **Scenario 2:** Global diabetes prevalence is held at a maximum of 10% by 2045 (weight distribution remains at 2017 levels and the rate of obesity is reduced by 25% in 2045).

Healthcare expenditure

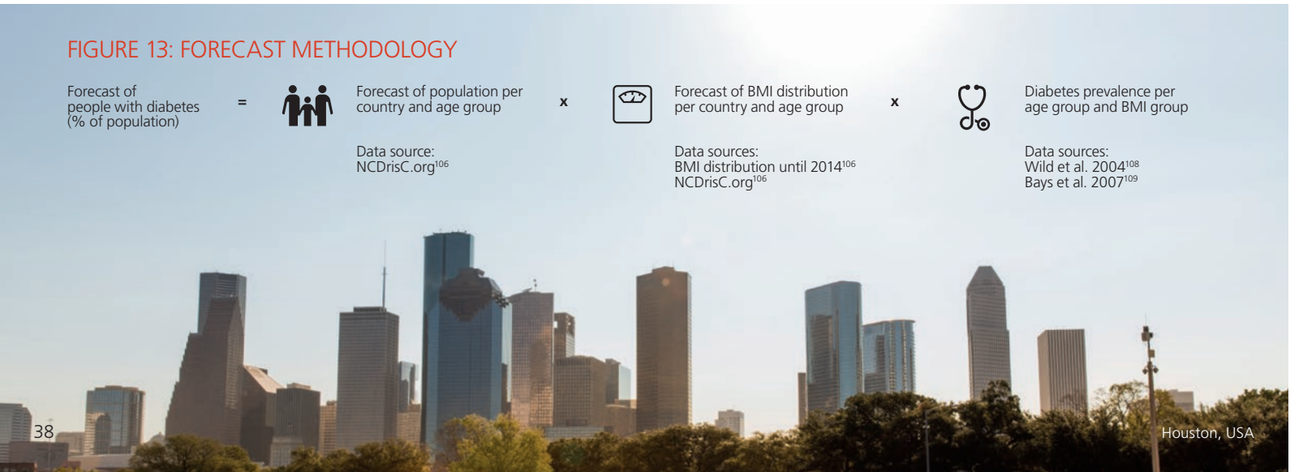
The model also estimates the global and country-specific diabetes-attributable healthcare expenditure. The calculations use country-specific IDF estimates, which assume that healthcare expenditures for people with diabetes are on average two times higher than for people without diabetes, and provide an average health expenditure per person with diabetes per country in 2014.[4]

VALIDATION

The model was reviewed and validated by a Delphi Board of experts.

For the full methodology please contact Cities Changing Diabetes at contactCCD@novonordisk.com.

FIGURE 13: FORECAST METHODOLOGY



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