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Evaluation of the Long-Term Impact of Improving Care for People with Type 2 Diabetes in China

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ABSTRACT

Background: The member states of the United Nations launched 17 sustainable development goals (SDGs) as part of the 2030 Sustainable Development Agenda. SDG target 3.4 focused on reducing premature mortality from noncommunicable diseases by one-third by 2030 through prevention and treatment and promoting mental health and well-being. Diabetes is associated with significant clinical and economic burden in China. **Objectives:** To examine the impact of improving care for people with diabetes in China, and how this relates to achieving SDG target 3.4. **Methods:** Long-term outcomes were projected for people with type 2 diabetes meeting treatment targets recommended by the Chinese Diabetes Society versus remaining at current care. Baseline characteristics were taken from the China Noncommunicable Disease Surveillance Study. Costs of treating diabetes-related complications were accounted in 2015 Chinese yuan (CNY). Outcomes were discounted at 3% annually when appropriate. **Results:** Bringing people with diabetes to treatment targets was associated with improved mean undiscounted life expectancy compared with current care (by 0.42 years). Nationally, discounted cost savings of up to CNY540 billion could be generated as a result of reduced onset of diabetes-related complications if all people with diabetes achieved treatment targets. Bringing people to treatment targets reduced premature mortality from diabetes by 6% compared with current care. **Conclusions:** Long-term projections suggested that bringing people with diabetes to treatment targets resulted in improved life expectancy and significant cost savings. However, this was not sufficient to meet SDG target 3.4, indicating that diabetes prevention should form a key objective in China.

Keywords: care, China, cost, diabetes mellitus, long term, sustainable development goals.

Introduction

Of the 415 million people with diabetes worldwide in 2015, 109 million were living in China, and this is predicted to increase to 130 million by 2030 [1]. The prevalence of diabetes is increasing faster in China than in any other country worldwide [1]. A number of contributing factors for this rapid increase have been suggested. People in China are at increased risk of developing type 2 diabetes at lower body mass index (BMI) than Europeans, and therefore other changes such as increased urbanization, increasingly sedentary lifestyles, and changes in diet may have a greater impact in China than in other countries [2]. The direct medical cost of diabetes in China has been estimated to be US $5.1 billion to US $8.8 billion [1]. Analysis of patient-level data has shown that a key driver of this is diabetes-related complications, with costs increasing as people develop more complications [3].

Data from a number of large-scale studies and meta-analyses have shown that improving glycemic control, as measured by glycated hemoglobin (HbA_{1c}), can reduce the incidence of micro- and macrovascular diabetes-related complications in people with type 2 diabetes [4–10]. Therefore, maintaining glycemic control forms the mainstay of treatment of the condition. However, data have also shown that people benefit from a multifactorial approach to treatment where, in addition to maintaining tight glycemic control, treatment aims to minimize the risk of hypoglycemia, control cardiovascular risk factors such as blood pressure and serum lipid levels, and reduce or control body weight [11,12]. Controlling these factors may also result in improved adherence to medications and therefore improved glycemic control. On the basis of this evidence, the Chinese Diabetes Society has released treatment guidelines, which include targets for risk factors for developing diabetes-related complications [13]. These guidelines, however, may not always be followed and people with diabetes are often not achieving treatment targets [14]. Not achieving treatment targets increases the risk of developing diabetes-related complications, increasing the clinical and

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economic burden. Bringing people with diabetes in China to treatment targets will reduce the clinical burden and the economic burden for health care payers.

On September 25, 2015, the 193 member states of the United Nations launched 17 sustainable development goals (SDGs) as part of the 2030 Sustainable Development Agenda, aiming to end poverty, protect the planet, and ensure prosperity for all [15]. The 17 SDGs comprise 169 targets, and SDG target 3.4 is to reduce premature mortality from noncommunicable diseases (NCDs) by one-third by 2030 through prevention and treatment and to promote mental health and well-being. This SDG target is particularly pertinent to China because NCDs account for 87% of deaths in China, and the probability of premature mortality from NCDs, defined by the World Health Organization (WHO) as death between the ages of 30 and 70 years from any cardiovascular disease, cancer, diabetes, or chronic respiratory disease, in China is 19% [16]. The government in China has shown that it is committed to reaching the SDGs set by the United Nations by releasing the Health China 2030 blueprint on October 25, 2016 [17]. This document sets out a number of targets based on 13 core indicators to be reported in 2020 and 2030, including a 30% relative reduction in premature mortality from NCDs and an increase in the mean life expectancy to 79 years [17].

The present study aimed to investigate the long-term impact of improving care for people with type 2 diabetes in China. The analysis examined the impact of bringing people with type 2 diabetes to recommended treatment targets, compared with remaining at current care, aiming to quantify how improving care related to improved clinical outcomes for people with diabetes, cost savings for health care payers, and achieving SDG target 3.4 that aims to reduce premature mortality from NCDs by one-third.

Methods

Model Description and Modeling Approach

The analysis was performed using the QuintilesIMS CORE Diabetes Model, the architecture, assumptions, features, and capabilities of which have been previously published [18]. The model is a validated, non–product-specific diabetes policy analysis tool and is based on a series of interdependent submodels that simulate the complications of diabetes (angina, myocardial infarction, congestive heart failure, stroke, peripheral vascular disease, diabetic retinopathy, macular edema, cataract, hypoglycemia, ketoacidosis, lactic acidosis, nephropathy including end-stage renal disease, neuropathy, foot ulcer and amputation, and nonspecific mortality). Each submodel has a semi-Markov structure and uses time, state, time in state, and diabetes type–dependent probabilities derived from published sources. Monte-Carlo simulation using tracker variables overcomes the memoryless properties of the standard Markov model and allows interconnectivity and interaction between individual complication submodels. Long-term outcomes projected by the model have been validated against real-life data in 2004 and more recently in 2014 [19,20].

In the present analysis, a simulated cohort of 1000 people was run through the model 1000 times for each simulation (base-case and sensitivity analyses). Mean values and standard deviations (SDs) were generated for long-term outcomes (life expectancy, quality-adjusted life expectancy, cumulative incidence of diabetes-related complications, time to onset of diabetes-related complications, and direct medical costs). A lifetime time horizon was applied in the base case (50 years) to capture all relevant long-term complications and associated costs, with background mortality captured based on WHO life tables [21]. This approach is in line with guidance on the assessment of the cost effectiveness of diabetes interventions [22]. Future costs and clinical benefits were discounted symmetrically by 3% per annum.

Simulated Cohort and Treatment Targets

The baseline cohort characteristics were chosen to reflect the average person with type 2 diabetes in China, thereby reflecting current care, on the basis of the China NCD Surveillance Study, supplemented with data from A1chieve and DiabCare (Table 1) [23,24]. Treatment targets, including HbA_{1c}, systolic and diastolic blood pressure, serum lipid levels, and BMI, were based on recommendations released by the Chinese Diabetes Society in 2016 (Table 1) [13]. In the treatment targets arm, all people were assumed to receive optimal treatment, achieving all recommended treatment targets and remaining at them for the duration of their lifetimes. In the current care arm, physiological parameters remained unchanged in all people, continuing to reflect the average person with type 2 diabetes in China. Differences between the two treatment arms were maintained for the duration of the analysis. Adherence to diabetes medications was not captured, because of the theoretical comparison of optimal treatment with current standard of care.

Costs and Utilities

Costs were accounted in 2015 Chinese yuan (CNY) from a health care payer perspective, capturing only direct costs. Annual costs of treating diabetes-related complications in the year of the event and in following years were taken from a published cross-sectional survey of 20 directors and deputy directors of endocrine and metabolism departments of hospitals across China [25]. No cost was associated with improving care, because of the theoretical nature of the analysis. However, this allows the budget available to improve care for people with type 2 diabetes without increasing overall health care spending to be identified. To capture the impact of diabetes-related complications on quality of life, utilities were taken from published sources [18,26,27]. Event disutilities were applied in the year that a complication occurred, with state utilities applied in subsequent years.

Table 1 – Baseline characteristics of people with type 2 diabetes and recommended treatment targets.

Characteristic	Mean	Treatment target	Change required to meet target
Age (years)	53.4	–	–
Duration of diabetes (years)	6.0	–	–
HbA_{1c} (%)	7.29	7.0	−0.29
Systolic blood pressure (mm Hg)	144.30	140	−4.30
Diastolic blood pressure (mm Hg)	80.00	80	0.00
Total cholesterol (mg/dl)	174.01	174.0	0.00
LDL cholesterol (mg/dl)	99.38	100.5	0.00
HDL cholesterol (mg/dl)	40.99	38.7	0.00
Triglycerides (mg/dl)	185.11	150.5	−34.66
BMI (kg/m^2)	25.30	24.0	−1.30

Note. The cohort reflected the average person with type 2 diabetes in China [23,24]. Treatment targets were based on recommendations released by the Chinese Diabetes Society in 2016 [13].
BMI, body mass index; HbA_{1c}, glycated hemoglobin; HDL, high-density lipoprotein; LDL, low-density lipoprotein.