

# Examining the Health Care Equation

## Actuarial perspectives on cost and quality

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### Key Points

- The number of adults who have been diagnosed with diabetes worldwide has more than doubled over the past three decades.
- Appropriate data can provide information on the extent of growing diabetes costs, and facilitate setting priorities and strategies to combat the problem.
- Many countries use societal interventions to reduce the costs of diabetes, including enhanced education to promote prevention, improvements in data collection, and greater deployment of information technology.
- Education and training to healthcare providers on diabetes care, integrated care, chronic disease management programs, and shifting patients from costly settings to less costly patient-centered programs have been used by different countries to make diabetes management more cost effective.

## Curbing the High Cost of Diabetes

U.S. health care spending consumed 17.2 percent of gross domestic product in 2012. With that share projected to grow at an average annual rate of 5.8 percent over the next decade, reducing costs associated with chronic diseases such as diabetes will be a major priority.

The United States isn't the only country facing escalating health care costs. Sadly, it also isn't the only country that's dealing with ballooning rates of diabetes. The prevalence of diabetes for adults aged 25 and above has either risen or remained unchanged in every region of the world (see Table 1), according to an international study by the British medical journal *The Lancet*. Worldwide, the number of adults who have been diagnosed with diabetes has more than doubled over the past three decades. While this increase is mostly due to population growth and aging, about 30 percent is attributable to an increase in prevalence rates of diabetes.

**Table 1: Number of Adults with Diabetes and Prevalence Rates**

	1980	2008	Increase
Number of adults with diabetes worldwide	153 million	347 million	> 2 times
Age standardized adult prevalence, male	8.3 percent	9.8 percent	18 percent
Age standardized adult prevalence, female	7.5 percent	9.2 percent	23 percent

Source: *The Lancet*, July 2011

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In recognizing the importance of intervention, on the individual and societal level, many countries are testing new policies and incentives to reduce the risk of developing diabetes, delay its onset, or reduce its severity and consequent treatment costs. The American Academy of Actuaries' Health Practice International Task Force developed this issue brief to explore current diabetes mitigation efforts in seven specific countries: Australia, Canada, Israel, Singapore, South Africa, the United Kingdom, and the United States.

## Diabetes Data

Diabetes is a chronic disease of high blood glucose, that leads to serious and costly complications if left uncontrolled. These include blindness, stroke, heart disease, kidney failure, or leg amputations. The three main types of diabetes are:

- **Type 1 diabetes** occurs when the body fails to produce enough insulin, a hormone that regulates blood sugar. Type 1 diabetes is generally diagnosed during childhood and accounts for about 10 percent of those diagnosed with the condition.
- **Type 2 diabetes** occurs when the pancreas produces insulin but the body's cells fail to use it properly. It usually appears after age 30, and its prevalence increases with age. In the United States, for example, the prevalence of diabetes among adults aged 45 to 64 is four and half times higher than among those aged 20 to 44. Type 2 diabetes develops gradually over many years, and people with pre-diabe-

tes often are unaware they have high blood sugar levels and are at risk of developing diabetes. Type 2 diabetes accounts for about 90 percent of diabetics in most countries.

- **Gestational diabetes** occurs when pregnant women, not previously diagnosed with diabetes, develop high blood glucose levels. Similar to Type 2 diabetes, it may pass after the pregnancy or develop into full-blown Type 2 diabetes.

A major difference between Type 1 and Type 2 diabetes is prevention. While Type 1 diabetes isn't preventable, better health decisions such as proper diet and regular exercise can help avert Type 2 diabetes. All types of diabetes can be controlled effectively through early diagnosis, diet management, a healthy lifestyle, exercise, and, for some people, medication.

Figure 1 displays 2010 diabetes expenditures in seven selected countries and worldwide, and Figure 2 compares the 2011 and projected future diabetes prevalence rates and health expenditures for those same countries and worldwide.<sup>1</sup>

In 2010, health expenditures on diabetes were estimated to be 11.6 percent of total health expenditures in the world, with an average annual per-person expenditure of about \$700. The mean diabetes-related expenditure per person varied considerably from country to country, ranging from less than \$10 per person in countries such as Myanmar, Cote d'Ivoire, and Burundi, to \$7,383 per person in the United States. As shown in Figure 1, although Singapore spent the highest percentage of health expenditure on diabetes at 15 percent, its diabetes cost per

<sup>1</sup>The data comes from articles published in *Diabetes Research and Clinical Practice*, the official journal of International Diabetes Federation (IDF), an umbrella organization of more than 200 national diabetes associations in more than 160 countries.

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person was significantly lower than that of the United States, at \$1,129.

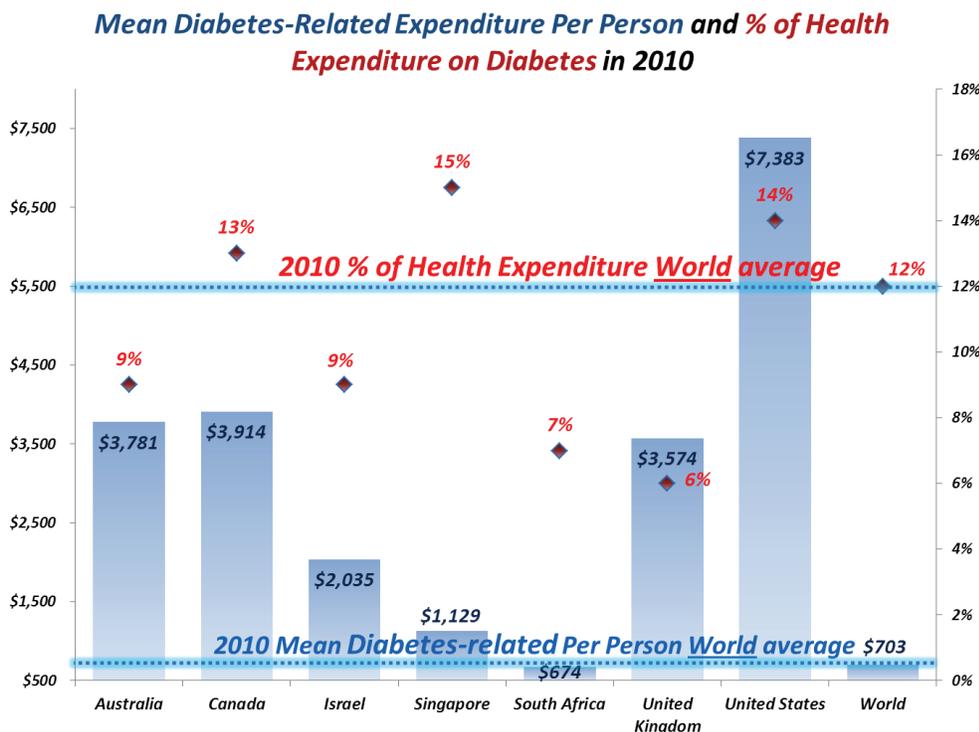
Total health expenditures for each country were estimated based on per capita health expenditure data from the World Health Organization (WHO) and population estimates from the United Nations. The health expenditures included all spending for medical care regardless of payer and included expenditures for public health programs and medical research, but excluded the unpaid caregiving of family members, relatives, and others. Health expenditures on diabetes were estimated using a formula that combined estimates of national health spending, diabetes prevalence by country, and the ratio of

expenditure for persons with diabetes to persons without diabetes (R).<sup>2</sup>

The IDF defines prevalence as the proportion of the people with diabetes among adults aged 20-79 years. The IDF estimated this by applying logistic regression models to country-level prevalence data. The IDF estimated the world's average prevalence of diabetes for adults in 2011 to be 8.3 percent and projected it to increase to 9.9 percent in 2030 – a 19 percent increase over the next two decades. This growing prevalence is driven by a combination of factors, including aging populations, greater longevity, and continuing urbanization in developing countries. The IDF's method for projections took into ac-

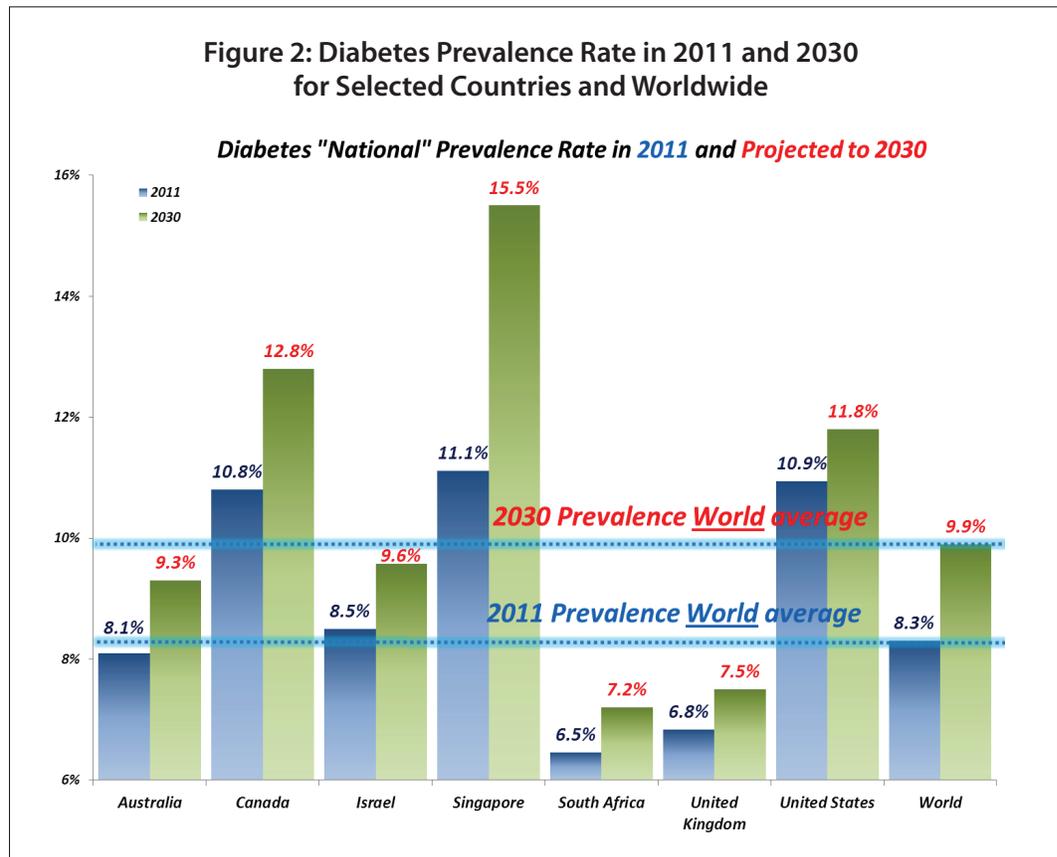
<sup>2</sup>In calculating the diabetes expenditure, authors of the IDF article assumed R having a lower and upper bounds of 2 and 3. Percent of health expenditure on diabetes was only shown for R = 2. Therefore, we are using R=2 for health expenditure shown in Figure 1 and Table 2.

**Figure 1: Share of Health Expenditure on Diabetes and Mean Per-Person Diabetes-Related Expenditures, R=2**



Source: International Diabetes Federation, [www.idf.org/sites/default/files/Economic\\_impact\\_of\\_Diabetes.pdf](http://www.idf.org/sites/default/files/Economic_impact_of_Diabetes.pdf)

**Figure 2: Diabetes Prevalence Rate in 2011 and 2030 for Selected Countries and Worldwide**



Source: International Diabetes Federation, November 2011.

count future demographic changes (age, sex, and urbanization) but didn't assume increases in diabetes incidence. If future changes in risk factors were to increase incidence, the projections would likely be understated.

Among the selected seven countries, Singapore had the greatest prevalence at 11.1 percent in 2011, and was projected to have the fastest growth with a projected prevalence of 15.5 percent in 2030. South Africa had the lowest prevalence at 6.5 percent in 2011. The United Kingdom and South Africa were projected to have the slowest growing diabetes prevalence from 2011 to 2030 (see Figure 2).

### Slowing the Growth of Diabetes

Diabetes imposes a large economic burden on health care systems worldwide. Annual global expenditure for diabetes in 2010 was estimated to be \$376 billion<sup>3</sup> (see Table 2).

The IDF estimated that the total diabetes expenditure among people aged 20-79 years, excluding increases in risk factors and medical inflation, would continue to grow due to population growth and aging. The United States bears the largest expenditures on diabetes, amounting to \$197.8 billion in 2010 – 53 percent of the estimated total global expenditure. By way of contrast, India, the country with the largest population of people with diabetes, was estimated to spend \$2.8 billion – less than 1 percent of the global total.

<sup>3</sup>It could be as high as \$672 billion if R=3.

**Table 2: Health Expenditure for Diabetes in 2010 and 2030 (Projected)  
with R=2, for Selected Countries and Worldwide**

**Health Expenditure for Diabetes in 2010 and 2030 for Select Countries (\$ in millions)**

<i>Year</i>	<i>Australia</i>	<i>Canada</i>	<i>Israel</i>	<i>Singapore</i>	<i>South Africa</i>	<i>United Kingdom</i>	<i>United States</i>	<i>World</i>
<b>2010</b>	\$4,105	\$11,217	\$649	\$493	\$865	\$7,648	\$197,956	\$375,984
<b>2030</b>	\$5,650	\$15,494	\$968	\$826	\$1,086	\$9,131	\$264,344	\$490,065
<b>Increase 2010 to 2030</b>	<b>38%</b>	<b>38%</b>	<b>49%</b>	<b>68%</b>	<b>26%</b>	<b>19%</b>	<b>34%</b>	<b>30%</b>

Source: International Diabetes Federation, [www.idf.org/sites/default/files/Economic\\_impact\\_of\\_Diabetes.pdf](http://www.idf.org/sites/default/files/Economic_impact_of_Diabetes.pdf)

Among the selected seven countries, Singapore is projected to have the largest percent increase in diabetes expenditure from 2010 to 2030, while the U.K. is projected to have the lowest percent increase. The measurement of health system cost is affected by the health care financing system of a given specific country. With the exception of the United States and South Africa to a lesser extent, all the countries are subject to some form of national budget limits that dictate capping overall health care costs.

Various countries use many of the same methods to reduce the economic burden of diabetes. Societal interventions include increased funding for diabetes awareness, enhanced education to promote prevention, improvements in data collection, and greater deployment of information technology. At the clinical level, common interventions include educating medical professionals on diabetes care, disseminating best practice guidelines to health care providers, and encouraging the provision of care in less expensive settings.

The risk of diabetes or the development of complications can be effectively reduced with a healthier lifestyle. Raising public awareness to prevent or better manage diabetes can be achieved through a variety of avenues. Information dissemination can be carried out at local, national, and international levels, and can be directed at different audiences: the general public, people with diabetes or pre-diabetes, and health professionals.

## Prevention Programs

### Prevention Directed at Children

Schools are actively involved in addressing growing obesity in the youngest members of society. In Canada, the Comprehensive School Health program promotes healthy eating and active living to address students' health risks. The U.K.'s Healthy Schools Toolkit enables schools to improve their children's health and well-being by better planning, putting in place appropriate services and monitoring outcomes, and the Change4Life program, which aims to improve the nation's health by encouraging students and their families to eat well and become more physically active.

In June 2013, the U.S. Agency for Healthcare Research and Quality performed a comprehensive review of studies on childhood obesity prevention programs for children and adolescents in the U.S. and other high-income countries. Its conclusion, overall, was "there is moderate to high strength of evidence that diet and/or physical activity interventions that are implemented in schools help prevent weight gain or reduce the prevalence of overweight and obesity." But more research is needed to determine the effectiveness of interventions implemented in the home, primary institutions, and the community.

### Private and Public Prevention Programs

In the private sector, many employers and insurers throughout the world have invested in well-

ness programs, with diabetes prevention as one of the main objectives. South Africa's Discovery Health, an insurance and financial services institution, tailors offerings to individual risk profiles and provides lifestyle-intervention and disease-management services through its Vitality program. Large employers such as American Express, with employees throughout the world, have created wellness programs that cater to each country's culture and levels of acceptance.

In Israel, employers, hospitals, private ventures, health maintenance organizations, and the government have all worked to address obesity, lack of physical activity, and diabetes. Current wellness offerings include diet and nutrition counseling and the promotion of physical activity. The Israeli Diabetes Association submitted a proposal to the Israeli Ministry of Health for a national program to prevent Type 2 diabetes. Due to budget constraints, a scaled-down version program eventually was implemented.

Diabetes South Africa, a nonprofit organization, publishes news and research on diabetes care and oversees a network of diabetes support groups. Funded by the state of Victoria, Australia's Life! started providing in 2008 a statewide evidence-based prevention program for those with a high risk of Type 2 diabetes. The program's centerpiece is the Life! Course: six structured group sessions conducted over a period of eight to nine months that encourage participants to reduce the risk of Type 2 diabetes through a healthy diet and active lifestyle.

The U.S. Healthy People 2020, led by the Department of Health and Human Services, is a strategic management tool for use by the federal and state governments. It offers set goals with 10-year targets designed to guide national health promotion and disease-prevention efforts. Objectives include reducing the annual number of new cases of diabetes by 10 percent by 2020 and increasing the proportion of adults with diabetes who have various examinations by 10 percent by the same date. In addition, several major health insurers have wellness programs aimed at pre-

### Individual Risk Factors Associated with Type 2 Diabetes

- Being overweight or obese
- A sedentary lifestyle
- Age
- Family history of the disease
- Genetic predisposition
- Urbanization
- Cultural beliefs

venting diabetes through early detection, identifying diabetics, as well as managing their care.

### Screening for Type 2 Diabetes

Unlike Type 1 diabetes, whose symptoms have an acute onset, Type 2 diabetes is often asymptomatic in its early stages. More than one third of people with Type 2 diabetes are not aware that they have the disease. Although early diagnosis of diabetes/pre-diabetes with follow-up intervention could reduce the burden of diabetes and its complications, it's not cost-effective to screen an entire nation's population. More effective targeting is to screen high-risk individuals. Opportunistic screening of people who are seeking treatment for other conditions is also an option. The South African government did this in 2010, automatically offering measurements of blood sugar and blood pressure at the same time as a screening for tuberculosis was conducted.

### World Diabetes Day

To increase awareness of the health issues connected with diabetes, the United Nations declared Nov. 14 as World Diabetes Day. Celebrated in more than 160 countries and territories by the more than 200 member associations of the IDF, the day supports organized activities that run throughout the year. The theme for the period 2009 to 2013 was diabetes education and prevention.

## Cost-Effective Care

Different countries have adopted a variety of approaches to make the management of diabetes more cost-effective. These include integrated care, chronic disease management programs, and managed care in which patients are shifted from costly settings to more accessible, less costly health professionals and holistic patient-centered programs.

Singapore's use of "right-siting," defined as "patients treated in the most appropriate location by medically competent teams at the lowest possible cost," is similar to the U.S. emphasis on primary care. Several programs in Singapore employ right-siting, and most of them focus on chronic diseases. One is the Chronic Disease Management Program (CDMP), targeting chronic diseases including diabetes, which was launched by Singapore's Ministry of Health in 2006. Under this program, patients are allowed to use their MediSave accounts to help reduce out-of-pocket costs for outpatient treatment. MediSave is a national medical savings account system that allows Singaporeans to set aside income to pay for hospitalization and selected outpatient treatment expenses. The Ministry of Health has published results showing diabetic patients who participated in the CDMP program exhibited improved control of their diabetes. For example, 46 percent of patients who had initial poor levels of glucose control achieved optimal control by the second year of the program.

Another example is the Deliver on Target program initiated by Singapore General Hospital. The hospital partners with local, private primary-care physicians to provide integrated care for diabetes patients. The program aims to shift stable patients away from the hospital to private physicians who have received customized education on diabetes care. As 80 percent of primary-care doctors in Singapore are private, patients who are discharged from the hospital need to be able to go to private primary care doctors rather than the more expensive (and fewer) specialists

at government-subsidized outpatient clinics. To further mitigate cost, patients can purchase subsidized drugs from the hospital, use laboratory vouchers, receive free retinal and foot screening, and use MediSave accounts. This right-siting strategy is expanding to other hospital/physician partnerships.

In Israel, most of the major public hospitals have created centers for treating diabetes and pre-diabetes patients, and many of these centers possess unique goals and characteristics. The Center of Successful Aging with Diabetes at the Sheba Medical Center takes a holistic and integrated approach by caring for the patients' physical, cognitive, and emotional needs. People with diabetes aged 60 and older are invited to a day-long comprehensive examination by a multidisciplinary team consisting of a doctor, neuropsychologist, physical therapist, occupational therapist, and nutritionist. The center creates a personal database to keep track of the patient's condition and recommends treatments based on new research findings. The Sheba Medical Center also conducts innovative research on new diabetes therapies, including cell replacement.

In 2011, the Australian government launched a three-year Diabetes Care Project that uses a coordinated consumer-centric approach to deliver care. The project has four key components: a care facilitator to coordinate care provided by a multidisciplinary team, an education and training program, a disease registry tool, and additional funding for patients with greater needs. The project plans to assess the new models of care in terms of health care outcomes, and patient and practitioner experience in order to determine if they are economically sustainable and scalable nationally.

Funded by the private sector, South Africa launched its Diabetes Management Program in 1996. To address the shortage of trained endocrinologists and experts in diabetes, family doctors and other health care professionals were invited to open accredited centers specializing in diabetes care. Prerequisites to establishing a cen-

ter included: all health care professionals receive training in practical diabetes management techniques; a trained registered nurse must be on staff; and contracted services with a dietician, a podiatrist, and an ophthalmologist. Established care centers receive a monthly capitation fee in advance for each diabetic with medical insurance participating in the program. Since physicians are responsible for all treatment costs, they have an incentive to manage and monitor care optimally and to minimize the risk of costly hospitalization. Over a 10-year period, the number of centers grew from 18 to 160, caring for more than 10,000 people with diabetes, and hospital admission rates were reduced dramatically.

Diabetes care management in the United States has evolved over time. Recent efforts by patient-centered medical homes to provide more coordinated and proactive care in primary care settings and to assign patients to a collaborative team of physicians have shown early success. Other related efforts designed to reduce costly emergency room use and hospitalizations include 24/7 nurse lines, telemedicine options, the expansion of urgent care centers and retail clinics, and disease-management activities.

Another way to reduce costs is through competitive bidding. An example of this is the U.S. Medicare program, managed by the Centers for Medicare & Medicaid Services (CMS), which implemented a new mail-order pharmacy program in July 2013. CMS contracted with 18 private companies through a competitive bidding process to provide diabetic testing supplies. By reducing the number of suppliers from hundreds to the selected 18, the cost was reduced from about \$78 per hundred test strips and lancets to \$22, a 72 percent savings. After market testing, CMS plans to expand the competitive bidding program to durable medical equipment and prosthetics.

### **Deploying Information Technology**

Appropriate data provides valuable evidence of the extent of growing diabetes costs but also

can facilitate setting priorities and strategies to combat the problem. Some countries have been tracking diabetes prevalence for years and have developed a wealth of free and public population health resources. For example, the U.S. Centers for Disease Control and Prevention (CDC) has had a dedicated diabetes division since 1977, with reported data on prevalence starting in 1980.

Data collection has expanded in many countries to improve monitoring of population risk factors and diabetes biometric markers, as well as adherence to best practice guidelines of care. For example, the CDC recently stepped up its national surveillance data to cover other diabetes metrics, including duration, insulin use, oral medication use, hospitalization, emergency department visits, risk factors for complications, and preventive procedures such as foot and eye exams. The CDC also tracks related data on physical inactivity and the prevalence of obesity.

The Public Health Agency of Canada collects similar data on prevalence, utilization, and risk factors. In Australia, the National Centre for Monitoring Diabetes tracks diabetes prevalence, complemented by the National Diabetes Services Scheme. The Australian Health Survey 2011-2013, a population survey that provides better understanding of the health of people living in Australia, monitors risk factor trends over time and identifies emerging issues.

Worldwide prevalence statistics are tracked by the IDF's Diabetes Atlas. Through its affiliation with the United Nations, the IDF allows developing countries, which may lack the financial resources and infrastructure to collect information on their own, to collaborate in a larger worldwide effort to prevent diabetes and improve care for diabetics. The World Health Organization also tracks global risk factors, including data on blood glucose, physical inactivity, and obesity.

Electronic health records (EHRs) contain a patient's comprehensive medical history from all providers. Although many countries are in-

vesting in EHRs, challenges exist, including no standardization of terminologies and software structure, a costly capital investment, provider adaptability, and privacy concerns. There also are no agreed-upon measures of success for EHRs, either in terms of productivity, effectiveness, return on investment, quality of health care, or improvement in public health.

Many developed countries have taken steps to implement nationwide EHRs. In the United States, technology solutions vary geographically and by health care provider. Although efforts over several decades to develop a national EHR system have yet to be successful, CMS' meaningful use initiative has increased the adoption of EHRs and reporting of clinical data.

In 2007, the Israeli government proposed a law regarding a National Medical Record, aimed to regulate a national EHR. This is feasible in Israel, where all hospitals, providers, and the four health maintenance organizations (HMOs) are subject to the National Health Act. Although a partial pilot has been implemented

in governmental hospitals, and the Israeli Ministry of Health has published standards for the electronic medical data that providers, hospitals, and HMOs must keep, nationwide EHR is still far from fully implemented.

Some countries are more advanced in their solution sets. Singapore's Ministry of Health, for example, has implemented the National Electronic Health Record (NEHR) system, with the dual goal of providing better care for Singaporeans and lowering health care costs. With data integrated from multiple sources and over a patient's lifespan, NEHR now is used widely across Singapore's public health care sector. In Australia, the government rolled out the Personally Controlled eHealth Record System (PCEHR) in July 2012 and is working on getting physicians to access and use the system.

In the private sector, Discovery Health in South Africa is using digital tools and big data to improve quality, cost, and user experience. Among these digital tools is Health ID, which gives doctors access to a patient's health record

### The Role of Actuaries

Health actuaries around the world can offer the professional skills they have honed in the analysis of morbidity information for organizations ranging from insurance companies to public and government entities. Actuaries possess a detailed understanding of economic, financial, demographic, statistical, and insurance risks, and are experts in developing appropriate models and applying economic and statistical tools to support strategic decisions.

Specific areas in which actuarial expertise is needed include:

- Integrating an understanding of population, morbidity, and mortality data with experience gleaned from similar populations to develop demographic projections.
- Incorporating diabetes risk factors and disease progression in estimating the probability of complications such as kidney failure or amputations, taking into consideration adherence

to medications, diet, or exercise and advances in medical technology.

- Developing models to assess the cost-effectiveness of health care initiatives, including measuring return on investment.
- Designing and evaluating financial structures and incentive mechanisms built into health care programs.
- Applying risk-adjustment tools to stratify patients for appropriate interventions such as preventive care, disease management, or coordinated care programs.
- Employing predictive modeling for revenue redistribution under risk-taking systems.
- Assessing diabetes' impact on morbidity and mortality, which in turn affects retirement, disability, and long-term institutional care programs.

instantly. Some 2,000 health care practitioners have adopted Health ID with the consent of more than 200,000 patients. Discovery Health also has mobile phone applications that allow the patient to carry an electronic membership card, submit insurance claims, compare medicine prices, and track medical spending. The use of telemetry for diabetics is a good example of its utility: a glucose meter is connected directly to the smartphone, readings are transmitted via the web, the patient's record in Health ID is updated, and doctor is alerted automatically if readings are out of range.

### A Collective Effort

Diabetes is a global pandemic that will continue to impose a major economic and social burden on countries worldwide. Without intervention, this burden will only increase. For any intervention to be successful, a collective effort across industries and communities by governments, health systems, providers, researchers, and the public, is necessary.

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