Economic Burden of Diabetes

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**ABSTRACT**

The prevalence of Type 2 diabetes is increasing worldwide, particularly in developing countries. Increased availability of refined foods and limited physical activity, have been recognized as the main causes of the burden of diabetes. In the coming decades, India and China are expected to have the greatest numbers of people affected with type 2 diabetes. In developed countries too, such as in Europe and the United States, there is an increasing trend mainly due to the prolonged survival of both the general and the diabetic populations.

The increased prevalence of both type 1 and type 2 diabetes, has a profound impact on overall health care costs, which is expected to increase in the coming years. Population-based studies that have examined this issue have consistently provided evidence that the increase in childhood type 1 diabetes is about 3% per year in specific areas of the world.

This article reviews the impact of economic burden of diabetes in the world in general and in a developing country like India in particular.

**GLOBAL SCENARIO**

While the direct costs of health care for a diabetic patient are generally higher than that of a nondiabetic, the actual cost of treatment can vary between countries because of country specific methodologies and pricing.

The costs involved in the care and management of diabetes are considerable for both the individual and the health care system. Caring for diabetics involves a direct cost borne by the affected individuals, their families and health care authorities. Indirect and intangible costs are larger. The indirect costs result from lost production as a result of frequent absence from work, an inability to work because of disability, premature retirement and even premature mortality as a result of complications. Intangible costs are those that reduce the quality of life, because of pain, anxiety and stress.

More than 80% of the total diabetes spending is in the developed economies, while over 70% of people with diabetes live in developing nations. As per International Diabetes Federation (IDF) atlas 4th edition, the US accounts for 52.7% of the total diabetes spending worldwide, whereas, India, which has largest diabetes population, spends 1% of the global total.

Several recent studies in the United States highlight the prevalence and national economic burden associated with diabetes by type and the stage of progression of the disease.

Nearly 17.5 million people living in the United States were diagnosed with type 1 or type 2 diabetes mellitus (DM) in 2007, at an estimated cost of $174.4 billion in higher medical costs and lost productivity. For the approximately 16.5 million people with type 2 diabetes, the annual national cost is $159.5 billion, and for the approximately 1.0 million people with type 1 diabetes, the cost is $14.9 billion.

Another 6.3 million US adults have undiagnosed DM—that is, they are unaware that they have the disease and hence are untreated; the associated cost was $16 billion in 2007.

Nearly 57 million adults have prediabetes: a state of elevated blood glucose levels that is a precursor to diabetes and is associated with $25 billion annually in higher medical costs. Gestational DM, which develops during pregnancy and usually disappears upon the delivery of the infant, affects about 4.5% of all pregnancies (an estimated 180,000 cases in 2007), at an associated cost of $636 million.

Together, the annual medical and indirect costs associated with all of these conditions are approximately $218 billion.

In the UK, the prevalence of diabetes is estimated at approximately 400,000 people with Type 1 diabetes and 3400,000 people with Type 2 diabetes. The total cost of direct patient care for diabetes in 2010/2011 is estimated at £9.8bn. The indirect costs associated with diabetes are estimated at £13.9bn. The direct costs of diabetes have been categorized as treatment/intervention and complications or adverse events. The cost of diagnosis/screening, treatment and interventions was over £2bn. The cost of complications experienced by those with Type 1 or Type 2 diabetes was estimated at £7.7bn. Peer-reviewed literature suggests that a significant proportion of these complications are caused directly by diabetes, although some may be caused by comorbidities such as obesity.

The cost burden of diabetes in 2010/2011 was approxi-mately 10% of total national health service (NHS) resource expenditure. If no changes are made to the way diabetes is treated by 2035/2036, this will rise to 17% of NHS expenditure. By the same rationale, the indirect costs of diabetes are likely to increase to over £22 bn by 2035/2036.

Approximately 37,000 working years were lost from deaths from Type 1 diabetes and approximately 288,000 from deaths from Type 2 diabetes in 2010/2011. The cost of mortality was estimated at c. £0.6bn for Type 1 diabetes and £4.2bn for Type 2 diabetes. An estimated 830,000 sickness days were taken for Type 1 diabetes and more than 7 million sickness days for Type 2 diabetes. The cost of sickness was over £94 mn for Type 1 diabetes.

The economic burden of diabetes is worsened due to its complications caused by treatment and the disease itself. For example, hypoglycemia is a primary obstacle to good glycemic control.
Diabetology

control. Frequent severe hypoglycemia adversely affects diabetes outcome and quality of life, and is causing a tremendous economic burden to the health care systems in the emerging epidemic of Type 2 diabetes.4

In the Action to Control Cardiovascular Risk in Diabetics (ACCORD) study, the annual incidence of hypoglycemia was 3.14 and 1.03% in the intensive treatment and standard glycemia groups, respectively. A total of 44.7% reported minor hypoglycemia and 2.1% reported severe hypoglycemia events during a median follow-up period of 5 years in the ADVANCE study.4

The annual prevalence of severe hypoglycemia reached 15% among insulin-treated Type 2 diabetes. This suggests that hypoglycemia becomes a more frequent clinical problem for patients with Type 2 diabetes as they approach the insulin-deficient end of the diabetes spectrum.4

The incidence of hypoglycemia in type 1 diabetes is far higher and more severe than that seen in type 2 diabetes.4

The direct medical costs are measured based on medical care utilization and expenditures to treat hypoglycemia (from – US$188 to US$2100 per episode, depending on severity and extent of medical care); indirect costs are measured based on loss of productivity when patients are absent from work (3 or 8.6 productive days per patient, – US$3169 per patient per year, varying from country to country).4

THE ECONOMIC BURDEN IN INDIA

In India, a recent study showed that total annual expenditure by patients on diabetes care was, on average, INR (Indian Rupee value) 10,000 (US $227) in urban areas and INR 6,260 (US $142) in rural areas. An increase of 44.7% was observed in the total expenditure between 1998 and 2005 in the urban population. Low-income groups spent a higher proportion of their income on diabetes care (34% and 27% for urban poor versus rural poor respectively) without subsidies. The medical costs incurred by a person with diabetes are two to fivefold higher than those incurred by people without diabetes.

The average expenditure per patient per year would be a minimum of INR 4,500 (approximately US $120). Therefore, the estimated annual cost of diabetes care would be approximately 180,000 million rupees.5

In India, estimates suggest that 85–95% of all health care costs are borne by individuals and their families from household income. The lowest income groups bear the greatest burden, paying a larger proportion of household income toward diabetes care. Direct expenses consume 27–34% of household incomes of rural and urban poor people while the middle-to-high income groups in rural and urban areas consume 5.0–12.6% and 4.8–16.9% of income respectively on diabetes care. Year-on-year increases in this proportion are greater in impoverised groups, worsening with duration of diabetes, presence of complications, hospitalization, surgical therapy and glycemic control requiring insulin.6

Furthermore, although family history and prevalence of glycemic abnormalities in high-income groups is almost double that of low-income groups, the reverse is true for prevalence of co-morbid cardiovascular risks and resulting occurrence of complications like macrovascular disease, cataracts, proteinuria and neuropathy. As such, recent prevalence and trend data show greater disease susceptibility in lower socioeconomic groups, mimicking patterns in wealthier nations.6

The cost of diabetes in India (CODI) and Bangalore Urban District (BUD) diabetes studies showed later age at diagnosis of diabetes and occurrence of disabling complications were associated with lack of awareness, being unemployed and less educated (a seven year difference in age of diagnosis was demonstrated between illiterate and those with college education). Socioeconomic disadvantage therefore amplifies the risk of disabling disease while augmented expenditures associated with complications further perpetuate destitution—a bi-directional link between poor health and poverty.6

The CODI and BUD are in fact the landmark studies on the economic burden in the Indian population.7

The CODI study was a large community based survey of diabetes costs. The study was preceded by a pilot study in the BUD. According to the results of the CODI study, ambulatory care constitutes 65% cost whereas hospitalization cost is 35%. Therapy cost is 31% of which specific antidiabetic drug cost is only 17%. Ambulatory care including monitoring and doctor visits constitute 34% costs (Figure 1).7

In another study, 44% of the study population was hospitalized for diabetes-related complications. The annualized estimate of costs on hospitalization was based on average hospital cost per event multiplied by the number of hospitalizations due to diabetes related events since diagnosis and dividing by the known diabetes duration. The mean cost of hospitalization in this study was INR 12,781. When annualized it was INR 2,434. Cardiac event was the most common as well as the costliest cause of hospitalization followed by a nonhealing wound. As with costs for routine care, hospitalization cost increased with number of complications.7

There are also deep-rooted urban–rural disparities in India. An overwhelming 70% of the population lives in rural areas, where awareness of chronic diseases is extremely low; the ratio of unknown to known diabetes cases is 3.3:1 (compared to 1.8:1 in urban areas). Data suggest diabetes prevalence in rural areas is rapidly catching up with urban estimates [rural diabetes prevalence increased almost threefold (from 2.4–6.4%) in the space of just 14 years]; and poor infrastructure and service provision are common place in these areas.8

A study in Indian patients by Ramachandran et al analyzed the urban-rural expenditure on diabetes. The study indicated that the economic burden of diabetes care on families in developing countries is rising rapidly, even after accounting for the inflation. The annual family income was higher in urban subjects [rupees (Rs) 100,000 or $2,273] than in the rural subjects (Rs 36,000 or $818) (P < 0.001). Total median expenditure on health care was Rs 10,000 ($227) in urban and Rs 6,260 ($142) in rural (P0.001) subjects.8

Treatment costs increased with duration of diabetes, presence of complications, hospitalization, surgery, insulin therapy and urban setting. For example, expenditure proportionately increased with the number of complications. Expenditure on treatment of complications varied significantly between the populations (Figure 2).8

The Delhi Diabetes Community (DEDICOM) study by Kumar et al. analyzed the direct cost of ambulatory diabetes care among the middle and high income group diabetics in the capital city of Delhi. The average estimate of direct annual expenditure on ambulatory care of diabetes was ~ Rs 6,000 (~US$ 150). Time elapsed since diagnosis

Figure 1: Distribution of direct costs in diabetes care

<table>
<thead>
<tr>
<th>Category</th>
<th>Direct Costs</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalization</td>
<td>27%</td>
<td></td>
</tr>
<tr>
<td>Doctor visit</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Laboratory</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Drugs</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Disposables</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Other drugs</td>
<td>11%</td>
<td></td>
</tr>
</tbody>
</table>

Section 5
(p < 0.001), education (p = 0.011), gross family income (p = 0.002), presence of co-morbidities (p = 0.009) and requirement for use of oral hypoglycemic agents (p < 0.001) or insulin (p < 0.001) were significant correlates. Direct ambulatory cost of care comprised 1–3% of the gross family income of the subjects. As seen in the Ramachandran study, this study also concluded that a majority of the diabetes patients spend a significant proportion of their family income on diabetes related expenditure. The cost is higher for subjects with longer duration since diagnosis, those with higher education or income, those with co-morbidities and those requiring oral hypoglycemic agents or insulin.9

In the Grover et al. study, the total annual cost of care for 50 patients of the sample population was 14,508 rupees (263.78 euros). The largest proportion of the total cost was made up of direct costs (68%), followed by indirect costs (28.76%) and provider’s costs (2.8%). Drug costs were high. Total treatment cost was significantly higher in those who were more educated, those who visited the hospital more often, and those receiving a greater number of drugs.10

As seen in all other studies, brunt of financial burden is borne by the family. The consequences of socioeconomic and urban–rural gradients are that they are associated with divergence in disease outcomes. In other words, the relatively more affluent or urban residents’ experience of diabetes is one of a more costly, but manageable, chronic condition, whereas the poor or rural dwelling people endure late recognition and rapidly progressive, often fatal or disabling disease.6

**Actions to be Taken**

Since available evidence suggests the sharp increase in diabetes in the developing world is related to lifestyle changes taking place as a result of global economic development, primary preventative measures aimed at lifestyle changes such as altering dietary behavior and educating people to the risks that they face could be an effective method of combating diabetes.11

With a high ethnic susceptibility for developing diabetes, a regular screening program of the Indian population could also be a vital and cost-effective measure for lessening the impact of diabetes. However, in countries with severely limited resources such as India, prevention is a low priority and the likelihood of funds becoming available for screening strategies is extremely low.11

The Indian diabetes prevention program evaluated the cost-effectiveness of the interventions in primary prevention of diabetes. According to this study, the direct medical cost to identify one subject with IGT was Indian rupees (INR) 5,278 ($117). Direct medical costs of interventions over the 3-year trial period were INR 2,739 ($61) per subject in the control group, INR 10,136 ($225) with lifestyle modification, INR 9,881 ($220) with metformin, and INR 12,144 ($270) with lifestyle modification and metformin. The number of individuals needed to treat to prevent a case of diabetes was 6.4 with lifestyle modification, 6.9 with metformin, and 6.5 with lifestyle modification and metformin. Cost-effectiveness to prevent one case of diabetes with lifestyle modification was INR 47,341 ($1,052), with metformin INR 49,280 ($1,095), and with lifestyle modification and metformin INR 61,133 ($1,359).12

The study indicates that both lifestyle modification and metformin were cost-effective interventions for preventing diabetes among high risk-individuals in India and perhaps may be useful in other developing countries as well.12

On the other hand, early detection, prevention and treatment of diabetic complications (secondary prevention) can be especially beneficial in terms of patient quality of life and cost-effectiveness. Any measure that can reduce this major expenditure associated with advanced diabetes. Several studies have estimated that cost savings of up to 75% can be made by re-focusing the provision of care toward an outpatient basis.11

Continued regular monitoring and treatment have been demonstrated to have great positive benefits to the diabetic patient over the long term by reducing the incidence of a number of complications such as cardiovascular disease and nephropathy and is most cost-effective in diabetic complications such as retinopathy, foot ulceration and amputation.11

A strong, GP-based framework as a basis for a comprehensive strategy to target those in need of treatment. Education programs for GPs and their patients should be taken up as a priority.11

A model of shared care amongst primary-care workers, i.e. GPs, and more specialized care workers may be particularly suitable to the diverse patient environment of India.

The Indian health care system seems to lack a sense of urgency with regard to the threat posed by diabetic complications. The large projected rises in the incidence of diabetes and IGT and the increase in age of the current diabetic population mean that there is a great risk of a future explosion in the occurrence of diabetes related disease. The ability of the Indian health service to cope with such an eventuality is reliant on the establishment of a complete tertiary care infrastructure and clear treatment guidelines.11

There are no specific treatment guidelines proposed by the World Health Organization (WHO) for India or SE Asia. As a result, there are serious deficiencies in the standard of care that can be expected by patients when they consult their physician for diabetes treatment. The consolidation of the network of regional clinics and national diabetes centers may be the organizational basis for educating less specialized physicians such as GPs in India.

Investment in infrastructure must be matched by investment in education. Success in reducing the incidence of diabetes, and hence the burden of disease on the Indian state, will only be achieved if patients and their families fully understand the issues that they face. Any key to promoting this message is the education of those health care professionals who have direct contact with the patients, such as GPs and all other health care professionals involved in diabetes care. It will be vitally important that policy makers are made aware of not only the potential cost of diabetes, but also of the vast savings that simple measures such as education could provide in the long term.11

The challenges that India faces are not unique. In virtually all developing countries common “causal associations” are contributing to the increase in prevalence of type 1 and type 2 diabetes.11

These include changes in traditional diet, increasingly sedentary lifestyles, general and visceral obesity, increased life expectancy and better treatments for other life-threatening diseases. In the face of unrestrained economic globalization and industrialization, it is predicted that diabetes is set to become a major public health concern.
Diabetology

for most countries in the 21st century. It is important that the profile of diabetes is raised and that governments initiate adequate investment in monitoring and prevention strategies as soon as possible.11

Last but not the least, application of diabetes guidelines on a countrywide basis is likely to have a deceleration effect on the escalating problem of T2DM and cardiovascular disease. These guidelines could be revised in future as appropriate, after another large and countrywide consensus process.13

CONCLUSION

Diabetes has already been described as an epidemic, but predictions for future increases in prevalence, especially in developing countries, point to a major health care crisis for the future. Very little is known about the economic impact of diabetes in the developing world where predicted increases in prevalence are greatest.

With an estimated 40 million people suffering from the condition in India, diabetes has become a major health care problem in India. The high costs of treatment of diabetes amongst all socio-economic patient groups will result in a serious burden on both patients and state resources alike. The long term economic implications are worrying. The considerable financial strain which households, particularly the poor, face in treating CVD and diabetes is alarming. As the burden due to CVD and diabetes increases in India, more households will be subject to these financial strains and unfortunately, the economically vulnerable among them will be the worst affected. While primary prevention of these conditions need more emphasis, in addition, insurance schemes targeted at the poor have an important role to play in financially protecting vulnerable households. With the Indian diabetic population predicted to rise to more than 80.9 million by the year 2030, immediate health policy restructuring and investment will be needed if the best use is to be made of scarce health care resources with accompanying economic constraints.

REFERENCES

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