

Economic analysis of diabetes care

Anil Kapur

World Diabetes Foundation, Lyngby, Denmark

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Many socio-economic factors and health care system related issues impact the outcome of diabetes and consequently its costs and vice versa. Factors that influence delay in diagnosis also determine complication rates and thus costs. Presence and severity of complications as well as co-morbid conditions are the most important determinants of treatment and monitoring regimen as well as the need for hospitalization and are therefore important factors related to costs. The average annual direct costs of hospitalized patients are more than double to those not hospitalized. Complications are also responsible for indirect costs in terms of productivity loss and absenteeism. Our studies show that the cost of providing routine care is only a fraction of the overall costs and is perhaps still manageable; however when this is not available or its quality is poor the overall direct and indirect costs, escalate with disastrous health and economic consequences to the individual, his family and society. Effective intervention means prevention both primary (health promotion and awareness) as well as secondary prevention (reducing the burden of complications by early diagnosis and effective care). Everyone involved in diabetes care need to be aware of what drives cost: proper effective treatment of diabetes is not but not treating diabetes or treating it ineffectively is very costly.

Key words Cost analysis - diabetes care - hospitalization - vascular complications

Diabetes is rapidly emerging as a major health care problem in India, especially in urban areas. The prevalence of type 2 diabetes has been steadily increasing in urban areas from a low 2.1 per cent reported in early 1970¹ to 12.1 per cent in 2000². Moreover, there is an equally large pool of persons with impaired glucose tolerance (IGT), many of whom will develop type 2 diabetes in the future^{2,3}. There is evidence to suggest that prevalence of type 2 diabetes is increasing even in rural areas⁴. The rapid increase in population, increased longevity and high

ethnic susceptibility to diabetes, coupled with rapid urbanization and changes from traditional lifestyles will most likely trigger a diabetes epidemic⁵. The WHO recently revised its estimates of the persons with diabetes in India in 2000 to 31.7 million; this number is likely to increase to 79.4 million in 2030⁶. Diabetes therefore is rapidly emerging as a major public health challenge.

Good health is a prerequisite to successful human endeavour and therefore core to economic growth

and activity. Economic loss due to chronic ill health is associated not merely with the cost of care but takes a heavy toll in terms of loss in productivity⁷. Economic burden of an illness can be divided into direct, indirect and intangible costs (Table I). The per capita expenditure on health care in India is only 6.4 per cent of the average world spending, while India accounts for 23.5 per cent of the world's disability adjusted life years (DALYs) lost due to diabetes⁸. Due to scant resources and burgeoning costs, health care planners and providers are being forced to cut resources worldwide. To be able to plan and allocate resources adequate background data are required. This includes amongst other information, on estimates of current costs. Diabetes complication account for 60 per cent of diabetes related health care costs (direct cost) and almost 80-90 per cent of indirect costs⁹. For example, in 1986 the total cost of type 2 diabetes in the US was estimated at 20 billion dollars but it had increased to over 100 billion US dollars in the mid 1990s¹⁰. This increase of over 5 times in a decade amounts to about one sixth of India's gross domestic product (GDP). The direct cost per patient per year for type 2 diabetes in Argentina was 330 US dollars, in France the cost was 675 US dollars and Denmark 3535 US dollars⁹. The Bangalore Urban District (BUD) Diabetes Study^{11,12} estimated the annual direct cost for routine care in Bangalore, India, in 1998 to be about 191 US dollars, the mean direct cost per hospitalization for a diabetes-related episode was about 208 US dollars. Health resources in India and other developing countries are very limited with only 5 per cent of GDP, (USD. 23 per capita) being spent on healthcare¹³. The majority

of healthcare expenditure was private (4% of GDP) with only 0.9 per cent of GDP spent on public health care. Therefore, careful planning based on health economic assessments is necessary in order to maximize the use of funds for the treatment and prevention of diabetes.

In chronic health conditions apart from the disease *per se*, many socio economic and health care delivery factors influence outcome and economic costs. Diabetes care in India is provided either by doctors in the health centres, clinics, district, municipal and tertiary teaching hospitals run by the central, state or municipal governments; or through private practicing general practitioners, specialists' clinics, nursing homes or large corporate hospitals. The quality and cost of care varies considerably from place to place, depending on the available resources, training and interest in diabetes of the treating doctor and the patients' ability to pay for it. Generally, care provided in government institutions is free or at low subsidized cost. Due to scant and limited resources the system is geared towards care of acute pressing illnesses. While most of them strive to do their best, given the limited resources and infrastructure for chronic diseases like diabetes, the quality of care suffers. Those seeking medical care in the private sector pay for everything out of their pocket as there is limited or no reimbursements and here too the infrastructure for chronic care is limited. This is a unique situation where the lack of adequate facilities and capacity to pay indirectly affect long term prognosis and cost. When uniformly good quality care is accessible to all, the disease outcome is at least not predetermined by his/her socio-economic standing.

Table I. Components of cost of illness

Direct costs	Indirect costs	Intangible costs
Consultation	Man days lost	Pain
Investigations	Disability payment	Anxiety
Treatment	Social security	Depression
Drug	Tax rebate	Loss of enjoyment
Monitoring		
Visits		

The prevailing poverty, ignorance, illiteracy and poor health consciousness further adds to the problem. Patients can access any level of care (primary, secondary or tertiary) based on proximity, knowledge and resources. Thus many sociological factors determine long-term outcome of illness. A study of these factors and their influence on the

prognosis and outcome is necessary to tackle diabetes in the community. Previous studies have looked at perceptions and attitudes of persons with diabetes and of the diabetes care providers and their significance to proper diabetes care delivery¹⁴⁻¹⁷. There is emerging evidence that diabetes education, awareness and improving motivation for self care improves care, reduces complications and may thus reduce overall economic costs of diabetes.

Persons with diabetes use higher health care resources. The excess cost is related to higher cost of treating complications and the economic loss due to lost man-days or lost economic opportunity. In the absence of significant or credible social security system to fall back on, the Indian social support system is centered on the (extended) family's support. Thus an illness affecting the earning or active member of the family has significant effect on others as well. It may force other non-working members to start work, often prematurely at lower wages, cut short children's education with its long-term financial consequence for them and the family.

The CODE 2 study¹⁸ showed that of the overall cost of diabetes care (type2), ambulatory care accounted for 18 per cent costs, anti-diabetic medications 7 per cent, medications for associated conditions 21 per cent but the bulk of the direct costs (55%) were due to hospitalizations. The study also showed that in the presence of microvascular disease the direct costs were 1.7 times higher as compared to patients with no complications, with macrovascular disease the cost was twice compared to patients with no complications and when both micro- and macrovascular disease was present the cost was 3.5 times compared to when no complications were present.

Cost of diabetes in India

The Cost of Diabetes in India (CODI) study¹⁹ was a large community based survey of diabetes costs. The study was preceded by a pilot study^{10,11}

in Bangalore Urban District. The study was conducted in association with the ORG-MARG Centre for Social Research, Bangalore. The questionnaire from the pilot study was modified to suit the national study and the modified version was pre-tested on a small sample (120 patients) across four towns. After analyzing the results of the pre test exercise the inadequacies were rectified and the questionnaire finalized. The questionnaire in English consisted of six sections and was designed to elicit substantial information; all field investigators were familiar with the local language as well as English and with a pre-survey training had no problem eliciting responses in local language and filling the data.

The direct cost of diabetes was estimated on a total monthly expenditure basis, on various items related to treatment; treatment delivery; laboratory tests and investigations, including travel, transportation and other miscellaneous costs; recent or past hospitalization and financial resource used to meet these costs. For indirect costs, information on current job, illness induced change in job, problems in current job, change in ability to work, absenteeism, economic loss to the individual due to disease related work change or absenteeism, influence of disease on the plans of dependent family members, need for other family members to work to augment family income, or give up, or change career objectives. For non-earning members the indirect costs were estimated using the Economic Value of the Individual (EVI) model²⁰.

Patients were selected using a listing method. In the absence of registries, proper hospital or clinic records, particularly in the peripheral, semi urban and rural areas, it required considerable effort to obtain a representative sample. A total of 5516 persons with diabetes (and on treatment) in the towns and cities constituting a representative sample of Indian population were identified through various sources and interviewed. The study details have been described elsewhere^{19,21}.

Estimation of economic burden

Direct costs

Ambulatory care – The cost of ambulatory care includes costs of routine visits to the clinic, laboratory costs and costs of medicines. The annual average expenditure on visit to the clinic, hospital or doctor was estimated by multiplying the average monthly expenditure by twelve; this includes the fees and other expenses related to the visit. Similarly, mean expenses on recent tests was multiplied by the stated frequency of the tests to get estimates of average annual costs on monitoring and laboratory investigations, the cost includes travel and other miscellaneous expenses. The estimates for monthly expenditure on treatment were arrived at by asking the patient what costs he or she incurs on medicines, disposables and fees paid to doctor, or nurse for insulin injection when not self injecting. The information was cross-checked with current known costs of medicines in use and the average dose.

The duration and number of complications often are a major determinant of direct costs and

hospitalization costs, as patients with more number or more severe complications require more laboratory investigations, more hospitalization and multiple therapies. This is clearly seen in the CODI study¹⁹. Fig. 1 shows the distribution of mean annual direct costs of diabetes at current quality and level of care. Ambulatory care constitutes 65 per cent cost whereas hospitalization cost is 35 per cent. Therapy cost is 31 per cent of which specific anti diabetic drug cost is only 17 per cent. Ambulatory care including monitoring and doctor visits constitute 34 per cent costs. In the CODE 2 study¹⁸ hospitalization constituted 55 per cent costs whereas specific anti diabetic treatment was only 7 per cent, with other therapies 21 per cent and ambulatory care 18 per cent of the overall costs. While the mean direct annual cost for outpatient care for all patients with diabetes was INR 4724/-, those without complications had an 18 per cent lower cost while those with three or more complications had a 48 per cent higher cost. (Fig. 2).

Hospitalization – In another study 44 per cent of the study population was hospitalized for diabetes-related complications. The annualized

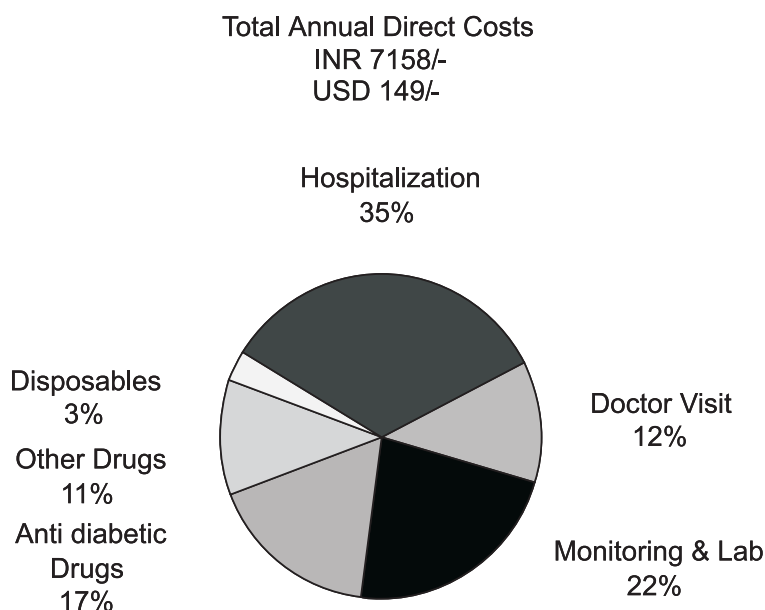


Fig. 1. Distribution of direct costs in diabetes care. Source: Ref. 19.

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 it by the known diabetes duration. The mean cost of hospitalization in this study was INR 12781/-. When annualized it was INR 2434/- (Fig. 3). Cardiac event was the most common as well as the costliest cause of hospitalization followed by a non healing wound. As with costs for routine care, hospitalization cost increased with number of complications.

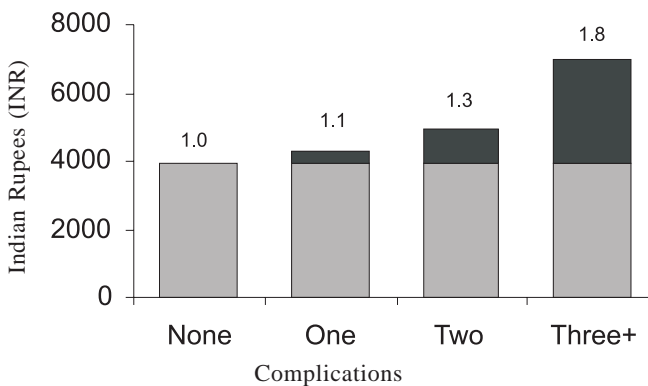


Fig. 2. Mean ambulatory direct costs (INR) in relation to complications. *Source:* Ref. 19. Darken areas (1.1, 1.3 and 1.8) indicate additional expences on diabetic complications over the basal cost (1.0).

Indirect costs: Data on indirect costs include man-days lost due to diabetes and the loss of personal as well as family income. All these put together constitute total indirect costs due to diabetes. Number of man-days lost has been estimated for earning respondents and the monetary value of man-days lost has been calculated by multiplying number of man-days lost with reported personal daily income (monthly income divided by 30). For non earning respondents monetary value of lost man-days is calculated using the economic value of an individual (EVI) model. EVI is calculated based on the replacement costs²⁰. Loss in personal and family income is calculated by reported percentage loss in income with the monthly income multiplied by 12. We have not made attempts to estimate the intangible cost, as these are difficult to compute in a society with a wide socio-economic and cultural spread. For non-wage earning respondents the total indirect cost was estimated to be INR 9748/- while for wage earning respondents it was INR 16831/-²⁰. Overall indirect cost was estimated to be INR 12,756/-, of this productivity loss accounted for INR 9166/-; while personal and family income loss accounted for an average of INR 1811/- and 1779/- respectively.

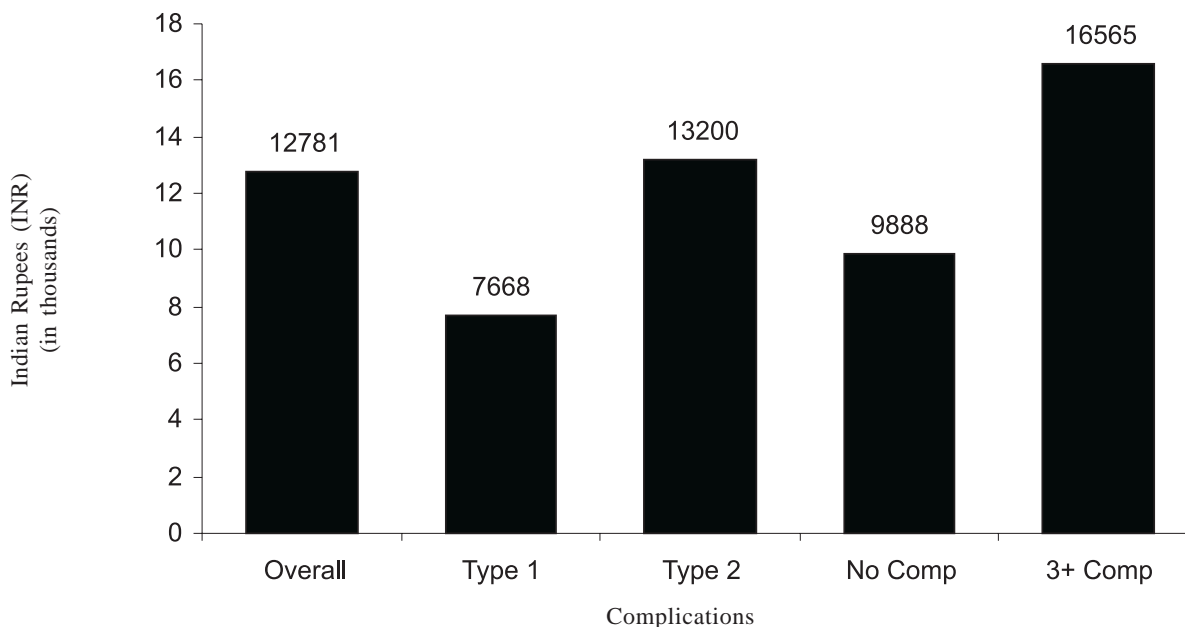


Fig. 3. Cost of hospitalization in INR. *Source:* Ref. 19.

The mean total annual cost direct (ambulatory plus hospitalization) as well as indirect for the entire study population was INR 19914/-²⁰ (Table II). This does not include subsidy effect.

Source of funding

Almost all respondents indicated that they met their expenses through family and personal resources, irrespective of work status. Some patients got help from governmental institutions where parts of the services are free. The majority of patients (89%) used their household income to fund the monitoring and treatment of their diabetes. Household savings were used by 22 per cent of retired patients and in 19 per cent of those in the lowest income bracket. However, the percentage of patients using household savings increased to 34 per cent to pay hospitalization fees because of increased costs compared with routine treatment. A small proportion of patients (9 and 10% respectively) received loans from their employers or relatives and only 1 per cent claimed the costs of treatment on insurance²⁰. In the BUD study¹² we had estimated how patients fund diabetes care delivery (Fig. 4). While most patients were able to fund routine care from personal or family income when faced with hospitalization 56 per cent patients had to dip into their savings or borrow in order to fund the costs.

Factors influencing costs of care

The cost of illness is dependent on many variables. It is important to keep these in mind,

Table II. Total overall mean direct and indirect costs in diabetes care

Item	Costs (INR)
Doctor	853
Monitoring and Lab	1609
Treatment	2262
Hospitalization (annualized)	2434
Mean total direct cost	7158
Mean indirect cost	12756
Total estimated annual cost	19914

Source: Ref. 20

particularly when comparing results from different studies. These include the type of disease, the number and severity of complications as well as the demographic characteristics of the study population. In a heterogeneous society like in India with great disparity in earning, access to medical care, as well as, differing quality of care, it is very crucial that all factors are taken into account to get the correct picture. The lack of medical records makes it even more difficult to carry out such studies. As inflation influences the cost, a factor for correction of inflation must be done when comparing two studies carried out at two different time periods.

Education, awareness and socio-economic status: Education appears to have a major effect on diabetes prognosis. Whether this is related to greater understanding of the illness and therefore greater commitment to self-care or is a reflection of a better socio-economic status and therefore better access to medical care, or both, is difficult to say.

The level of education and place of residence were important determinants of how quickly diagnosis was made in both the CODI¹⁸ and the BUD study^{10,11}. In the CODI study patients with a higher educational status were diagnosed at a younger age: 43.6 ± 10.7 yr college-educated; 45.4 ± 13.1 yr school educated and 50.4 ± 13.2 yr illiterate patients. This is consistent with the finding in the BUD Study where an almost seven year delay in diagnosis between

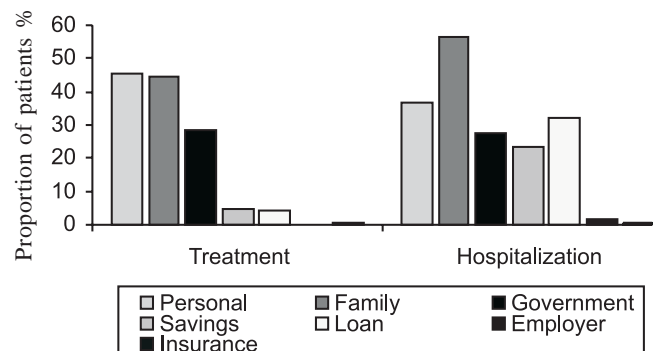


Fig. 4. Proportion of subjects using different resources used to fund care. Source: Ref. 12.

illiterate and college educated persons and an almost three year delay between city and semi-urban area was seen. Also despite a longer mean duration of diabetes, (perhaps reflecting earlier diagnosis) those with a college education had a much lower complication rate¹¹ (complication free rate 44.6 vs 19.8% for illiterates). Shobhana *et al*²² reported similar findings in their study from Chennai. Patients attending private hospital had a longer diabetes duration compared to those attending public hospital. Patients in the private clinic had significantly higher income; higher education and higher employment level.

Pre-diagnosis diabetes awareness may result in earlier diagnosis. This was seen in the BUD study¹². The mean age at diagnosis was 48.3 yr for those who were aware compared to 50.1 yr for those not aware, 47.7 yr for those with a family history compared to 50.5 yr for those without. Despite similar mean duration of diabetes, aware patients had much lower complication rate. However, no difference was noted between those with and without family history of diabetes.

In the CODI study¹⁹, 61 per cent of patients were aware of diabetes as a disease before diagnosis. The level of education was a determining factor for pre-diagnosis awareness: 57 per cent of illiterate patients were unaware of their diabetes before diagnosis compared with 42 per cent of school-educated and 28 per cent of college-educated patients. Pre-diagnosis awareness itself did not result in diagnosis of diabetes at a younger age, as the mean age at diagnosis was not significantly different between aware and unaware patients in all income bands and educational backgrounds²¹.

As type 2 diabetes produces few symptoms and is initially not life threatening, people often do not bother about the weakness and tiredness that is often the only manifestation of the disease. It is the actively working persons that take notice of the symptoms as it influences their work capacity. Due to their economic situation and perhaps dependence on

others, those not actively working will often not seek medical attention till other incapacitating symptoms or complications develop. In the BUD study there was an almost a ten years difference in the age of diagnosis between the actively working and non-working respondents. Similarly, there is a trend towards later diagnosis amongst those in the lower socio-economic group. An over four year delay was noted between the highest and lowest socio-economic groups. Patients with multiple complications are diagnosed on an average five years later compared to those without complications currently²¹. The place of stay seems to play an indirect role, those staying in the semi-urban/rural (taluka) areas had a higher complication rate, despite lower mean duration of illness, perhaps reflecting delayed diagnosis and availability of less than optimum care. Similar trend is noted with regard to employment/work. Persons currently employed or working had fewer or no complications as compared to those not working or working as agricultural labour¹².

Higher family income increases the likelihood of proper care; more so, if the affected family member is actively working (gainfully employed or a housewife). This greater care should translate into fewer diabetes related complications. In the BUD Study¹¹ those in the high family income group reported the highest complication-free rate - 54.1 per cent and lowest multiple complications (8.1% three or more complications), compared to those in the lowest socio-economic group 22 per cent no complication, 26 per cent three or more complications.

Complications and quality of care

To prevent diabetes complications, it is crucial that proper monitoring be carried out, first to assess response to treatment and secondly to detect any complications. In the given socio-economic situation in India, the lack of proper health care infrastructure and support for chronic illnesses; the rampant ignorance and absence of clear cut, even barely minimum, guidelines on protocols for care and monitoring, at the primary level means that diabetes

care at this level is poor and the approach to the illness is *ad hoc*. When resources are scant, and the option is to choose between monitoring and treating it is quite understandable that monitoring is neglected and does not receive the attention it deserves. Many times it is not merely an issue of resources but knowledge about its need is the biggest problem.

In the CODI study majority of patients (70%) were diagnosed by their general practitioners (GP) and 70 per cent had approached their GP for some other problem. The average diabetes duration was over 8 yr. Since diagnosis approximately 93 per cent of patients underwent urine tests and 92 per cent underwent fasting blood sugar (FBS) and post-prandial blood sugar (PPBS) tests. Specialized tests such as the HbA_{1c}, lipid analysis, blood circulation and kidney function assessments were undertaken by only 7-11 per cent of patients, irrespective of socio-economic status. Blood pressure measurement and eye examinations were only carried out in a relatively low proportion of the patient population (54 and 35%, respectively). Foot examination was done in abysmally low 7.5 per cent patients. This may indicate a lack of awareness among GPs, or a feeling that, more specialized tests may not be necessary, or patients may have decided themselves not to have the tests. Cost may also have been a factor. Post-diagnosis, disease monitoring was poor. Although 48 per cent of patients were aware of urine test strips, and 37 per cent were aware of blood test strips, only half of these patients had ever used them. Only 6 per cent of patients monitored their diabetes more than once a month. The rest monitored their diabetes once every 2 months or more (48%) or once every 3 months or more (47%). Educated patients monitored their diabetes more frequently than illiterate patients (11 vs. 9 times/year, respectively), as did patients from middle- and high-income backgrounds compared with patients from low-income backgrounds (12 vs 11 times/year, respectively)²⁰.

Health system and care provider: Being a chronic disease, diabetes requires support service infrastructure and team approach to care. Whereas, generally the level of clinical care in most big cities

in India is good, lack of support system, non availability of trained paramedical personnel is problematic. There are practically no nurse educators, no podiatrists, and few dieticians, which means that the treating doctor takes the entire burden of responsibility of caring for these patients. The patient's inability/unwillingness to pay for these additional support services also hinders their development. Lack of medical reimbursement and poor State funding for health is a barrier to quality care, often because the patient is unable to afford certain tests or therapy.

Most of the patients (over 70%), initially visit a non-specialist for diagnosis. It is this segment of doctors who are the most important link in early diagnosis and guiding the patient properly, but are often ill-trained to handle diabetes related issues, unaware of the latest trends, or unable to devote time to diabetes due to their busy practice.

An important dimension is health care provider's behaviour. Physicians are trained to provide acute care, where effort and success are easily measurable and are linked to a sense of achievement and power. Need for patient involvement and participation in therapeutic decision making is limited. In chronic diseases this "mind set" does not work. Role transition is difficult in the setting of overburdened services and limited time. In good faith, physicians make decisions for the patients. Many have misplaced concerns about their patients' fears, apprehensions and capability for self-care. These impressions are coloured by the "acute care" mind set and physicians' own feelings and are at best subjective and empirical. A study by Hunt *et al*²³ mentions how clinical interactions between the doctor and patient can unwittingly create barriers to care. The health care providers' ability to motivate a patient to change attitude and behaviour to an illness or accept a certain line of treatment can influence long- term prognosis^{24,25}. The inability / unwillingness to discuss treatment options and the patients inability (due to inadequate information) to initiate such discussions deprives him/her the opportunity to actively participate in management.

The Cost of Diabetes in India (CODI) is the most extensive and comprehensive study on the cost of diabetes and the factors that influence it²¹. On comparing the results of the BUD study¹², the Chennai Study²² and the CODI study¹⁹, the data on costs corroborate quite well. The major differences are that in the CODI study patients were slightly younger, had a higher socio-economic status as compared to BUDS. Although there were similar complications, the rate of multiple complications (three or more) was higher in BUDS- 20 vs 17 per cent in the CODI study; and finally there were more patients on insulin in BUDS (36.0 vs 22.2%). The estimates of costs were similar and the differences noted could be easily explained by differences in the study population. When South Zone data from the CODI study were used for comparison the overall direct cost was similar to BUD study.

Conclusion

Many socio-economic factors and health care delivery related issues impact the outcome of diabetes and consequently the costs and vice-versa. Those with higher education, higher income and actively working people are diagnosed earlier because of better awareness, affordability and the need to remain fit to earn a livelihood for the family. Lower income groups are diagnosed later and so are people living in remote areas. Persons aware of diabetes or those with a diabetic family member may be diagnosed slightly earlier. Factors that influence delay in diagnosis also determine complication rates; thus patients in rural and semi urban areas are likely to have more complications. For similar diabetes duration 45 per cent of college educated patients have no complication vs 20 per cent illiterate group. Persons employed and working have fewer complications. Larger proportions of persons from higher socio-economic strata are free or have fewer complications (54% no complication, 8% three complications) compared to the lower socio-economic group (22% no complication, 26% three complications). Those aware of diabetes are less likely to have complications, however awareness alone

cannot overcome the hurdles placed by socio-economic factors, but within the same socio-economic segments those aware do better than those not aware. Presence and severity of complications are the most important determinant of treatment and monitoring regimen and need for hospitalization and therefore is the most important factor related to costs. Amongst patients hospitalized, the average annual direct costs are more than double to those not hospitalized. Complications are also responsible for indirect costs in terms of productivity loss and absenteeism.

Studies show that the uneducated, unemployed people, especially those living in semi urban or rural areas who cannot afford or do not have access to even bare minimum health care facilities, are likely to be diagnosed late, to develop or have at presentation, diabetes related complications (because of delay in diagnosis and/or improper treatment). This has remarkable socio-economic significance - those who will need more advanced/more expensive care for diabetes related complications, are often the ones who can ill afford such care. While some of these unfortunate people may still be able to afford routine care, when burdened with complications requiring advanced expensive care- it would be like the proverbial last straw that broke the camels backs and would drive many of them to borrow and enter the debt trap with disastrous consequences to the individual and society.

Effective intervention means prevention and prevention means both primary and secondary prevention. Each of us involved in diabetes care needs to be aware of what drives cost. Proper treatment of diabetes is not costly; not treating diabetes properly is very costly.

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Reprint requests: Dr Anil Kapur, Managing Director, World Diabetes Foundation, Lottenborgvej 24, DK -2800 KGs Lyngby, Denmark
e-mail: akap@novonordisk.com