ECONOMIC COST OF DIABETES CARE

THE BANGALORE URBAN DISTRICT DIABETES STUDY

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INTRODUCTION :

The prevalence of type 2 diabetes in India has been steadily increasing in urban areas form a low 2.1% reported in early 1970[1] to a whopping 11.6%[2] IN 1996 in the adult population. Moreover, there is an equally large pool of persons with IGT, many of whom will go on to develop type 2 diabetes in the future [2]. There is evidence to suggest that prevalence of type 2 diabetes is increasing even in rural areas [3]. The rapid increase in population, increased longevity and high ethnic susceptibility to diabetes, coupled with rapid urbanization and changes from traditional lifestyles will most trigger a diabetes epidemic [4]. The WHO estimates that there were 19.4 million persons with diabetes in India in 1995 and that this number is likely to be 57.2 million in 2025[5]. These figures are based on lower estimated prevalence rates than currently seen. Based on current estimates there are about 25 million persons with diabetes of which only 3.6 million receive pharmacological treatment [6]. Moreover, type 2 diabetes amongst Indians is being increasingly seen in younger, less obese persons than reported in the West. The earlier occurrence, coupled with delayed diagnosis and improper care may lead to high complication rates, greater productivity loss and consequently higher costs.

Persons with diabetes use higher health care resources. The excess cost is related to higher cost of treating late diabetic complications and the economic loss due to lost man-days or lost economic opportunity. Diabetes complications account 60% of diabetes related health care costs (direct costs) and almost 80-90% of indirect costs[7]. 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 a 100 billion US dollars in the mid 1990's, for diabetes related health care problems[8]. This increase of over five times in decade is astronomical, and amounts to a little lower than one third of India's GDP. Other studies on direct costs of type 2 diabetes have been carried out in Argentina, France and Denmark. 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 the cost was 3535 US dollars[7].

From the available information it is clear that diabetes will pose a severe burden on the already fragile and under-resourced health care system in India in the near future. The per capital expenditure on health care in India is only 6.4 of the average world spending, while India accounts for 23.5% of the world's disability adjusted life years lost due to diabetes (DALYs) [9].

So far, there are neither published studies on the cost of diabetes treatment in India, nor on the sociological factors that influence it. In the absence of adequate public health programmes to effectively deal with this problem, estimates of cost, however imprecise, will help conceptualize strategies to deal with the situation at local, regional and national level. This information is also useful to the individual.

Cost of illness can be classified into direct, indirect and intangible costs as shown in Table 1. 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 is required. This includes amongst other information, an estimate of current costs.

Table 1 : Components of costs of illness

Direct Costs	Indirect Costs	Intangible Costs
Consultation	Man days lost	Pain
Investigations	Disability payment	Anxiety
Treatment	Social security	Depression
Drugs	Tax rebates	Loss of enjoyment
Monitoring		
Visits		
Hospitalization		
Costs of treating		
Complications		

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As a prelude to a much larger national study to be undertaken later, we carried out a pilot study in Bangalore urban district, with a primary aim to test the method/questionnaire. The secondary aim was to assess the present state concerning the treatment of patients with diabetes, demographic and cost figures in rural and urban parts of Bangalore district, in South India. The study is exploratory in nature and meant to help develop a framework for the larger survey.

The study was carried out by the Institute of Social and Economic Change (ISEC) Bangalore, an autonomous, partly government funded institute, in collaboration with Novo Nordisk Pharma India Ltd. Bangalore and Pharmaco Economic Affairs department of Novo Nordisk A/S. Denmark in late 1997 and early 1998.

The Socioeconomic factors that influence diagnosis, care, progression and prognosis of diabetes in the population under study, representation of the urban/semi urban India has been presented earlier. In this paper we present the economic aspects of diabetes care in the population under study.

METHODS OF STUDY

Instrument of survey

After detailed discussion on the protocol amongst the investigators and prominent diabetes health care providers in Bangalore a structured questionnaire was developed and tested on a small sample (60 patients in two stages) and obvious inadequacies rectified. The questionnaire is structured for easy flow of interview and data entry, and has only a few open ended questions. On as average it took 30 minutes to fill, (28-32 minutes). The questionnaire is in English, all field investigators were familiar with language as well as English and with a presurvey training had no problem in eliciting responses and filling the data.

The questionnaire consisted to six sections and was designed to elicit substantial information. The details of the questionnaire have been presented earlier[10] and are not described here. The costs diabetes care were estimated as follows – for direct costs details on the weekly expenditure on various items related to treatment and treatment delivery, laboratory tests and investigations, recent or past hopspitalization and financial resource used to meet these costs were elicited using a structured interview so as to elicit maximum possible information. For indirect costs information on the 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 requiring other family members to work to augment family income, or give up or change career objectives.

Selection of respondents and representativeness of the study sample:

A random, unbiased selection of sample respondents, representative of the population under study is a pre-requisite. When the universe selection for field studies poses problems. In the absence of registries, proper hospital or clinic records, particularly in the government run institutions and in the peripheral, semi urban and rural areas, it required considerable efforts to obtain a representative sample. This was achieved by including patients belonging to differents socioeconomic groups. In Bangalore city, patients were selected from government institutions teaching hospitals and private institutions, ranging from minor clinics to major hospitals and hospitals and clinics meant only for diabetes care. In tuluka areas, a list of diabetes patients known to the staff of the primary health centers (PHCs) and community health centers (CHCs) was prepared and patients interviewed. Out of the local of 31 PHCs and 2 CHCs in the study area, patients attending 9 PHCs and both CHCs were selected. In all 620 patients were contacted and 611 could provide enough information to be included in the analysis. Ideally the representativeness of the sample should tested by comparing with a diabetic universe, but in its absence, we compared it with the general population in the area under study [11, 12]. The sample representativeness and background characteristics have been described elsewhee[10].

Interview process and data quality :

Interviewers were non medical graduates and post graduates from ISEC, Bangalore who were given a through orientation to the questionnaire and to basics about diabetes. They were also trained in the techniques of interview. Interviews were conducted at the patients' home where address was previously available or in the hospital or clinic when addresses were not previously available. Interviews were conducted in the patients' own language and they were allowed to take help from other family members if required and available at the time of interview. While field work was in progress, weekly review meetings were held to check the quality of

data and progress of work. Field work monitored on a daily basis by the project staff. The data was evaluated for its quality by internal cross checks. The comprehensive data collected on hospitalization and treatment was used to cross check expenses, and discrepancies, if any, were verified and corrected immediately. The study is based on patient interviews and therefore reflected patient perceptions. These perceptions are based on what their treating doctors informed them. It was not possible to cross verify the information provided by the respondent with hospital or clinical records as these were not widely available. When his information was readily available it was used to confirm the patients' responses. Attempts were made to collect information on the result of clinical and lab tests undergone by the patient but it was not possible in many cases. Expenses on treatment were cross checked for consistency with current treatment and the known costs of such treatment. Investigators particularly made attempts to find any discrepancy in test undergone and tests prescribed and in general found that patients, more often than not, undergo the prescribed tests. Patients were generally able to recall in detail monthly expenses prior to the interview and in these cases it was converted to weekly expenses. Patients' ability to recall expenses o tests was fairly good. However, their ability to recall in detail expenses on each aspect of hospitalization cost was very poor and in general were able to only provide total costs of hospitalization. On quality cross checks, interviewer's bias in eliciting information on expenses is found to be statistically insignificant.

The data was entered into a computer system and analyzed. Random checks were performed to ensure correct transfer of data from paper to electronic record.

ESTIMATION OF ECONOMIC BURDEN :

Direct costs :

The annual average expenditure on medical care has been estimated by multiplying the average weekly expenditure by fifty two. Similarly information collected on expenses for recent test has been multiplied by the stated frequency of the tests to get estimates of average annual costs on monitoring and lab investigations. The estimates of costs on hospitalizations is based on average hospital costs per event multiplied by the number of hospitalizations per year. By adding all the three the total annual direct costs have been estimated.

Indirect costs :

Data on indirect costs covered in this study 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 men-days lost have been estimated for workers only. 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). 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 costs as these are difficult to compute in a society with a wide socioeconomic and cultural spread.

Apportioning of direct costs to individual, family and society :

This is not easy and often it is difficult to estimate who is paying in a traditional Indian family setting. 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 part of the services are free. We have used the following thumb rule to apportion costs between individual and family: \non –worker 100% share family, worker 75% individual and 25% family and retired person 50% individual 50% family. This weight is arbitrary and many may disagree with it. Estimation of societal costs is even more difficult as services are provided by public, private and charitable organizations. The imputed societal costs have been derived by calculating the difference between average costs at private paid institutions versus charitable and public institutions and the number of persons using and not using the service. There are limitations to this procedure as poorer sections use public institutions and the richer section use private institutions. Also because of resource differences, if the quality of care is significantly different between the two it could impact long term costs.

RESULTS & DISCUSSIONS :

A total of 620 patients were interviewed of which adequate information was in 611 patients. The rejection rate was 1.5% Background characteristics were quite similar to the population of the study area as reported earlier [10].

In the absence of a uniform health care delivery system and diabetes care protocol the type of

Table 2: Percent patients reporting complications, hospitalization, receiving special (SPI) non surgical treatment (RX) or surgical treatment for the complication.

Complication	Percent (n) reporting the complication	Percent (n) with complication hospitalized	Percent (n) with complication undergoing spl. non-surgical Rx	Percent (n) undergoing surgery for complication
Limb	45.3 (277)	20.2 (53)	--	15.2 % (42)
Eye	29.0 (177)	16.9 (30)	21.5% (38)	
Heart	11.3 (69)	31.9 (22)	--	31.9 % (22)
Hypertension	18.9 (116)	--	--	--
Stroke	2.5 (15)	80 (12)	--	--
Kidney	1.8 (11)	27.3 (3)	63.6 % (7)	9.0 % (1)
Hypoglycemia	13.9 (85)	82.3 (70)	--	--
Other (Hyperglycemia)	19.8 (121)	97.5 (118)	--	--

institution and training of the doctor influences the treatment protocol and thus outcome and costs. 28.2% visited doctors in government run institutions at the time of diagnosis while 71.8% visited private doctors. \only 8.2% visited diabetes specialists for diagnosis.

Table 2 : shows the complications reported by the respondents as well as details about hospitalization, surgical or non surgical treatment received for the condition.

Apart from compliance and adherence to the prescribed treatment and the general quality of care, the most important variables that influence late complications and therefore the costs and prognosis of type 2 diabetes, are delayed diagnosis and duration of diabetes. This has been shown in many earlier studies and recently confirmed in the UKPD study [13]. We looked at the influence of demographic and socioeconomic factors such as sex, place of residence, education level, occupation, monthly family income, family history of diabetes and pre-diagnosis diabetes awareness on the age if diagnosis, mean duration of illness and complications. As the number of respondents with

suspected type 1 diabetes (diagnosis before 30 years of age, continuous insulin requirement since diagnosis, classical symptoms and hospitalization for drowsiness or coma related to high blood sugar) was only 30 and hence inadequate to make a meaningful analysis, the data is further analyzed for type 2 diabetes (not belonging to the suspected type 1 category) only.

While socioeconomic factors may influence the age of onset of type 2 diabetes, we believe that the differences noted are more a result of delayed diagnosis. The influence of various socioeconomic variables on the age of diagnosis for respondents with type 2 diabetes in this study ate described elsewhere, but briefly an almost seven year delay in diagnosis between illiterate and college educated person; an almost three year delay between city and semi-urban area; an almost one decade's difference between the actively working and non working respondents; an over four years delay between the highest and lowest socioeconomic groups and on an average five year delay in patients with multiple complications as compared to those without complications was seen in the study.

The duration if diabetes is the most important independent determinant of long term diabetes complication and is function of current age and the age at diagnosis. The not so surprising finding is that other factors being equal, with increasing

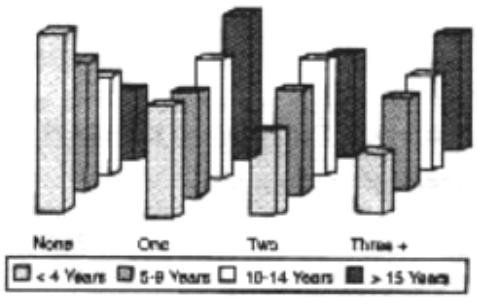

Figure 1: *Relationship between diabetes complications and diabetes duration. With increasing diabetes duration the number and severity of complication also increase.*

duration the proportion of patients with more number of complications increases (figure 1). However, because of the influence of delayed diagnosis, no significant co-relation was found between mean diabetes duration and number of complications.

The influence of other socioeconomic and care variables such as education, income occupation and employment , place of stay, diabetes awareness, treatment modality and physician factors, on the diabetic state and prognosis seen in the study have been described earlier[10].

70% of the respondents reported one or more complication related to the limb, eye, heart, hypertension, hyperglycemia. Uncontrolled hyperglycemia was the most common cause for hospitalization. Amongst patients undergoing surgery for diabetes related complications, surgery on the limbs (feet) was the most common. 30 of the 53 respondents (56.6%) reporting hospitalization for foot problems underwent amputations, (seven toes, four feet, eighteen legs and one finger). Another twelve underwent other foot surgery. One respondent had renal transplantation, and twenty two had surgery related to their heart problem.

Despite a slightly higher mean diabetes duration (9.2 vs. 8.3 years), patients with type 1 diabetes had more complication free rate (30.7% vs. 22.9%). Insulin treatment in type 2 diabetes is usually given for patients with long standing uncontrolled diabetes not responding to oral agents alone. The mean diabetes duration for insulin receiving patients was 11.1 years compared to 7.0 years for those not receiving insulin. 37.6% respondents currently not on insulin had no complication compared to 17.1% currently on insulin. Type 2 respondents currently on insulin perhaps have a longer (both diagnosed and pre diagnosis), more severe hyperglycemia which is reflected in a higher complication rate.

Direct cost of routine treatment

The type of therapy and place of treatment are important determinants of costs in an environment of no reimbursement or health insurance.

Most of the respondents (over 91%), initially visited a non specialist for diagnosis. It is this segment of doctors who are diagnosis. It is this segment of doctors who are the most important link in early diagnosis and in guiding the patient properly, but are often ill-trained to handle diabetes related issues, are unaware of the latest trends, or unable to devote time to diabetes due to their busy practice.[14]

Figure 2 shows proportion of patients receiving different therapies. Table 3 shows average annual direct costs adjusted for other background variable for routine treatment not requiring hospitalization under different setting. Significant differences were

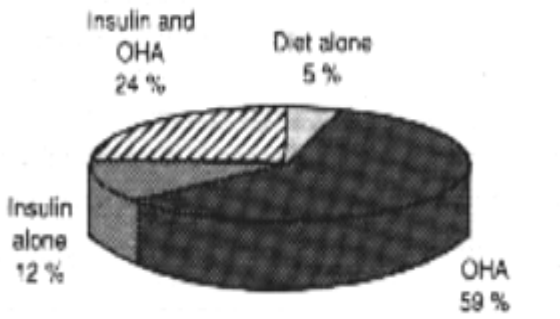

Figure 2 : *Proportion of patients receiving different therapies.*

Table 3 : Annual Direct Cost (background variable adjusted) for routine diabetes treatment, not requiring hospitalization in different settings.

Setting (sample size)		Adjusted Annual Costs (INR)
All patients (611)		5959/-
Type 1 (35)		6432/-
	OHA alone (394)	4722/-
	Insulin alone/plus OHA (217)	8195/-
Sex	Males (335)	5580/-
	Females (276)	6417/-
Place	Government (172)	2855/-
	Private (439)	7176/-
Duration	<5 years (216)	5522/-
	5-14 years (277)	6240/-
	15+ years (118)	6063/-
Stay	Urban	5756/-
	Rural	6266/-
Income	upto 2500 (293)	5470/-
	2501-5000 (155)	6505/-
	5001-10000 (126)	6136/-
	< 10000 (37)	6885/-
Education	Illiterate	5429/-
	School	6011/-
	College	6271/-
Complications	None (185)	5606/-
	One (168)	5616/-
	Two (134)	5954/-
	Three + (124)	6947/-

noted between patients receiving treatment in government institutions and amongst insulin and OHA treated patients and family, in government institutions is a result of no/low consultation charges and subsidized medicine costs which are partly offset by slightly higher transportation costs and a higher societal cost because of subsidy. Cost also increased with increasing duration and number of complications (figure 3). Males spent less compared to females. The overall break up of the annual direct treatment costs is shown in the figure 4. As can be seen, the cost of medicines comprises only one third the total annual costs.

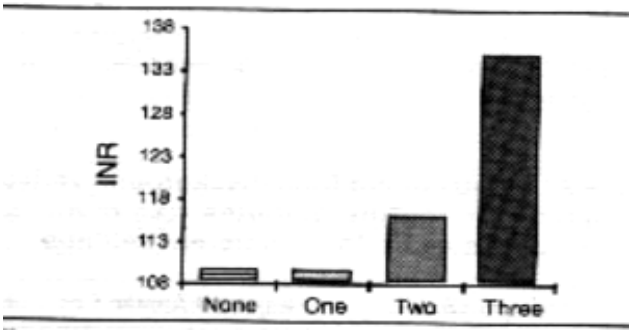

Figure 3 : *Average weekly expenses as a function of number of complications*

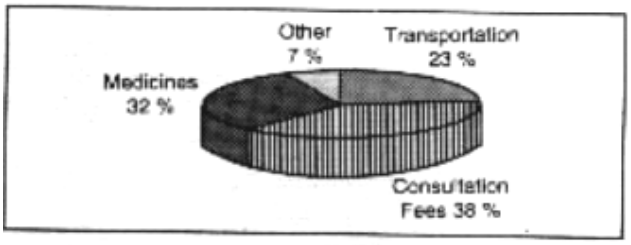

Figure 4 : Break up of annual direct treatment costs.

Direct costs of routine monitoring/test

To prevent diabetes complications, it is crucial that proper monitoring be carried out, firstly to assess response to treatment and secondly to detect any complications. In the given socioeconomic situation in India, the lack of proper health care infrastructure and support for chronic illness; 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 adhoc. When resources are scanty, and the option is a choice between monitoring and treating, it is understandable that monitoring is neglected and does not receive the attention it deserves. Many times of- course, it is not merely an issue of resources, but knowledge about its need which is a problem.

Routine monitoring was very low. Only seven respondents out of 611 (1.1%) undertook home monitoring of blood glucose. Twenty one did not ever monitor their blood sugar, while the remaining visited a lab or clinic for monitoring. The inability of the person to afford the cost of the meter and strips is often quoted as the reason for poor HMBG rates. And although lab charges are similar, what is not taken into account is the time and money spent by the patient to go to the lab for tests. If those costs are also considered, home monitoring is any day more cost effective and a good self management learning tool. This is clear from the fact that one third of the total cost on monitoring, is spent on transportation to visit the lab. The frequency of monitoring as reported by the respondents is shown in figure 5.

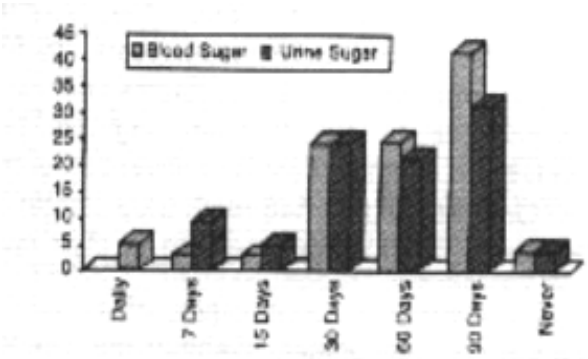

Figure 5 : Frequency of blood and urine sugar monitoring

Table 4 shows the lab tests and special clinical examinations that respondents have undergone at least once, either at the time of diagnosis, or ever since diagnosis. We cannot vouch for the accuracy of this

Table 4 : Lab tests/clinical examination ever undertaken

Test	Percent
Urine examination	98.7
Blood Sugar	
Fasting	96.4
Post prandial	94.9
Glucose tolerance test	66.1
Blood lipids	7.7
Kidney function	13.1
Blood pressure check	23.6
Eye exam	18.0
Check for circulation/ sensation in legs	11.9
X-ray exam	17.0
ECG	20.6
Other	3.9

examinations that the respondents have undergone at least once, either at the time of diagnosis, or ever since diagnosis. We cannot vouch for the accuracy of this reporting, but even considering a 30-40% under reporting, these figures are worrying. Informal discussions by one of the authors (AK) with a lot of practicing diabetes specialists indicated that the general opinion was that the actual picture is not very different from the respondents' responses.

Lipid analysis, kidney function tests, X-ray, ECG etc. were either carried out only in a few patients, or only a few patients had knowledge or records of these test being performed on them. Even simple clinical examination of the feet, measurement of blood pressure and examination of the eye, was not done in over 80% of the cases. It is important to carry out certain baseline clinical/laboratory tests for persons diagnosed with diabetes in order to detect complications and to follow up progress. It is quite likely that the rate of complications may have been even higher than noted in this study, as many of the complications may have been even higher than noted in this study, as many of the complications may as yet be sub-clinical and would be revealed only by lab or special clinical tests.

Given the background of poor monitoring and lab investigations, it is obvious that costs related to it are not high. On an average patients spent Indian rupee (NIR) 823/- annually on lab investigations and monitoring. Patients on insulin therapy, those with multiple complications and patients attending private clinics, spent more on investigations and monitoring than the rest. As most patients with multiple complications were also on insulin, the only significant factor increasing monitoring costs was multiple complications (three or more). The lower costs in Government institutions is a result of subsidy which accrues under indirect costs and does not materially change anything. Based on average current costs and assumed bare minimum investigations. This has been termed as hypothetical costs. Increased spending on monitoring and

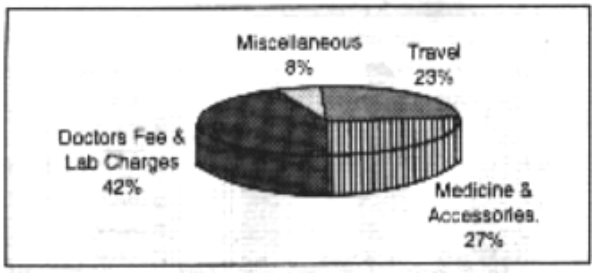

Figure 6 : *Breakup of direct costs for routine care (not requiring hospitalization) into different components.*

Investigations is likely to result in early detection and by focusing attention on improved control may actually bring down complication rates and thus overall costs (Figure 7).

Direct costs of hospitalization :

As well known, persons with diabetes use higher health care resources compared to non diabetics. Amongst the cohort of 611 patients studied, a total of 308 events of hospitalization were reported by patients. Of these 164 (53%) events required seen days or more of

Table 5 : Details of hospitalization based on complications.

		Number of Days Hospitalized						
Complications	**n**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
Limb	53	2	--	4	--	2	2	43
Eye	30	2	3	4	--	4	--	17
Heart	22	--	1	4	1	2	1	13
Stroke	12	1	1	--	--	--	--	10
Kidney	3	--	1	--	--	--	--	2
Hypoglycemia	70	64*	3	--	2	--	--	1
Hyperglycemia	118	2	11	10	4	11	2	78

*duration varied from one to ten hours.

Table 6 : Average Direct Costs (background variable adjusted) per hospitalization in different settings.

Setting (sample size)		**Adjusted Costs NIR**
All patients (214)		9944/-
Type 1 (19)		9456/-
Type 2 (155)		9992/-
	OHA alone (94)	10401/-
	Insulin alone/plus OHA (120)	9586/-
Sex	Males (131)	12780/-
	Females (83)	5468/-
Place	Government(59)	7069/-
	Private (155)	11039/-
Duration	<5 years (59)	7261/-
	5-10 years (49)	7902/-
	10 + 15 years (46)	13079/-
	15+ years (60)	11847/-
Stay	Urban (119)	10817/-
	Rural (95)	8851/-
Income	upto 2500 (124)	10272/-
	2501-5000 (45)	8546/-
	5001-10000 (35)	11019/-
	>10000 (10)	8407/-
Education	Illiterate (52)	8453/-
	School (124)	8343/-
	College (38)	17207/-
Complications	One (75)	8485/-
	Two (55)	4939/-
	Three + (84)	14525/-

costs of hospitalization varied considerably depending on the duration, reason and place, and no significant associations between background characteristics and hospitalization cost could be established expect that spending was much higher amongst males and persons with college education. Also the cost of hospitalization was higher for person with multiple complications (Table 6). The average overall costs for hospitalization was INR 9944/-. As indicated earlier, it was difficult to get detailed breakup of hospitalization costs. Detailed information with break up was available for only 41 cases and the average costs in these patients was estimated at INR 8746/- and this has been used in the analysis of total costs and for apportioning costs to individual, family and society.

Indirect Costs :

The method used for estimating indirect costs has been described earlier. In the present study only one third of the respondents were working. As indirect costs are mainly related to lost productivity[7] from those working and employed, it is likely that this study under represents productivity loss. The better way of estimating productivity loss is based on the economic value of individual, which us based on replacement cost. For example, from the current model, it is difficult to estimate the productivity loss for a house wife unable to carry out certain activities because of illness. If the EVI is used it would be possible to assign value to her inability to perform certain tasks. Of those working, a large proportion experienced problems at the job, affecting their productivity and at times requiring change to less strenuous job or giving up the job. (Table 7 & 8).

Table 7 : Problems faced by respondents at work due to their diabetes status.

Working	33.4%	Took diabetes related leave	25.0%
Changed job	5.9%	Reasons	
Problems in current job	23.0%	Unable to work	9.3%
Unable to work	14.7%	To visit doctor	12.3%
Get tired	4.9%	Feeling uneasy	2.0%
Worried about injury	5.4%	Other	1.5%
Employer not happy	5.9%		
Often fall sick	3.9%		
Others	2.0%		

Table 8 : Impact of diabetes on the mean individual and family income.

Income Source (n = No. Responses)	No. reporting change (%)	Mean degree change (SD)
Personal Income (204)	63 (30.9%)	↓ 20.9% (17.1)
Family Income	127 (20.8%)	↓ 17.4% (13.3)
Forced other family Member to work (611)	48 (7.9%)	

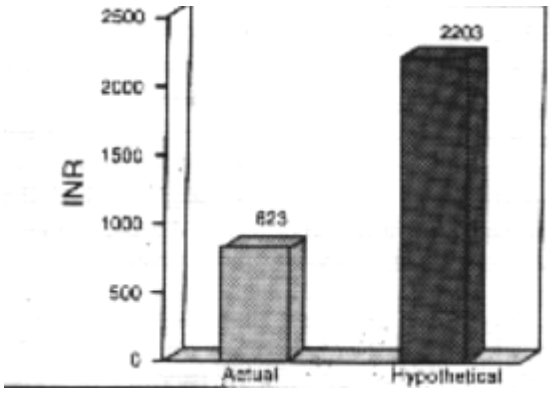

Figure 7 : *Actual and hypothetical monitoring and investigation costs*

Burden of diabetes at personal, family and societal level

The total direct annual cost of diabetes care at current cost (1998) and level of care of patients not requiring hospitalization, in Bangalore Urban district, was estimated as INR 6782/- based on spending by the consumer. In addition, community (society) also supported these expenses by a subsidy. For calculating overall direct costs this amount is added to costs incurred by the individual and family. The amount subsidized by the community (society) for routine diabetes care and monitoring and lab investigations is estimated at INR 1238/- per patient per year. Thus the total direct cost for non hospitalized patients undergoing routine care is INR 8020/- per patient year. Of this INR 7072/- is spent on treatment related costs and INR 947/- on monitoring related costs. The break up of costs under different heads is shown in figure 7.

Source to support diabetes care :

In the absence of medical insurance, it is important to know the source for support of direct costs of diabetes care. For most respondents that source of support was the individual's disposable income (figure 8). The next important source was governmental support especially for government

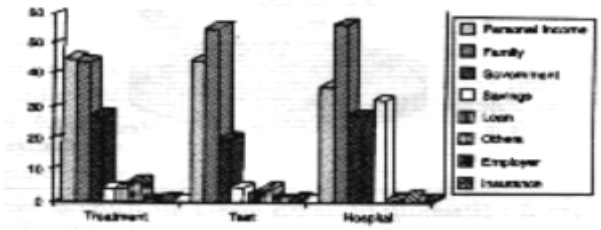

Figure 8 : *Source used to fund diabetes treatment.*

employees with access to reimbursement of medical costs or free medical care through state funded hospitals. For hospitalization, a lot more respondents took recourse to using their/family savings and even borrowing (figure 8).

Limitations and value of the study :

As mentioned above the study is a pilot study to evaluate the questionnaire for a major national study and has several limitations. The study is based on patient interviews – it has not been possible to verify and confirm the information provided by cross checking with medical case records. The general paucity of medical records is a barrier to such a community based study anyway. On the other hand a hospital or clinic based study may provide better authentication of some of the findings but will be skewed in terms of patient selection. A more detailed analysis using multivariate analysis or other advance statistical methods may provide greater insight to the apparent links and associations seen in this study.

Despite limitations, it is the first community based study to understand the interplay between socioeconomic factors and diabetes in India. In the first part we looked at the impact of socioeconomic factors on diabetes prognosis. This is important, in the unique Indian situation, where in the absence of a universal optimum diabetes care program, and individual's paying capacity determines the quality of care and therefore prognosis. In most developed and developing countries a diabetes care program fully supported by the state or through insurance usually exits. Some of them have education and awareness programs. When uniformly good quality care is accessible to all (as in many countries), it is the individual's own decision to make advantage of it or not; and the disease outcome is at least not pre determined by his/her socioeconomic standing .

In this study we have presented the costs of diabetes care in Bangalore urban district. The finding are quite revealing. The cost of care is high and comparable to costs in other countries, especially if one keeps in mind the purchasing power parity. The Bangalore Urban Diabetes Study revealed that direct and indirect costs of diabetes care for patients undergoing treatment that involved hospitalization was approximately; US$ 850 per patient per year. Of this the direct costs account for US $399 per patient per year (Table 9).

Diabetes is often diagnosed late – perhaps too late. 50% of patients even in developed countries have complications at presents even in developed countries have complications at presentation (UKPDS). Untreated or improperly managed diabetes leads to complications. Complications requiring prolonged hospitalizationare responsible for most of diabetes related direct costs. Amongst patients hospitlized the average annual direct costs were more than double than those not hospitalized. Complications are also responsible for indirect costs in terms of productivity loss and absenteeism.

This study shows that the uneducated, unemployed people, especially those living in semi urban or rural areas, who cannot afford or do no have access to even bare minimum health care facilities, are likely to be diagnosed late, are likely to develop or have at presentation, diabetes related complications (because of delay in diagnosis and/or improper treatment\0. This has remarkable socioeconomic significance – those who will need more advance / 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 reuiring advanced expensive care – it would be like the proverbial last straw that broke the camel's back and would drive many of them to borrow and enter the debt trap with disastrous consequences to the individual and society.

Proper control can prevent, retard or arrest development of complications both in type 1 and type 2 diabetes as shown by the DCCT, UKPDS, Kumamoto, and numerous other studies. Without effective intervention, the diabetes epidemic will continue to grow. Effective intervention means prevention and prevention means primary prevention – life style changes, and secondary prevention – reducing the burden of complications by early diagnosis and proper care.

There is an urgent need to develop simple cost effective protocol for care which covers "Basic Minimum Standards". Such protocols must become the basis of medical education. Efforts must be directed to empower, encourage and educate primary care physicians to use these basic standards.

There is a need to improve case record maintenance, develop registries and carry outcomes research to refine standards and identify "at risk" patients. Large scale efforts to improve awareness and knowledge amongst those affected and their families as well as populations at large are needed.

Table 9 : Annual economic burden of diabetes direct and indirect. Apportioned at individual, family and societal level.

Level of Burden	Direct Costst (INR)				Indirect Costs (INR)	Total Costs (INR)
	Routine	Moni & Lab	Hospital	Total		
Personal	1882.40	291.30	2551.10	4724.80	1850.50	4024.20
Family	4076.80	531.30	6127.50	10735.60	1722.00	5330.10
Society	1112.80	124.90	67.50	1305.20	15376.30	16614.00
Total	7072.00	947.40	8746.10	16765.50	18948.80	35714.30

Action taken early in the course of diabetes is more beneficial in terms of quality of life and is more cost effective, especially if it can prevent hospitalization. Proper management requires investment in awareness, education and better care.

Providing health care to prevent and treat diabetic complications requires resources. The cost of not doing so will be phenomenal.

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REFERENCES:

1. Ahuja MMS., Epidemiological studies on diabetes mellitus in India In: Ahuja MMS(ed). Epidemiology of diabetes in developing countries. New Delhi: Interprint, 1979; 29-38.

2. Ramachandran ± , Snehkata C. NIDDM in India and Indians: Is it increasing? Bull IDF 1995; 40: 27-9.

3. Ramaiya KL, Kodali VRR, Alberti KGMN. Epidemiology of diabetes in Asians of the Indian sub-continent. Diabetes Metab Rev 1990; 6 : 125-46.

4. Zimmet P. Challenges in diabetes epidemiology – from West to the rest. Diabetes Care 1992; 15: 232-52.

5. King H, Aubert RE, Herman WH. Global Burden of diabetes, 1995-2025. Prevalence, numberical estimates and projections. Diabetes Care : 21 : 1414-31.

6. Kapur A, Shishoo S, Ahuja MMS, Sen V, Mankame K, Diabetes care in India, Patients' Perceptions Attitudes and Practices (DIPPAP – 1 Study). Int. J. Diab. Dev. Countries 1997; 17 : 2-12.

7. The economics of diabetes and diabetes care – a report of a diabetes health economics study group. Ed. Gruber W, Lander T, Leese B, Songer T, Williams R. An IDF WHO Publication 1997.

8. Rubin JR, Altmann WM. Memdelson DN. Health care expenditures for people with diabetes mellitus 1992. J Clin Endocrinol Metab 1994; 78 : 809±-F.

9. World Bank. World development report 1993: Investing in health. World development indicators. Oxford. Oxford university press, 1993; 213-4.

10. PH Rayappa, KNM Raju, Anil Kapur, Stefan Bjork, Camilla Sylvest, KM Dilip Kumar. The impact of

socio-economic factors on diabetes care, Int. J. Diab. Dev. Countries. 1999; 12; 1; 7-16.

11. Government of Karnataka (1996) Economic Survey, 1995-1996, Government Press, Bangalore.

12. Government of Karnataka, Directors of Economics and Statistics (1997) Study on poverty, unemployment safety nets in Karnataka, Government Central Press, Bangalore.

13. UK Prospective Diabetes Study (UKPD) Group. Intensive blodd-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). Lancet 1998; 352: 837-53.

14. Kapur A, Shishoo S, Ahuja MMS, Sen V. Mankame K. Diabetes care in India – Physicians' Perceptions Attitudes and Practices (DIPPAP – 2 Study). Int. J. Diab. Dev. Countries 1998; 18: 124-30.