A STUDY OF THE ECONOMIC COSTS OF DIABETES MELLITUS IN TANZANIA IN 1989/90

by

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DECLARATION

I declare that the whole of this work has not been submitted for a degree in any other University.

Date 18 - 9 - 1991

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ABSTRACT

Objectives: To estimate the direct and indirect costs of diagnosis, treatment, complications and follow up of diabetic patients in Tanzania.

Design: Diabetes costs estimated from the data and reported experience of diabetic patients first seen at the diabetes clinic at Muhimbili Medical Centre, Dar es Salaam in 1981/82 and patients with newly diagnosed diabetes seen in 1989/90.

Setting: Muhimbili Medical Centre, Dar es Salaam, Tanzania.

Subjects: 464 patients: 315 men, 149 women. All 202 patients diagnosed to have diabetes between 1 June 1981 and 31 August 1982 (Group I). All 262 patients diagnosed between 1 September 1989 and 31 October, 1990 (Group II).

Results: The average direct cost of diagnosis per person was Tshs. 2212 (US $ 11). The average one year direct cost of diabetes care in 1989 - 90 was Tshs 57365 (US $ 287) for a patient with insulin-requiring diabetes mellitus (IRDM) and Tshs 20553 (US $ 103) for a patient with non-insulin dependent diabetes mellitus (NIDDM). Outpatient costs accounted for 79.8% of the total direct cost in an IRDM patient while the corresponding figure for an NIDDM patient was 67.2%. For an IRDM patient insulin purchase accounted for 68.2% of the average one year direct outpatient costs, and treatment of chronic complications and infections accounted for 13.2%. For an NIDDM patient, of the total one year direct outpatient costs, purchase of oral hypoglycaemic drugs was 42.5% and treatment of chronic complications and infections was 48.8%.

Indirect costs were calculated in terms of Healthy Life Days (HLDs) lost because of diabetes mellitus. It was found that total future healthy life days lost per patient were 4100 days. Of these 69% were lost because of premature mortality, 1% was lost due to disability before death, 29% because of chronic disability and 1% due to infections and acute complications associated with diabetes.

For outpatient care of all diabetic patients 15 years and above in Tanzania in 1989 - 90 about US $ 2,721,151 were needed. The outpatient costs were distributed as follows: 30.8% for treatment of infections and chronic complications of diabetes, 32.2% for insulin purchase, 24.3% for oral hypoglycaemic drugs, 3.5% for self home care urine glucose strips, 5.9% for self care syringes, needles, spirit and cotton swabs, 1.9% for clinic urine and blood glucose tests and 1.2% for transport costs. Doctors' and nurses' costs accounted for 0.2% of the total one year outpatient care costs.

The total direct inpatient care costs for all diabetic patients 15 years and above in Tanzania in 1989 - 90 were estimated to be US $ 1,255,312 The inpatient costs were distributed as follows: investigations 40.4%, meal and bed 22.0%, insulin 5.9%, antibiotics 3.7%, intravenous fluids 4.5%,syringes and needles 5.1%, oral hypoglycaemic drugs 0.5%, antihypertensives 1.4%, other inpatient treatment costs 4.8%. Nursing and doctors' costs accounted for 9.1% and 2.5% respectively of the total inpatient costs.

To have cared for all diabetic patients 15 years and above in Tanzania in the year 1989/90 about Tshs. 795,292,530 (US $ 3,976,463) would therefore have been required. Of the total direct costs, 68% was for outpatient care and 32% for inpatient care. Excluding costs for transport (born by the patients themselves) and self home blood or urine glucose monitoring (not presently done) from the total direct costs of diabetes care, then the actual government expenditure on diabetes care in 1989/90 was Tshs. 769,713,714 (US $ 3,848,569). This implies that 0.2% (diabetic patients who were on treatment) of the Tanzanian population 15 years and above used about 8.1% of the total government health expenditure which was Tshs. 9,481,676,460 (US $ 47,408,382)

Financial requirements for the care of diabetic patients in Tanzania are therefore extensive, and place a very great burden on the limited government resources available for health care. This study highlights the increasing strain which the care of patients with chronic diseases will place on the health budgets of developing countries and the need for exploring alternative methods of health care financing.

INTRODUCTION

Developing countries have a low real income (GNP) per head, an economy dependent on one or two crops or minerals, national resource not fully exploited, rampant unemployment and a high proportion of the population dependent on agriculture. Tanzania with a total population of 23,174,336 people is one of the 25 poorest developing countries. The gross per capita income in Tanzania ranges from US $ 160 to US $ 200 per year with monthly salaries ranging from Tshs. 3,000/= (US $ 15) to Tshs. 25.000 (US $ 125).

The major health problems of Tanzania do not differ from those experienced by other developing countries. Diseases associated with poverty, including infections, parasitic diseases and problems associated with nutritional deficiencies remain the major cause of morbidity and mortality.

Experience from developed countries indicates that with better living conditions, adoption of a western life style and an increase in life expectancy, an increased incidence of noncommunicable diseases may result. These include diabetes, hypertension, coronary artery disease, peripheral vascular disease, cancers, chronic bronchitis and emphysema. These diseases exact a considerable toll on health service resources because of their chronicity and many related complications. The incidence of many of these noncommunicable diseases is now increasing in developing countries still beset with other economic, social and health problems. Developing countries can ill-afford the costs involved. It has been observed that the overall prevalence of diabetes in rural Tanzanians is 0.9%, ranging from 0.5 - 1.3%.[1] Preliminary studies in Dar es Salaam indicate that the prevalence of diabetes among the urban poor may not be significantly different from that among rural inhabitants. It has also been observed in other studies that diabetes in Tanzania affects the poor people.[2]

Research from a number of developed countries demonstrates that people with diabetes are consistently heavy lifetime users of health care resources. The economic implications of diabetes in the Third World have been ignored but they represent a potentially massive burden for many developing economies.[4,5] Having noted this, I was thus interested in studying the economic burden of diabetes in Tanzania. Before indulging into the study, it is worth reviewing the health care system in Tanzania.

HEALTH CARE FACILITIES IN TANZANIA

In Tanzania there are about 155 hospitals, 274 health centres and 2851 dispensaries.[5] The health centres and dispensaries are situated mainly in the rural areas where over 80% of the population live. In general, 93% of Tanzanians are within 10 kilometres of a health facility and 72% of the rural population live within 5 km of a government health facility.[6] Tanzania has 23,400 hospital beds, 6,168 beds in health centres and 11,340 beds in dispensaries.[5] Some dispensaries do not admit patients except for delivery. About 510 Tanzanians have to share

one hospital bed in one year.[5,6,7] According to the available data on population and health facilities, on average a health unit is supposed to serve 7,269 people. But there are units which serve less than 1,500 people and others more than 7,269 people depending on location. There are 36,747 health workers in Tanzania,[5] distributed as follows:

	Number	%
Medical officers	978	2.7
Assistant medical officers	316	0.8
Medical assistants	3836	10.4
Rural medical aides	10,414	28.3
Health officers	703	1.9
Assistant health officers	3,351	9.1
Nurses grade A	3,352	9.1
Nurses grade B	9,289	25.3
MCH aides	4,508	12.3

Over 65% of all the health workers are either rural medical aides, nurses grade B or MCH aides who work mainly in rural areas.

UTILISATION OF HEALTH SERVICES IN TANZANIA

The average number of outpatient visits per person per year in 1989 was 2.5 for hospitals, 1.1 for rural health centres and 3.3 for dispensaries (unpublished). Of all the visits to health units 37% were to hospitals, 16% to rural health centres and 47% to dispensaries.[5,6] The high percentage of outpatient visits to hospitals could be due to hospitals being better equipped than the other health units.

About 1,964,000 Tanzanians were admitted in the various health units in 1989.[5,6] Therefore the admission rate in the general population was about 9%. The rate of use of beds has been very high in health centres probably because many of these health centres are in the rural areas where the majority of the population live. On average, the number of people using one bed in a year was found to be 48 inpatients and the average number of days per hospitalisation was 7.6 days(unpublished). The average number of days of hospital stay in 1980 was 8.3 (unpublished). The decrease in the number of hospital days could be a result of an increase in population with slow increase in number of beds which creates excess hospital bed demand and hence forcing hospitals, health centres and dispensaries to reduce the number of hospital days.

FINANCING HEALTH CARE IN TANZANIA

The Tanzanian health system is financed from different sources. Government funding comes from four sources, viz, Ministry of Health budget, Ministry of Local Government budget, revenues from district and urban councils (from the development levy) and the Prime

Minister's budget. Other sources of health expenditure include voluntary agencies, multilateral and bilateral donors, private organisations, individuals and community contributions.

The aggregate central budget on health has been nominally increasing but declining in real terms since 1981. This has had a significant effect on the quality of health care which is delivered by the government facilities. The percentage of the total government expenditure approved for the health sector has been very low, fluctuating between 5.8 and 11.1%.[9]

Within the health sector, hospital services have been allocated the bigger portion of the budget, ranging between 69% and 79% over the last decade. The portion allocated to manpower development has ranged between 4.5% and 7.5%. The least financed service is the medical supplies and production which receives between 1.5% and 4.9%.[9]

The big proportion of the total expenditure on health has been for recurrent expenditure ranging from 80% to 92% of the total. This is essentially to maintain the already installed capital in health services.

The per capita health expenditure has been declining in US dollar values although nominally increasing in Tshs. In 1980 it was about US $ 7 (Tshs. 56.1), in 1988 it was slightly above US $ 2 (Tshs. 207.6) and in 1989 it was also slightly above US $ 2 (Tshs. 315.0, calculated). In 1989/90 it was Tshs. 421 (US $ > 2) On a per capita basis, health expenditures have fallen in real terms, to about three quarters the level of the mid-seventies. This amount of money is grossly inadequate. In order for this amount to "artificially" meet the costs, less care has to be given to the patient.

The rural health centres and dispensaries are under the Ministry of Local Government. Due to instability of the revenues collected by the district and urban councils, these health units have been receiving a low share of the levy collected and they are not able to buy drugs to satisfy their demands.

The amount of money allocated to drug production is only about 3% of the Ministry of Health budget.[9] As a result drug production is not enough. The national drug factories produce only 5% of the national demand.

Foreign financing

DANIDA and UNICEF have been the major contributors to the Tanzania health system. Between 1983 - 1987 they provided US $ 30 million for drugs and other medical supplies.[9,10] The total annual inflow, from all donors, is now around US $ 11-12 million as donor provided pharmaceutical supplies .[8] Other major contributors to the Tanzania health system include SIDA, GTZ, FINNIDA, WHO, USAID, NORAD and ODA.

Private financing

There are a number of private health facilities, including traditional practitioners and birth attendants. But only a few people can afford the expenses in the private health facilities. The private facilities are only for the financially well-off and employees whose costs are met by

their employers. Most of the poor people resort to the traditional healers who charge moderately and can be paid in kind.

The financial problems of the health sector, are more the result of general budgeting pressure arising from revenue weakness, foreign exchange shortages and a crowding out of all forms of sector expenditures by debt servicing. Budgetary constraints have undermined a system of social services delivery that had been expanded rapidly in earlier years, and had already achieved extensive coverage throughout the country. A further factor has been the pressure of an expanding population. While the number of hospitals, health centres and dispensaries has only marginally changed since 1980, the patients base has increased by over five million.

The Government health financing system is functioning, but is under strain. Among the most serious problems are[10]:

a) the declining real pay of medical staff which affects morale and productivity;
b) shortages of drugs and other medical supplies;
c) management and operational deficiencies in the Central Medical Store (CMS) and the domestic pharmaceutical industry;
d) lack of foreign exchange to repair and replace equipment; and
e) neglected maintenance of buildings.

AIMS OF THE STUDY

Broad objective

To estimate the direct and indirect costs of diagnosis, treatment, complications and follow up of diabetic patients in Tanzania.

Specific objectives

1. To study the clinical characteristics of diabetic patients in Tanzania.
2. To estimate the direct costs involved in establishing the diagnosis of diabetes mellitus in terms of:-
   a) Time spent on visits to dispensaries and clinics before diagnosis.
   b) Number of visits to dispensaries and clinics before diagnosis.
   c) Transportation charges for the visits to dispensaries and clinics before diagnosis.
   d) Investigation charges before diagnosis
   e) Treatment charges before diagnosis
   f) Time off work before diagnosis
3. To estimate the direct costs involved in the follow up of diabetic patients in terms of:
   a) Time spent on outpatient follow up visits to Muhimbili Medical Centre
   b) Transport charges for follow up visits to Muhimbili Medical Centre
   c) Charges for urine and blood glucose monitoring during follow up visits at MMC.
   d) Costs of oral hypoglycaemic drugs and insulin prescribed over the last one year period.

e) Cost of doctors' and nurses' time spent at the clinic during follow up visits

f) Costs of basic equipment for self care for:-

- estimation of urine glucose
- syringes and needles
- spirit and cotton wool

4. To estimate time used for self-injection by patients who are on insulin.
5. To estimate indirect costs for follow up visits and self-injection time over a period of one year.
6. To identify the common complications which occur in diabetic patients.
7. To estimate the costs of managing the complications.
8. To estimate the indirect costs of the complications and disabilities.
9. To estimate the direct costs involved for inpatient care in terms of:-
   a) Investigations
   b) Treatment
   c) Doctors' time
   d) Nursing time
   e) Meals and bed
10. To estimate the indirect costs incurred during the inpatient period.
11. To estimate the proportion of patients who have died during the follow up period.
12. To establish the reasons for deaths i.e whether because of acute metabolic complications, infections and chronic complications of diabetes or unrelated to diabetes.
13. To estimate the duration of diabetes at the time of death.
14. To estimate the indirect costs due to premature deaths.

REVIEW OF LITERATURE

Diabetes mellitus, was until recently, considered rare in sub-Saharan Africa.[11,12] Prevalence rates of non insulin dependent diabetes in rural areas are lower than rates reported in most other parts of the world,[1,13] but diabetic clinics are now found in many large hospitals in cities throughout Africa. In some hospitals diabetes accounts for 2 - 5% of all medical admissions.[14,15,16]

Diabetes is a major public health problem for several reasons: first there is an increasing number of patients as life expectancy increases, second, diabetes is a chronic disease with many possible complications and third, its management requires substantial patient education.

Diabetes mellitus is chronic and largely irreversible. Its aetiology is still incompletely understood. Although all diabetes cases are classified and reported under one code (No. 250) in the International Statistical Classification of Diseases, Injuries and Causes of Death[17], it is now generally accepted that epidemiologically there are two main types of illnesses and this is well acknowledged in the revision of the International Classification.[18]

Insulin-dependent diabetes mellitus (IDDM) generally occurs among younger age groups (with 25 - 50% cases occurring before the age of 15 years), and its onset is nearly always acute. Sufferers require regular doses of insulin by injection at least once per day, in order to sustain life and avoid acute and long-term complications. Those with non-insulin-dependent diabetes mellitus (NIDDM) usually suffer from a milder illness which has a slower onset and is most common in the older age groups (over 40 years).

A third type of diabetes now frequently called malnutrition-related diabetes mellitus (MRDM), has been reported from many developing countries. The patients are usually young and have a history of nutritional deficiency. This illness is believed to be clinically distinct and therefore a separate grouping has been proposed.[18] It has been extensively reviewed[19], but the population incidence of MRDM is still largely unknown. Although the aetiology is not understood, it is possibly caused by toxins in cassava, other food toxins and/or protein-calorie malnutrition. The case management is similar to that for IDDM.

Some individuals have lesser degrees of tolerance to glucose and when challenged with an oral loading dose of 75 grams of glucose[18] cannot be classified as diabetics but are nevertheless at increased risk of coronary artery and peripheral and cerebrovascular diseases. Many of these individuals with impaired glucose tolerance (IGT) revert, without any intervention, to a normal state but as a group they are at a higher risk of developing diabetes mellitus subsequently and are believed to make a significant contribution to total mortality.[20]

Gestational diabetes may present as IDDM, NIDDM or IGT and is therefore not considered separately. The incidence is low in most developing countries.

Other types of diabetes associated with certain conditions and syndromes include pancreatic disease, disease of hormonal aetiology, drug-induced or chemical induced conditions,

the prevalence estimates, and very little data exists on incidence. The information for Latin America is sparse and poorly standardised.[39] Some anecdotal evidence from sub-Saharan Africa suggests that NIDDM may be increasing in some urban populations. For instance, a report from a chronic disease register compiled in Zimbabwe showed that diabetes was responsible for 12.4% of the cases[40] and population based estimates from Tanzania estimate the prevalence in adults to be between 0.5% and 1.3%.[1] However, such estimates contrast with the report of a survey from rural Nigeria where no one with diabetes was found in over 1,300 villagers.[13]

EVIDENCE OF HIGH HEALTH CARE USAGE AMONG PEOPLE WITH DIABETES

Research from a number of countries demonstrates that people with diabetes are consistently heavy lifetime users of health care resources. In the UK people with diabetes account for something over 1% of the population but consume between 4% and 5% of health care resources. Not all direct health care costs can be identified, but those that can amounted to £484 million in England and Wales in 1986-7. The full cost of diabetes to the national health service in the UK in 1989 was probably around £ 1 billion.

In Britain, William's[42] study of Hospital Activity Analysis (HAA) found that the estimated 1.2% of people with diabetes in East Anglia occupied 5.6% of bed-days in non psychiatric hospitals in 1981. Bed occupancy rates of the same order were found by Alexander et al[43] in their HAA of South East Thames region for 1985 where patients with diabetes occupied 4.7% of non psychiatric beds.

Moreover, these are underestimates to the extent that HAA fails to record co-existing diabetes as either a primary or secondary cause of admission. Thus Williams, Fuller and Stevens[44] found in their three-centre study of HAA that the presence of diabetes went unrecorded in 27% of a sample of 751 admissions of patients known by other means to have diabetes. Under-recording has also been found in a study of SHIPS, the Scottish equivalent of HAA.[45]

A similar pattern of high health care use has been observed in the United States, where a major study using 1977 data from the National Medical Expenditure Survey found that average health care utilisation costs among people with diabetes (for all causes - not just diabetes) were about three times higher than for the non diabetic population.[46]

The American Diabetes Association study[47] of the costs of diabetes calculated the risk of hospitalisation for complications of diabetes such as cardiovascular disease (the largest individual component of cost) to be 2.2 times higher among people with diabetes than in an age matched non-diabetic population. Insulin, hypoglycemic drugs, syringes, tests and other special therapy pushed the outpatient cost of individuals with diabetes above the average, though data from the National Ambulatory Medical Care Survey[48] showed that the physician

visits, the largest single cost component of ambulatory care, are not significantly different for the diabetic and non-diabetic populations, except for the under 25 age group where first diagnosis of IDDM is concentrated. Overall, the American Diabetes Association's[47] report suggests that the typical United States citizen with diabetes consumes about twice the amount of health care resources as an age-matched individual without diabetes.

In Denmark, the Frederica study covered 60 - 74 year olds only, 90 percent of whom had NIDDM. They were found to use 2 - 3 times more hospital bed days than a control group.[49] Their ambulatory health-care costs were 2.2 times as high as that of the control group.[50]

Both the British and United States studies found extra resource usage among people with diabetes to be particularly high among younger age groups, where people with IDDM are concentrated and to taper off among older age groups with their heavy preponderance of NIDDM. Williams[42] found that bed usage among 0 - 14 year olds with diabetes was 11 times the expected level for boys and 22 times for girls. In the United States, the American Diabetes Association's[47] report found that the relative risk of hospital admission for cardiovascular disease was 20 times as high for people under 25 with diabetes as for people of the same age without diabetes. For neuropathy the relative risk was 90 and for ophthalmic problems 55. However, the number of admissions of young persons for these conditions was small compared with those of older age groups where NIDDM is concentrated. There is also a greater risk of complications of pregnancy among diabetic patients.

LIFE EXPECTANCY IN DIABETIC PATIENTS

Evidence of Reduced life Expectancy - IDDM

Reduced life expectancy among people with diabetes with the associated welfare costs to the individuals themselves, their families and friends, is well documented though there remains uncertainty over the number of years by which life expectancy is reduced. In developed countries the outlook for stabilised IDDM patients is good and there is some evidence that good control of the disease can delay (and may even prevent) the onset of long term complications.[18,51] Indeed after stabilisation diabetics in developed countries may live for 15 - 20 or more years before the onset of complications although life expectancy is generally reduced by up to one third.[18]

Limited contact with the health system, scarcity of specialist staff, and the lack of regular supplies of insulin and the necessary equipment are bound to lower the prognosis for patients with IDDM in developing countries. A report from a specialist clinic at a large teaching hospital in a capital city in sub-Saharan Africa put the case fatality at 30 - 40% during the first 4 - 6 years following diagnosis.[40]

IDDM is associated with a particularly high loss of life expectancy. Thus Donovan et al[52] reported the experience of just under 2000 patients diagnosed as children between 1950 and

1981 who showed a seven fold excess mortality compared with the general US population. Mortality experience was worse in males than females and worse in Blacks than in Whites. A surprisingly large proportion of deaths in this IDDM population (just under 20%) were the result of acute complications (such as ketoacidosis), this being the most important single cause of death under the age of 20. But for all age groups combined renal disease was the largest single cause (45% of all deaths). Data from the European Dialysis and Transplant Association confirm the high risk of renal failure among people with IDDM, despite accounting for only about one-fifth of the diabetic population. Their 5-year survival on treatment is relatively poor ranging from 51% for 15 - 34 year old patients (compared with 82% for non diabetic patients) to 13% for diabetic patients over 65 (compared with 34% for non diabetic).[53] Coronary heart disease is also a major contributor to mortality in IDDM. Veikko and Tuomilehto[4] estimated excess mortality to be between 2 and 8.5 fold compared with the non-diabetic population though calculations were vitiated by the difficulty of distinguishing between IDDM and NIDDM populations at risk.

Life expectancy tables for people with diabetes have been constructed in the United States, but they vary widely in their estimates of lost life years. Thus a study of excess mortality among life insurance applicants over the period 1950-71 found that people who developed diabetes before the age of 15 (i.e. IDDM population) lost 27 years of life compared with the general population. In contrast life expectancy derived from death certificates in Iowa and Pennsylvania where good estimates of diabetes prevalence are available, indicate a loss of less than 10 years of life expectancy for those whose diabetes was diagnosed when young.[54]

Evidence of reduced life expectancy - NIDDM

Panzram[55] has reviewed the evidence that NIDDM is associated with excess mortality across all age groups of about 50 - 100%. Coronary heart disease is the most frequent cause of death in NIDDM in developed countries and the age-adjusted cause-specific mortality rate is 2 or 4 times higher than in comparable non-diabetic subjects. The second most important cause of death is cerebrovascular disease, because of its close relationship to frequently co-existing hypertension. A WHO committee[18] has estimated that stroke accounts for 15% of deaths among NIDDM patients. Panzram[55] points out in his review that there are few prospective and representative studies of the incidence and prevalence of stroke in diabetic patients.[56] Pyorala[4], reported that the data that have been published indicate there is about a 2 - 4-fold greater risk of death from cerebrovascular disease in both sexes, than in non diabetic individuals. In contrast with IDDM renal disease is a minor cause of death in NIDDM patients. In studies reviewed by Panzram[55] it did not account for more than 5% of deaths in Caucasian NIDDM populations.

All studies agree that the degree of excess mortality among people with diabetes declines with increasing age. Panzram[55] reports that a 10 years cohort study within the defined diabetic

population of the Erfurt district in the German Democratic Republic, did not find any significant differences in the death rates of NIDDM patients beyond the age of 75 as compared with non-diabetic control subjects.

METHODOLOGIES USED IN THE ESTIMATION OF THE COST OF DIABETES MELLITUS

Over the last twenty years expenditure on medical care has risen dramatically throughout the world.[57,58] One consequence of these large increases is that individuals with chronic diseases face an increasing financial burden because of their long term medical care needs. It is therefore important to know the economic costs of diabetes care.

In general, there are two economic cost practices that can be used to assist in diabetes planning and policy: studies of the cost of diabetes and studies of the cost-benefit/cost-effectiveness of diabetes interventions. Studies of the economic costs of diabetes show the amount of resources that are used or lost due to diabetes. Estimates of the cost of diabetes can provide information to prioritise the allocation of research funds, hospitals, physicians, treatment programmes, etc. to diabetes care. Cost of diabetes studies can also provide baseline data for evaluating subsequent policy, reimbursement, health care practice, or technological changes. Cost-benefit or cost-effectiveness studies, through the appraisal of alternative diabetes programmes, treatments, and procedures, can prioritise the direction of future resources and therapies.

General methods in estimating the cost of illness

There are two general methodologies used to estimate the cost of illness: the human capital approach and the willingness-to-pay approach. Most studies have used the human capital approach and followed the examples set by Rice.[59,60,61] In these studies the cost of illness is sub-divided into two categories: the direct and indirect costs of disease. Direct economic costs of disease include the expenditures for medical care and treatment of the illness (hospital care, physician services, nursing home care, drugs and other medical needs). These direct costs are often easily measured by surveys and studies. Indirect economic costs include the societal costs of morbidity, disability and premature mortality. These non-medical costs of disease are not easily measured or calculated. In the human capital approach, the individual is regarded as producing output in their lifetime that can be valued as equal to the individual's earnings during that time. Indirect expenses, then, are seen as the earnings, present and future, lost to that individual and his/her employer as a result of the illness. A third category, the psychosocial costs of illness, is often mentioned as another dimension in the cost of illness studies but usually is not included in the studies because of the difficulty in measuring these costs.

The main criticism of the human capital approach is that it values life in terms of the earnings of the individual. Changes in lifestyle due to disease are expressed by changes in the earnings

of the individual. Thus, the human capital approach may economically undervalue some segments of society relative to others (e.g. females, the young and the elderly) because people are valued by their baseline earnings and not by their ability to produce goods and services. To answer this criticism, the willingness-to-pay approach to estimating the cost of illness was proposed.

In the willingness-to-pay approach, life and lifestyle changes are valued as equal to the amount that the individual is willing to spend to reduce his/her risk of death or illness.[62,63] This methodology, however, has been very difficult to implement and has been used in very few cost of illness studies. The human capital approach has been the only methodology used in the cost of diabetes studies known to the author.

Internationally, there are few studies on the cost of diabetes. The majority of studies have been conducted in the United States. While many developing countries may not have the population-based and/or diabetes - specific data needed to complete a cost of diabetes study, many developed nations do have the necessary data or the capacity to generate it. These data generally include information on 1) the utilisation of health services (hospital and physician care, medications, etc) in the diabetes population or a sample thereof, 2) the cost of health services, 3) the number of persons with diabetes who are unable to work due to disability, 4) the number of persons working and the average earnings of workers in the general population, 5) mortality in the diabetes population and life-expectancy in the general population and 6) the prevalence or incidence of diabetes.

Different studies[64] using the human capital approach have used different data sources to generate and estimate economic costs. The author has identified five different designs of generating data to estimate the economic costs of diabetes.

Design A. The majority of the economic cost data in diabetes have been based on national health, health care, disability, and mortality statistics. National statistics have been broken down by diagnostic categories based on the International Classification of Diseases (ICD) codes. In general, data are only attributed to the diabetes mellitus category when diabetes is listed as the primary diagnosis or reason for a health care visit, disability, or cause of death.

The diagnostic category data design has been widely used to estimate the cost of diabetes because the data have been easily available and it is a relatively inexpensive study to conduct. However, serious limitations are present in this design that may underestimate the true costs of diabetes. Estimates based exclusively on figures where diabetes is the primary diagnosis, cause of death, or reason for disability exclude the health care costs incurred by diabetic individuals where diabetes is a secondary or tertiary factor. The critical point is that often individuals with complications associated with diabetes (e.g. heart disease) do not have diabetes listed as the primary diagnosis upon hospitalisation[65] or the underlying cause of death.[66,67] Some account of the costs incurred by these individuals need to be undertaken.

Also since chronic diseases, such as heart disease, occur frequently in the general population, analysis using control groups of non-diabetic individuals are needed to separate the excess morbidity costs related to diabetes from those costs that would be expected to occur normally. Another limitation of this design is that costs related to IDDM or NIDDM cannot be separated. The ICD diagnostic category for diabetes only considers the general definition of diabetes. Subgroups of diabetes, such as IDDM and NIDDM are not distinguishable in diagnostic category data. It is also not possible to determine the economic impact of diabetes from the perspective of an individual with diabetes or the family.

This design is not possible in the developing countries because these data are not easily available.

Design B. Diabetes cost estimates have also been predicted from the results of previous cost studies. In this study design, cost estimates determined in a previous study and changes in the health care utilisation and mortality rates associated with diabetes, as well as the change in prevalence and inflation rates, were utilised to forecast the economic costs of diabetes. The advantage of this design is that it is even more easy and inexpensive to conduct. However, major limitations concerning the interpretation of the data are present since this approach assumes the limitations of the previous studies and those of its own. The primary restraint is that the cost estimates are based on the assumption that the changes in the costs of diabetes will be similar to the changes in inflation, utilisation, prevalence, and mortality rates. This may or may not be true.

Design C. The costs of diabetes have also been estimated from the data of diabetic individuals identified from the general population, diabetes registries, or diabetes clinics, hospitals, practices, etc. Cost estimates derived from this design have been determined from the survey data or reported experience of persons with diabetes. This approach differs from the first design where costs were based upon diagnostic category data. The advantage of surveying individuals is that more precise estimates of the costs of diabetes can be attained since one is directly observing costs and/or utilisation patterns of individuals rather than estimating costs from aggregated categories which mask the influence of subgroups and individuals. Also, if a representative sample of the population is used data based upon the reports of diabetic individuals are much more likely to reflect the experience of the diabetes population than data based upon diagnostic categories. Data based upon diagnostic categories have not been representative of the diabetic population for the reasons mentioned earlier, i.e. not all persons with diabetes will have diabetes listed as a primary diagnosis. The disadvantage of surveying costs among a representative sample of individual diabetics is that it is an expensive and lengthy process to complete. Analysis of data grouped by primary diagnosis category is much quicker to complete in developed countries because of the availability of government statistics and thus, much less expensive to conduct. There have

been basically, three population sources in the literature used to estimate the costs of diabetes from the data of diabetic individuals. These include 1) the estimation of the direct costs in diabetes from surveys of health care use and cost in the general population, 2) the estimation of selected health care costs in diabetes from the data of diabetes population registries, and 3) the estimation of selected health costs for diabetes from the data of diabetes clinics, practices, etc. Each has concentrated on estimating the health care costs of diabetes rather than the total costs.

Design D. Some components of the health care costs of diabetes have also been estimated from the surveys of population-based diabetes registries. In this approach, selected costs of diabetes care including the costs for daily treatment of diabetes, physician care, and the treatment of diabetic ketoacidosis, were surveyed or determined from diabetic individuals listed in a diabetes registry. These diabetes registries contained individuals who were representative of the diabetes population in a specific geographical region.

The main advantage of surveying costs by this method is that, again more precise-estimates and subgroup analysis of the costs in diabetes care are possible. Costs for insulin-dependent diabetes can also be ascertained since the majority of diabetes registries are composed entirely of insulin-dependent cases. The main disadvantage of this methodology is the expense and time required to establish a diabetes registry.

Design E. Finally, estimates of the cost for selected components of diabetes care, such as equipment, drug therapy, diagnosis, and pregnancy costs, have been generated from diabetes clinics, practices, and organisations. In this approach, the costs associated with diabetic individuals at a particular hospital, physician's office, drug company, or organisation were surveyed. These cost estimates were not often based on representative samples of the diabetes population. However, this method of cost estimation may be a good source of hypothesis-generating data on the costs of diabetes care, therapies and procedures and can provide a rough estimate of the overall pattern of costs.

DIABETES COST ESTIMATES IN DEVELOPED COUNTRIES

Cost of diabetes studies have been completed largely in the United States. Estimates of the economic costs of diabetes mellitus in the United States suggest that the costs of diabetes are quite substantial. The Statistical Bureau of the Metropolitan Life Insurance Company (SBMLIC) has estimated the costs of diabetes mellitus over a period of years using diagnostic category data on health care utilisation, disability, and mortality. In their reports, the total economic impact of diabetes rose from US $ 2.6 billion in 1969 to a projected US $ 12.8 billion in 1984.[68] The direct costs or health care costs of diabetes rose from US $ 1.0 billion in 1969 to a projected US $ 7.4 billion in 1984 and the indirect costs or the loss of earnings due to diabetes rose from US $ 1.6 billion to US $ 6.3 billion in the same time frame. Reasons cited

for this increase in the economic costs of diabetes and the increase seen in the percentage of total costs related to health care, include the inflation of medical care prices, the increased prevalence of diabetes, the increased utilisation of medical services among diabetics and the development of new treatment technologies for diabetes. From 1969 to 1980, the estimated health care costs of diabetes rose by 380% while the medical care component of the consumer price index rose by 134%.[69,70]

Other studies used design and calculation procedures different from that of the SBMLIC to arrive at their estimates for the cost of diabetes. Platt and Sudovar, using cost projections from the 1975 SBMLIC data estimated the total cost of diabetes in 1979 to be US $ 15.7 billion.[71] Of this figure the total costs for insulin dependent diabetes (IDDM) were projected to be US $ 4.8 billion. In another study, Miller[72] estimated the total costs of diabetes to be near US $ 12.4 billion in 1979. Smeeding and Booton[73] estimated an US $ 18.9 billion price tag for diabetes in 1980. Both studies relied upon diagnostic category statistics and data from previous cost studies to derive their cost estimates. While the estimates of these three studies are from 1.3 to 2.0 times higher than the cost estimated by the SBMLIC for 1980, the differences between these estimates and that of the SBMLIC are not large given the use of different methodologies.

More recently, Fox and Jacobs[47] estimated the cost of diabetes to be US $ 20.4 billion in 1987. Their methods, though, differed from the previous studies all of which costs were based upon primary diagnosis data. Fox and Jacobs used primary diagnosis data, but went one step further and estimated the hospitalisation and mortality costs in instances where diabetes was listed as a secondary or tertiary diagnosis or cause of death.

Policy Analysis, Inc. (PAI)[74] is the only cost estimate which has considered the costs of diabetes over the entire lifetime of a diabetic cohort. The other studies estimated the costs of diabetes in a given year for the prevalent diabetes population using diagnostic category data. PAI estimated the lifetime costs for all persons diagnosed in 1977 to total US $ 11.8 billion. To interpret this, roughly US $ 11.0 billion in present and future costs would be saved if all incident cases of diabetes in 1977 were prevented.

The National Medical Care Expenditure Survey has provided the only economic cost figures for diabetes estimated from the experiences of the individual diabetic. In 1977, the National Medical Care Expenditure Survey (NMCES) estimated that the direct costs of diabetes were US $ 6.9 billion.[68] This figure contrasts sharply with the US $ 3.4 billion estimate reported by the SBMLIC for 1977. The primary reason for this difference lies in the methodological procedures utilised in both studies and suggests that the SBMLIC, which exclusively used primary diagnosis data in its calculations, considerably underestimated the health care costs of diabetes.

The broad trends shown by the studies suggest that indirect costs are of decreasing magnitude

within the overall economic burden of diabetes (e.g. falling from around 62% in the USA in 1969 to 46% in 1984). In most studies these indirect costs predominantly reflect the cost of disability caused by the disease although the most recent US study[47] suggests that mortality costs are more important. This finding, however, probably results from the study's inclusion of deaths where diabetes was a contributory cause rather than considering only those deaths directly due to the disease.

There are limited data on the cost of diabetes from countries other than United States. The most thorough study on the cost of diabetes has been conducted by Johnson in Sweden.[75] Based on diagnostic category data, Johnson estimated the total cost of diabetes to be 1317 SEK in 1978. Health care costs accounted for 43 percent of the total costs, while indirect costs due to premature morbidity and mortality explained 57% of the diabetes costs.

In Great Britain, Laing[64] used diagnostic category data to estimate the direct costs of diabetes at 83.4 million pounds in 1979. Disability costs were approximately 60.9 million pounds. Laing did not calculate a monetary figure for the burden of premature mortality, but did find that 64,047 years of life lost were related to diabetes. In another study, total direct costs of diabetes and its complications 1986-7 in England and Wales amounted to £ 484 million. The full cost of diabetes to the National Health Service in the United Kingdom in 1989 was estimated to be around £ 1 billion.[4] In France, Triomphe[76] estimated that the average cost of diabetes was 7711 francs for non-insulin-using diabetic patients in 1984. These estimates were based on the charges and utilisation data of 109 patients with diabetes to constitute a representative sample of French diabetics. Figures on the cost of diabetes in Australia and Canada have been projected from the results of cost studies completed in the United States. In Australia the cost of diabetes was estimated at Australian $ 1.2 billion for 1986[64], while costs in Canada approached Canadian $ 1.8 billion for 1985.[64] At present, cost comparisons between countries are speculative because there is no standardised methodology for measuring costs across the world.

The studies that are available show that the cost of diabetes treatment programmes is substantial and is increasing in developed countries (e.g. rising from US $ 1.65 billion in the US in 1973 to US $ 7.4 billion in 1984). This trend reflects the inflation of medical care prices, increased prevalence of diabetes, increased utilisation of medical care amongst diabetic patients and development of new treatment technologies.[3,4] Direct costs are now equally if not more important than indirect costs within the overall economic burden of the disease. A large portion of direct costs (usually not estimated) is likely to be due to treatment of the complications of and illnesses associated with diabetes rather than to diabetes itself. Indeed one study demonstrated that patients with chronic complications of diabetes incurred health costs 14 times as high as diabetic patients without any record of complications.[4] Prevention and case management programmes therefore have the potential both to reduce the indirect costs of the disease and to reduce the costs of caring for complications.

DIABETES COST ESTIMATES STUDIES IN DEVELOPING COUNTRIES

In the Third World the magnitude of the problem of diabetes is altogether different. The economic implications have hitherto been ignored but they represent a potentially massive burden for many developing economies. The only developing country studies[3] that shed light on the costs of diabetes are those reported from Guam and Ghana.

The Guam study estimated the total economic burden of diabetes in 1976 to be US $ 3 million. Of these, 80% were indirect costs and only 20% were direct costs. It is not clear whether mortality or morbidity costs dominated in the estimated indirect costs. In Ghana, where the average age at onset was estimated as 40 years, with a case fatality rate of 50% after 15 years (and average age at death being 53 years) and 30% disablement before death, the indirect costs were estimated in terms of future healthy life days lost because of diabetes and its complications. The total days of life lost were thus calculated as 217 per 1000 persons per year of which 52% was due to premature death. This picture of the balance of indirect costs differs from most developed country studies in which morbidity costs are dominant. The difference may reflect the younger average ages at death of diabetic patients in Ghana, which could often be before the onset of complications and other disabilities.

In many developing countries patients with IDDM may not survive onset because of poor or non-available care, and the indirect costs of morbidity attributable to diabetes, therefore will be dominated by those associated with NIDDM. Indirect costs due to disability are probably equivalent to or greater than, costs due to mortality. However, as prevalence rises and age of onset falls (as some evidence would appear to indicate is likely), the disability costs will probably become even more important relative to mortality costs - especially because the complications associated with diabetes will generate such costs. The balance between the two forms of indirect cost (and the absolute level of disability costs) will depend on the incidence of NIDDM and on whether patients change their health behaviours in ways that reduce the likelihood of their developing severe complications.

Preliminary cost estimates for diabetes case management in a developing country based on international prices for essential drugs and main hospital cost data, suggest that the cost of treating IDDM patients will be dominated by their need for insulin, at an estimated cost of over US $ 100 per diabetic patient per year. It is more difficult to estimate the costs associated with NIDDM patients, but it seems likely that the biggest cost will be for oral drugs at approximately US $ 25 per diabetic patient per year. These findings reflect the relative costs of diabetes drugs when compared to those of hospitalisation.[3]

For IDDM, it seems that the cost of hospitalisations for complications is likely to dominate the total cost in institutional care for IDDM patients (US $ 9 per diabetic patient per year compared to US $ 1 per diabetic patient per year for care directly related to diabetes). However this result is dependent on assumptions about the level of hospital care provided for

diabetic patients. It indicates that as case management improves in developing countries so will the cost of caring for diabetic patients.

There is substantial variation between countries in the treatment patterns adopted and these differences also influence costs. The technology used is an especially important influence and the trend towards more expensive care within developed countries is one that developing countries can ill-afford. Developing countries need to assess the cost-effectiveness of all standard case management practices. For example a UK study showed that if follow-up times were increased by 30% (e.g. from 6 to 8 months) an additional 2000 known non attenders could be seen for a cost increase of less than 5% of the existing annual cost.[77]

In most developing countries the existing level of direct costs associated with diabetes is likely to be low. Many IDDM patients probably do not survive onset and so will not require care. Those diabetics who do survive will only receive such care as is available which for many of these countries will be limited.

DIRECT COSTS BORN BY INDIVIDUALS

Direct costs of diabetes also include those borne by the individual. In Britain, patients on insulin or oral medication are exempt from prescription charges and also receive syringes and blood and urine testing supplies free. However, diabetes may give rise to higher living expenses. In particular, the British Diabetic Association has highlighted the need to follow a carefully controlled diet. Diabetic patients also need to take particular care of the shoes they wear because of liability to foot problems.

Of the two dietary costing exercises quoted by Knibbs, one[4] found that the cost of a diabetic diet for an adult was not significantly different from that shown by the National Food Survey for lower income adult only households. Hall[4], did find that younger diabetic patients are faced with significantly increased food costs, up to about 50% more than the rest of the population but that pensioners are not. Knibbs concluded that although a strong case can be made for increased food allowances for children and young people, the case for extra allowance for pensioners is more difficult to argue.

Though people with diabetes may not have to spend more money than average because of their condition, they may have to spend substantial amounts of time in managing it and preventing its complications. Triomphe has proposed a novel technique of 'time budgeting' in order to identify the magnitude of this element of personal cost faced by people with diabetes, but no data have yet been published.

PROBLEMS OF EMPLOYMENT

Robinson[4] has reviewed the situation throughout Europe and found that people with diabetes face a much greater range of employment restrictions and problems than others. Generally, people receiving medication for diabetes whether oral or insulin, are not allowed to join the

armed forces, the police, the fire brigade or merchant navy, fly aeroplanes or drive main line passenger trains. People whose diabetes is well controlled by tablets and/or diet are usually able to continue driving heavy goods or public service vehicles for a living. But people dependent on insulin are usually not. They may also be barred either by regulation or custom and practice from other jobs where unpredictable attacks could put themselves or other people at risk.

A recent survey of a sample of IDDM and NIDDM clinic attenders from 8 towns in Britain[4] found that unemployment rates for men with diabetes (22%) were significantly higher than for non-diabetic controls (8%). Similarly, in the United States, the 1978 survey of work and disability has shown that 33.7% of the diabetic population of working age were severely disabled and unable to work regularly or at all, compared with 8.8% for the general population.[4]

Robinson points out that in a time of continuing unemployment where training for many jobs is expensive, it is unrealistic to expect an employer not to discriminate against groups known to be employment risks. A particular problem for employers may be extended periods of sickness absence among a minority of employees with diabetes. According to a British Diabetic Association survey[4] the proportion of people with diabetes reporting time off was no higher than for controls, but 29 percent of diabetics compared with 16 percent of controls had taken 20 days or more off sick in the last year and this difference was highly significant.

METHODOLOGY

SUBJECTS AND METHODS

Dar es Salaam is Tanzania's largest city and has a population of 1.5 million people. Muhimbili Medical Centre is the country's largest hospital and a national referral centre. Nearly all the African diabetic patients from the city attend this hospital. All the dispensaries, clinics and district hospitals in Dar es Salaam refer their patients to Muhimbili Medical Centre for outpatient and inpatient management, there being no regional hospital. Since Muhimbili is the national referral hospital, patients difficult to manage are also referred here from various parts of Tanzania.

The patients who need inpatient care are admitted into the general medical wards and attended by the physicians in charge there. Endocrinologists see the patients not admitted into their general medical wards on request by the other physicians. A nurse with special training in diabetes sees all the patients in the wards. She instructs them on urine testing, injection techniques and diet. She also does blood glucose estimations using an Ames glucometer. While in the ward, all patients have urine tests four times daily for glucose and as necessary for ketones. Blood glucose measurements are done depending on the patient's condition and availability. There are no routine tests on admitted patients and other investigations depend on the attending doctors. All inpatients are seen by at least one doctor every day. Major rounds when the physicians and consultants are also present are conducted twice a week.

A special diabetic outpatient clinic runs morning and afternoon every Thursday. Patients are given an appointment at least once per three months but they may attend even weekly if necessary. All patients who attend are seen. Patients are not referred back to their districts unless they themselves request.

Dietary advice is given to each patient individually by the attending doctor and the diabetic nurse. The patients are weighed at each visit and encouraged to maintain an ideal weight. Glycaemic control is assessed through urine testing for glucose, the aim being to keep the urine glucose free. Blood glucose estimations are done at the clinic using an Ames glucometer in patients with poor control or where hypoglycaemia is suspected. All patients are given all the prescribed drugs, syringes and needles, spirit, cotton wool and facilities for urine glucose estimation, depending on availability but all free of charge. Patients have to buy from private pharmacies items not available in the government pharmacy.

Selection of patients

The patients studied were in two groups:

a) Group I: 202 patients first seen between June 1, 1981 and May 31, 1982 and followed up since that time.

b: Group II: all 262 newly-diagnosed patients seen at the diabetic clinic and in all the wards of Muhimbili Medical Centre between September 1, 1989 and August 31, 1990.

The case notes of Group I patients were scrutinised to get their socioeconomic status, the number of follow up visits and the documented complications. Admissions and deaths were also noted. A nurse had been assigned to follow up these patients from the time of diagnosis. She recorded the home address of each patient and if a patient missed two appointments she would contact his/her home to find out what was happening, especially whether the patient was still alive or not. Seventy eight patients who were still alive and attending the clinic were interviewed and a questionnaire filled in by the author. Group II patients were also interviewed using the same questionnaire. All the patients were followed up to the time of closing the study on October 31, 1990.

The questionnaire was designed to obtain the following information:

a) the socioeconomic status of the patient.

b) the costs incurred from the start of the illness until the diagnosis of diabetes mellitus was made - number and type of health institutions visited (including traditional healers), time spent and transport costs for each visit, and the costs of investigations and treatments prescribed. In many patients, an infection precipitated the symptoms of diabetes and the patients received anti-infective agents (including antibiotics and antimalarials) for many days before the diagnosis of diabetes was made. Some patients had attended several institutions for the same complaints before diagnosis.

c) the cost of follow up - the time spent and transport charges per visit to the diabetic clinic and the frequency and time spent on self-injections with insulin.

Data for estimating the costs of diabetes were obtained from the above questionnaire and the records in the patients' case notes. For inpatients, the case notes were scrutinised and all the individual items of expenditure, e.g. number of syringes, units of intravenous fluids, the number and dosage of drugs, etc, spent during admissions were noted. For the patients first diagnosed in 1981/82, this was done over the whole period of follow up until October 1990, and the average amount for a year worked out.

Methods of direct costing of diabetes

The costs of hypoglycaemic drugs, insulin, syringes, spirit, cotton wool and urine monitoring facilities prescribed over the last one year and any other documented drugs or treatment modalities were calculated using the prices charged by the Central Medical Stores and the estimates of the Muhimbili Medical Centre budget. The prices charged by the pharmacies in the city were used for those facilities which were not regularly available at Muhimbili Medical Centre and which patients had to buy. The costs of treatment and investigations done at the various private hospitals were calculated as per prices charged by the various private hospitals in the city.

In the calculations the following assumptions were made:

a) an IRDM patient used one syringe and a needle for one week.

b) every IRDM patient was assumed to use some spirit and a swab before self insulin injection.

c) IRDM patients monitored their urine for glucose once per day and NIDDM patients twice per week.

d) at each visit to the diabetic clinic, urine tests for glucose were done.

f) For insulin, oral hypoglycaemic drugs and drugs for treatment of chronic conditions like hypertension, it was assumed that the patient received the drugs prescribed at each visit to the clinic and in sufficient amounts to last until the next prescription.

In estimating the direct costs of personnel, it was assumed that:

a) a doctor spent 7 minutes with each patient at the diabetic clinic at each visit and 10 minutes with each admitted diabetic patient daily.

b) a nursing staff (including nursing attendants and record attendants) spent 10 minutes with an outpatient and 90 minutes for an inpatient daily.

c) the average salary of a doctor was 60 TShs per hour and that of a nursing staff 2.4 TShs per hour.

Costs of complications included costs of treating infections and one year costs of the chronic complications.

In calculating the direct costs for caring for all diabetic patients in Tanzania aged 15 years and over, it was assumed that:

a) the prevalence of diabetic patients on treatment and aged 15 years and over in Tanzania was 0.2%

b) the proportion of the total population of Tanzania above 15 years was 55%

b) the proportion of all diabetic patients who require insulin was 21%.

In the analysis, patients were sub-divided into two groups:

a) **Insulin requiring patients (IRDM)** - those using insulin to achieve glycaemia control. Patients diagnosed in 1981/82 were followed up for a duration enough to ascertain that they truly required insulin. The newly diagnosed patients were not followed long enough to establish the true demand for insulin. They were thus categorised depending on the treatment they were receiving during the study period.

b) **Non-insulin dependent patients (NIDDM)** - those treated by either diet alone or together with oral hypoglycaemic drugs.

c) **Uncertain** - those not easily placed in the above types of diabetes because they died shortly after diagnosis, or they had been followed up for a period of less than three months and good control was not yet achieved, or they never came back for follow up at the clinic.

Calculation of indirect costs

A quantitative method of assessing the health impact of different diseases in less developed countries as given by Ghana Health Assessment Team was used.[78] By this method an estimate

is made of the healthy life days lost including hospital admission days, sick leave days, days of disability and premature death. Each patient was assigned an age-specific life expectancy at the onset of diabetes based on figures used by the Ghana Health Assessment Team in 1976 (Appendix 2). Health life days lost due to premature death were estimated for each patient who died as the expectation of life at onset of diabetes less the duration of diabetes. To estimate the number of healthy days lost due to disability only patients with incapacitating complications, for example stroke, amputations, and cataracts or retinopathy impairing vision were considered. Those with less incapacitating complications, for example uncomplicated hypertension and neuropathy were not counted. Because of the short durations of diabetes in these patients, the disability was assumed to be present for the whole duration of diabetes. It was also assumed that the disability was 100% since only incapacitating complications were counted. Appendix 2 gives the details of calculating the healthy life days lost.

Statistical analysis

Data was analysed using the Statistical Package for the Social Services (SPSS).[79] Chi-square test (procedure crosstabulation) and the Mann-Whitney test (procedure npar tests) were used for comparisons between groups.

SECTION III: RESULTS

A. SOCIOECONOMIC AND CLINICAL CHARACTERISTICS OF THE PATIENTS

464 patients were registered for the study. 202 patients diagnosed between 1 June 1981 and 31 August 1982 were in group I and 262 patients diagnosed between 1 September 1989 and 31 October 1990 were in group II.

The difference in distribution of IRDM, NIDDM and uncertain type of diabetes in the two study groups was statistically significant (Table 1).

Table 1: Distribution of types of diabetes in the two study groups

	IRDM n (%)	NIDDM n (%)	Uncertain n (%)	Total n (%)
Group I	60 (29.7)	102 (50.5)	40 (19.8)	202 (43.5)
Group II	32 (12.2)	222 (84.7)	8 (3.1)	262 (56.5)
Total	92 (19.8)	324 (69.8)	48 (10.4)	464 (100)

$X^2 = 65.7070$ p = 0.0000

Patients in group I with IRDM had a significantly lower mean age than those with NIDDM (Table 2).

Table 2: Mean age for group I patients

	IRDM	NIDDM	Uncertain diabetes	Overall	p-value IRDM vs NIDDM
Number of patients	60	102	40	202	
Mean age (years)	44	54	43.4	49	0.0000
Median	44	53	42	50	
Range	12-82	30-78	14-99	12-99	

Table 3: Mean age for group II patients

	IRDM	NIDDM	Uncertain diabetes	Overall	p-value IRDM vs NIDDM
Number of patients	32	222	8	262	
Mean age (years)	41	47	57	46	0.1465
Median	42.5	46	58	46	
Range	8-71	22-79	41-70	8-79	

Patients in group I with IRDM had a significantly lower mean age of onset compared with NIDDM patients (Table 4).

Table 4: Average age at onset of diabetes for patients in group I, 1981-82

	IRDM n = 60	NIDDM n=102	Uncertain diabetes n=40	Overall n=202	p-value IRDM vs NIDDM
Mean age (years)	36	46	42	42	0.0000
Median	38	45	42	43	
Range	5-75	22-70	16-99	5-99	

Table 5: Average age at onset of diabetes for group II patients, 1989-90

	IRDM n = 32	NIDDM n=222	Uncertain diabetes n = 8	Overall n = 262	p-value IRDM vs NIDDM
Mean age (years)	40	46	57	47	0.0565
Median	42	45	58	45	
Range	8-71	21-78	41-70	8-78	

The distribution of age at onset for IRDM patients was significantly different from that o NIDDM patients (Tables 6, 7).

Table 6: Distribution of age at onset in group I patients, 1981-82

Age group (years)	IRDM n(%)	NIDDM n(%)	Uncertain n(%)	Total n(%)
0 - 24	13 (21.6)	1 (1.0)	8 (20.5)	22 (11.0)
25 - 34	15 (25.0)	10 (9.9)	4 (10.3)	29 (14.5)
35 - 44	14 (23.4)	34 (33.7)	9 (13.1)	57 (18.5)
45 - 54	12 (20.0)	40 (39.6)	12 (30.8)	64 (32.0)
55 - 64	4 (6.7)	10 (9.9)	5 (12.9)	19 (9.5)
65 - 74	1 (1.7)	6 (6.0)	0 (0.0)	7 (3.5)
75+	1 (1.7)	0	1 (2.6)	2 (1.0)
Total	60 (30.0)	101 (50.5)	39 (19.5)	200 (100%)

The age at onset of two patients was not known.

$p = 0.0011$.

Table 7: Distribution of age at onset for group II patients, 1989-90

Age (years)	IRDM n(%)	NIDDM n(%)	Uncertain n(%)	Total n(%)
0 - 24	7(22)	2(1)	0	9(3)
25 - 34	2(6)	20(9)	0	22(8)
35 - 44	9(28)	79(36)	2(25)	90(34)
45 - 54	8(25)	69(31)	0	77(30)
55 - 64	4(13)	37(17)	4(50)	45(17)
65 - 74	2(6)	13(6)	2(25)	17(7)
75+	0	1(0)	0	1(0)
Total	32(12)	221(85)	8(3.0)	261(100)

p = 0.0000 IRDM vs NIDDM

The average duration of symptoms before diagnosis for IRDM and NIDDM patients was not statistically significant (Tables 8, 9).

Table 8: Average duration of symptoms before diagnosis for group I patients 1981-82

	IRDM	NIDDM	Uncertain diabetes	Overall	p-value IRDM vs NIDDM
	n=60	n=102	n=40	n=202	
Mean duration (weeks)	10.8	11.2	10.3	10.9	0.5206
Median	4	4	3	4	
Range	1 - 52	1 - 104	1 - 104	1 - 104	

Table 9: Average duration of symptoms before diagnosis for group II patients, 1989/90

	IRDM	NIDDM	Uncertain diabetes	Overall	p-value IRDM vs NIDDM
	n=32	n=222	n=8	n=262	
Mean duration (weeks)	9.6	11.6	5.3	11.1	0.7975
Median	4	4	1.5	4.0	
Range	1 - 52	1 - 156	1 - 16	1 - 156	

Duration of symptoms before diagnosis was not available for 43 (9.2%) patients. The reas
for failure to get the exact duration were:

(i) The patient did not present with the classical symptoms of diabetes but w complications and associated illnesses and hence was ignorant of the duration

(ii) Incidental diagnosis

(iii) Poor patient memory

(iv) Lost documents etc. (Table 10).

Table 10: Duration of symptoms before diagnosis in group I and group II

Duration (Months)	IRDM	NIDDM	Uncertain diabetes	Total
Group I				
< 1	17 (33.3)	39 (44.3)	18 (52.9)	74 (42.8)
1 - 2	19 (37.2)	19 (21.6)	9 (26.5)	47 (27.2)
3 - 5	9 (17.6)	17 (19.3)	2 (5.9)	28 (16.2)
6+	6 (11.8)	13 (14.8)	5 (14.7)	24 (13.9)
Total	51 (100)	88 (100)	34 (100)	173 (100)
Group II				
<1	12 (38.7)	68 (32.4)	5 (62.5)	85 (34.1)
1 - 2	9 (29.0)	85 (40.5)	1 (12.5)	95 (38.2)
3 - 5	6 (19.4)	28 (13.3)	2 (25.0)	36 (14.5)
6 +	4 (12.9)	29 (13.8)	0	33 (13.2)
Total	31 (100)	183 (100)	8 (100)	249 (100)

Table 11 shows male predominance in almost all age groups and in all types of diabetes. Overall male to female ratio was 2.1:1.

Table 11: Sex distribution according to age groups

Age (years)	Sex	IRDM n (%)	NIDDM n (%)	Uncertain n (%)	Total n (%)
0 - 24	M	6 (50)	2 (100)	4 (50)	14 (58)
	F	6 (50)	0 (0)	4 (50)	10 (42)
25 - 34	M	10 (71)	18 (78)	1 (50)	29 (74)
	F	4 (29)	5 (22)	1 (50)	10 (26)
35 - 44	M	19 (86)	62 (67)	9 (64)	90 (70)
	F	3 (14)	30 (33)	5 (36)	38 (30)
45 - 54	M	19 (83)	78 (71)	4 (57)	101 (72)
	F	4 (17)	32 (29)	3 (43)	39 (28)
55 - 64	M	12 (71)	37 (53)	9 (60)	58 (57)
	F	5 (29)	33 (47)	6 (40)	44 (43)
65 - 74	M	3 (100)	16 (70)	1 (50)	20 (71)
	F	0 (0)	7 (30)	1 (50)	8 (29)
75+	M	1 (100)	3 (80)	1 (100)	5 (83)
	F	0 (0)	1 (20)	0 (0)	1 (17)
Total	M	70 (76)	216 (67)	29 (60)	315 (68)
	F	22 (24)	108 (33)	19 (40)	149 (32)

(%) of total in the age group of IRDM, or NIDDM, or uncertain diabetes.

Patients with IRDM had a significantly lower mean body mass index (BMI) compared to NIDDM patients (Tables 12, 13).

Table 12: Mean body mass index (BMI) for group I patients 1981-82

	IRDM	NIDDM	Uncertain diabetes	Overall	p-value IRDM vs NIDDM
Number of patients	60	102	40	202	
Mean BMI (kg/m^2)	23.6	27.2	25.6	25.9	0.0003
Median	23.4	26.5	20.8	25.4	
Range	17.4 - 43	13 - 45.3	125 - 68.4	125 - 68.4	

Table 13: Mean body mass index (BMI) for group II patients 1989-90

	IRDM	NIDDM	Uncertain diabetes	Overall	p-value IRDM vs NIDDM
Number of patients	32	222	8	262	
Mean BMI (kg/m^2)	23.0	27.2	34.8	26.8	0.0008
Median	22.6	26.9	34.8	26.7	
Range	16.2 - 28.7	12.5 - 46.6	33.6 - 35.9	12.5 - 46.6	

Thirty-two percent of the patients were unable to read or write or had only attended adult literacy classes or received instruction on reading the Koran. Only 89 (19%) patients had secondary school education or higher education (Table 14).

Table 14: Educational status of diabetic patients

Educational status	n	%
Illiterate	148	32
Primary	181	39
Secondary	67	14
Higher education	22	5
Unknown	46	10
Total	464	100

About 421 (91%) of the registered patients were Dar es Salaam residents (Table 15).

Table 15: Residence of patients in group I and group II

Residence	Group I n (%)	Group II n (%)	Total n (%)
Dar es Salaam	177 (88)	244 (93)	421 (91)
Outside Dar es Salaam	25 (12)	18 (7)	43 (9)
Total	202 (100)	262 (100)	464 (100)

DRINKING AND SMOKING HABITS

104 (22.4) of all the patients drank alcohol. 41 (8.8%) of all the patients reported to have stopped taking alcohol because of diabetes. 73 (15.7%) of all the patients continued to smoke while 26 (5.6%) patients had stopped smoking because of diabetes.

FAMILY HISTORY

61 (13.1%) of the patients had a positive family history of either a first degree relative or other relatives.

Thirty-one percent of the males were self employed while 75% of the females were housewives and self engaged in small businesses. Forty eight percent of the males were employed while only 12% of the females were employed (Table 16).

Table 16: Occupational status of male and female patients in groups I and II

(a) Males

Occupation	Group I n (%)	Group II n (%)	Total n (%)
Employed	66 (48.0)	85 (48)	151 (48)
Self employed	51 (37.0)	48 (28.0)	99 (31.0)
Retired because of diabetes	11 (8.0)	1 (1.0)	12 (4.0)
Student/child	2 (2.0)	30 (1.0)	5 (2.0)
Retired because of age	2 (2.0)	0 (0.0)	2 (1.0)
Unknown	4 (3.0)	42 (23.0)	46 (14)
Total	136 (43.0)	179 (57)	315 (100)

(b) Females

Occupation	Group I n (%)	Group II n (%)	Total n (%)
Employed	6 (9.0)	12 (15)	18 (12)
Self employed	53 (80.0)	59 (71)	112 (75)
Retired because of diabetes	2 (3.0)	0 (0)	2 (2)
Retired because of age	1 (2.0)	0 (0.0)	1 (1)
Student/child	4 (6.0)	1 (1)	5 (3)
Unknown	0	11 (13)	11 (7)
Total	66 (44.0)	83 (56.0)	149 (100)

About 72 (42%) of the employed males were in the middle and high monthly income levels while only 4 (19.0%) females were in similar income levels (Table 17).

Table 17: Monthly salaries of the employed and retired patients in groups I and II according to gender

Monthly Salary (Tshs)	Sex	Group I Patients n (%)	Group II Patients n (%)	Total Patients n (%)
< 5000	M	54 (68)	46 (49)	100 (58)
	F	8 (89)	9 (75)	17 (81)
5000 - 10000	M	15 (19)	24 (26)	39 (23)
	F	1 (11)	3 (25)	4 (19.0)
>10000	M	10 (13.0)	23 (25)	33 (19)
	F	0 (0)	0 (0.0)	0 (0.0)
Total	M	79 (46)	93 (54)	172 (100)
	F	9 (43)	12 (57)	21 (100)

(%) of either total males or females in group I or II.

The difference in mean duration of diabetes between IRDM and NIDDM patients was not statistically significant (Table 18).

Table 18: Mean duration of diabetes (months) from time of diagnosis for groups I and II patients

		IRDM	NIDDM	Uncertain diabetes	p-value IRDM vs NIDDM
Group I	n	60	102	40	
	Mean	94.2	96.3	13.0	0.8343
	Median	101.5	102	2.5	
	Range	12 - 109	2 - 108	0.3 - 108	
Group II	n	32	222	8	
	Mean	8.8	9.4	3	0.7524
	Median	9.5	11	1	
	Range	3 - 13	2 - 14	0.1 - 13	

The average duration of diabetes for group I patients was 79.2 (median 100, range 0.3 - 109) months.

The average duration of diabetes for group II patients was 9.1 (median 10, range 0.1 - 14) months.

For group I patients (1981-90) the difference in mean duration since last seen at Muhimbili Medical Centre between IRDM and NIDDM was not statistically significant (Table 19).

Table 19: Mean duration since last seen at Muhimbili Medical Centre for group I patients, 1981-90

	IRDM	NIDDM	Uncertain diabetes	Overall	p-value IRDM vs NIDDM
Number of patients	60	102	40	202	
Mean duration (months)	40.7	48.8	92.2	55.7	0.2056
Median	32.5	48	100	60	
Range	1 - 108	1 - 108	10.8 - 110	1 - 110	

For group II patients (1989-90), IRDM patients had a significantly lower mean duration since last seen at Muhimbili Medical Centre when compared with NIDDM patients (Table 20).

Table 20: Mean duration since last seen at Muhimbili Medical Centre for group II patients, 1989-90

	IRDM	NIDDM	Uncertain diabetes	Overall	p-value IRDM vs NIDDM
Number of patients	32	222	8	262	
Mean duration (months)	3.6	4.9	6.1	4.8	0.0399
Median	3.0	4.0	5.5	4	
Range	0.25 - 13	0.25 - 13	1 - 13	0.25 - 13	

Table 21 shows 101 (50%) patients were lost to follow up for more than 4 years. Only 78 (38%) patients were seen in the period between September 1, 1989 and October 31, 1990.

Table 21: Duration since last seen at Muhimbili Medical Centre in group I patients

Duration (months)	IRDM n (%)	NIDDM n (%)	Uncertain n (%)	Total n (%)
<1	17 (28.0)	23 (22)	1 (3)	41 (20)
1-3	8 (13.0)	12 (12)	0 (0)	20 (10)
4-6	4 (7.0)	5 (5)	3 (7)	12 (6)
7-12	2 (3.0)	3 (3)	0 (0)	5 (2)
13-24	4 (7.0)	4 (4)	1 (3)	9 (5)
25-48	3 (5)	10 (10)	1 (3)	14 (7)
49+	22 (37)	45 (44)	34 (85.0)	101 (50)
Total	60 (100)	102 (100)	40 (100)	202 (100)

INSULIN INJECTION

30 (50.0%) of the IRDM patients in group I injected insulin once per day while the remaining 30 (50%) injected insulin twice per day. 54 (90.0%) of these patients reported to practice self injection while the other 6 (10.0%) needed a different person to inject insulin.

Only 14 (43.8%) of the IRDM patients in group II injected insulin once per day while 18 (56.3%) injected insulin twice per day. 27 (84.4%) of the patients in group II reported to practice self injection while 5 (15.6%) needed another person to inject insulin.

Patients with NIDDM achieved significantly better glycaemic control when compared to IRDM patients (Tables 22, 23). Patients were considered to have good control if in 75% or more of the visits to the clinic their urine was negative for glucose.

Table 22: Degree of diabetes control achieved during follow up period in group I patients 1981-1990

Control	IRDM n (%)	NIDDM n (%)	Uncertain n (%)	Total n (%)
Good	3 (7)	25 (30)	2 (67)	30 (23)
Poor	42 (93)	58 (70)	1 (33)	101 (77)
Total	45 (34.4)	83 (63.4)	3 (2.3)	131 (100)

$X^2 = 8.07$, $p = 0.0023$.

For 71 patients there were no follow up visits recorded and their degree of control could not be determined (Table 22).

Table 23: Degree of diabetes control achieved during follow up period in group I patients September 1989 - October 1990

Degree of control	IRDM n (%)	NIDDM n (%)	Uncertain n (%)	Total n (%)
Good	14 (44)	142 (64)	0 (0)	156 (59)
Poor	18 (56)	80 (36)	8 (100)	106 (41)
Total	32 (100)	222 (100)	8 (100)	262 (100)

$X^2 = 4.8037$, $p = 0.0142$

B. UTILISATION OF HEALTH CARE SERVICES

TRANSPORT AND PLACES VISITED

388 (83%) of all the patients depended on communal buses to reach the various clinics, dispensaries and hospitals. Only 77 (17%) patients used either private or office transport.

117 (45%) of the group II patients reported to have visited various dispensaries before the diagnosis was established.

65 (25%) of group II patients had visited private hospitals before they reported to Muhimbili Medical Centre.

Only 2 (1%) patients reported to have consulted traditional healers before seeking modern health facilities.

For group I patients (1981-90), IRDM patients had a significantly higher average number of outpatient follow up visits at the diabetic clinic than NIDDM patients (Table 24).

Table 24: Mean number of one year documented outpatient diabetic clinic visits in group I patients

		IRDM	NIDDM	Total	p-value
Follow up diabetic clinic	n	58	98	156	0.0406
visits (number)	Mean	3.0	2.3	2.6	
	Median	3.2	2.0	2.3	
Range	Range	0.1-7.2	0.1-7.9	0.1 - 7.9	

The mean (SD) number of one year follow up visits at diabetic clinic for the whole group was found to be 2.6, (Median = 2.3, range = 0.1 - 7.9)

For group II patients (1989-90), there was no significant difference in average number of visits before diagnosis between IRDM and NIDDM patients. But IRDM patients had significantly more follow up visits at the diabetic clinic compared with NIDDM patients (Table 25).

Table 25: Mean number of outpatient hospital visits in group II patients

		IRDM	NIDDM	Uncertain diabetes	Overall	p-value IRDM vs NIDDM
Visits before diagnosis	n	30	218	6	254	0.2173
	Mean	3.1	3.9	2.0	3.8	
	Median	3.0	3.0	1.0	3.8	
	Range	1 - 7	1 - 50	1 - 5	1-50	
Follow up visits	n	30	214	1	245	0.0459
	Mean	3.9	3.1	6	3.2	
	Median	4.0	3.0	6	3.0	
	Range	1 - 8	1 - 16	6	1 - 16	

The mean number of hospital visits for diagnosis for the whole group was 3.8 (median = 3.0, range = 1 - 50).

The mean number of follow up visits for the whole group was 3.2 (median = 3.0, range = 1-16).

The rate of admission was significantly higher for IRDM patients when compared with NIDDM patients (Tables 26, 27).

Table 26: Frequency of admission in group I patients, 1981-90

Frequency	IRDM n(%)	NIDDM n(%)	Uncertain diabetes n(%)	Total n(%)
0	4 (7)	42 (41)	0	46 (23)
1	22 (37)	42 (41)	34 (85)	98 (49)
2	16 (27)	11 (11)	4 (10.0)	31 (15)
3	8 (13)	3 (3)	1 (2.5)	12 (6)
4+	10 (16.3)	4 (4)	1 (2.5)	15 (7)
Total	60 (30)	102 (50)	40 (20)	202 (100)

$X^2 = 34.866$ p = 0.0000

Table 27: Frequency of admission in group II patients, 1989-90

Frequency (n)	IRDM n(%)	NIDDM n(%)	Uncertain diabetes n(%)	Total n(%)
0	5 (16)	175 (78)	1 (11)	181 (69)
1	22 (69)	38 (16)	6 (78)	64 (24)
2+	5 (15)	11 (5)	1 (11)	17 (7)
Total	32 (12)	222 (84)	8 (4)	262 (100)

$X^2 = 54.6236$ p = 0.0000

The mean duration of admission because of acute metabolic complications and for all causes combined was significantly higher for IRDM patients than NIDDM patients. There was no significant difference in mean duration of admission for infections and chronic complications as well as for unrelated causes when IRDM patients were compared with NIDDM patients (Tables 28, 29).

Table 28: Mean duration (days) of admission for group I patients, 1981-90

		IRDM	NIDDM	Uncertain	Overall	p value
Acute	n	46	34	16	96	0.0110
metabolic	Mean	24	15	25	21	
complications	Median	18	10	20	16	
	Range	4 -102	1 - 60	1 - 135	1 - 135	
Infections and	n	25	25	26	76	0.5800
chronic	Mean	50	35	36	40	
complications	Median	25	21	23	22	
	Range	3 - 190	4 - 112	1 - 176	1 - 190	
Unrelated	n	8	7	0	15	0.9071
conditions	Mean	10	26		18	
	Median	7	10		10	
	Range	1 - 32	2 - 133		1 - 133	
Overall	n	55	59	40	154	0.0018
	Mean	44	26	34	34	
	Median	27	15	19	21	
	Range	4 - 234	1 - 133	1 - 223	1 - 234	

Table 29: Mean duration (days) of admission for group II patients, 1989-90

		IRDM	NIDDM	Uncertain	Overall	p value
Acute	n	16	29	2	47	0.0001
metabolic	Mean	10	5	10	9	
complications	Median	13	3	10	7	
	Range	3 -42	1 - 19	9 - 11	1 - 42	
Infections and	n	13	18	4	35	0.4107
chronic	Mean	23	18	7	18	
complications	Median	12	12	6	10	
	Range	2 - 90	2 - 90	4 - 10	2 - 190	
Unrelated	n	1	8	1	10	0.1056
conditions	Mean	11	4	73	11	
	Median	11	3	73	3	
	Range	11 - 11	1 - 9	73 - 73	1 - 73	
Overall	n	27	47	7	81	0.0001
	Mean	21	11	17	15	
	Median	14	5	9	10	
	Range	3 - 90	1 - 90	4 - 73	1 - 90	

C. MEDIUM AND LONG-TERM COMPLICATIONS OF DIABETES MELLITUS

Table 30 shows 64% of group I patients developed at least one complication. Infections were the most frequent complications in IRDM patients while vascular complications were leading in the NIDDM patients.

Table 30: Frequency of the different chronic complications and associated illnesses in group I patients, 1981-90

Complication	IRDM n=60 n (%)	NIDDM n=102 n (%)	Uncertain n=40 n (%)	Total n=202 n (%)
None	13 (22)	26 (26)	34 (85)	73 (36)
Retinopathy	9 (15)	11 (11)	0	20 (10)
Cataracts	10 (17)	19 (19)	1 (3)	30 (15)
Blindness	0	4 (4)	1 (3)	5 (3)
Nephropathy	5 (8)	9 (9)	0	14 (7)
Neuropathy Paraesthesia	13 (22)	23 (23)	1 (3)	37 (18)
Hypertension/CCF	7 (12)	35 (34)	4 (10)	46 (23)
Cerebrovascular accident	0	3 (3)	4 (10)	7 (4)
Diabetic foot/hand	11 (18)	9 (9)	3 (8)	23 (11)
Gangrene/amputation	1 (2)	0	2 (5)	3 (2)
Impotence	6 (10)	11 (11)	1 (3)	18 (9)
Recurrent abscesses	13 (22)	7 (7)	2 (5)	22 (11)
Pulmonary tuberculosis	15 (25)	4 (4)	0 (0)	19 (9)
Others	3 (5)	2 (2)	2 (5)	7 (4)
Total with complications (%)	47 (78)	76 (75)	6 (15)	129 (64)

(%) of total (n) in each diabetes type.

Table 31 shows that 99 (38%) of the patients in group II developed at least one or more complications during the one year of follow up. As in group I patients, infections were the leading complication in patients with IRDM and vascular problems led in the NIDDM patients.

Table 31: Frequency of different chronic complications and associated illnesses in group II patients, 1989-90

Complication	IRDM n=32 n (%)	NIDDM n=222 n (%)	Uncertain n=8 n (%)	Total n=262 n (%)
None	16 (50)	142 (64)	5 (38)	162 (62)
Retinopathy	3 (9)	3 (1)	0	6 (2)
Cataracts	1 (3)	2 (1)	0	3 (1)
Blindness	0	0	0	0
Nephropathy	1 (3)	2 (1)	0	0
Neuropathy Paraesthesia	4 (13)	18 (8)	1 (12.4)	23 (9)
Hypertension/CCF	1 (3)	43 (19)	1 (12.4)	45 (17)
Cerebrovascular accident	0	2 (1)	0	2 (1)
Diabetic foot/hand	4 (13)	9 (4)	1 (12.4)	14 (5)
Gangrene amputation	0	0	1 (12.4)	1 (0.4)
Impotence	1 (3)	2 (1)	0	3 (1)
Recurrent abscesses	3 (9)	7 (3)	1 (12.4)	11 (4)
Pulmonary tuberculosis	6 (19)	8 (4)	0	14 (5)
Others	0	7 (3)	0	7 (3)
Total with complications n (%)	16 (50.0)	80 (36.0)	3 (38)	99 (38)

D. PROGNOSIS OF DIABETES MELLITUS

The general condition of patients with IRDM and NIDDM was not significantly different when last seen at Muhimbili Medical Centre. Significantly more patients with uncertain type of diabetes were dead when compared with IRDM and NIDDM patients (Table 32).

Table 32: General condition of patients when last seen at Muhimbili Medical Centre in group I patients

Condition	IRDM n (%)	NIDDM n (%)	Uncertain n (%)	Total
Good	40 (67)	72 (71)	9 (22)	121 (60)
Satisfactory	8 (13)	16 (15)	0 (0.0)	24 (12)
Dead	12 (20)	14 (14)	31 (78)	57 (28)
Total	60 (30)	102 (50)	40 (20)	202 (100)

$X^2 = 1.1519 = 0.5622$ (IRDM vs NIDDM)

$X^2 = 61.3026$, $p = 0.0000$ (IRDM vs NIDDM vs Uncertain diabetes)

Nine (3.4%) patients were dead in the first year of follow up for patients in group II (Table 33).

Table 33: General condition of patients when least seen at Muhimbili Medical Centre in group II patients

Condition	IRDM n (%)	NIDDM n (%)	Uncertain n (%)	Total n (%)
Good	24 (75)	203 (91.4)	2 (25)	229 (87.4)
Satisfactory	6 (18.7)	15 (6.8)	0	21 (8.0)
Poor	0	3 (1.3)	0	3 (1.2)
Dead	2 (6.3)	1 (0.5)	6 (75)	9 (3.4)
Total	32 (12.2)	222 (84.4)	8 (3.4)	262 (100)

p-value not done because of small numbers.

Forty-seven (82.5%) deaths were either due to acute metabolic complications or infections and chronic complications associated with diabetes mellitus (Table 34).

Table 34: Reasons for death in group I patients

Variable	IRDM n (%)	NIDDM n (%)	Uncertain n (%)	Total n (%)
Acute metabolic complications	2 (3)	2 (14)	11 (35)	15 (26)
Infections and chronic complications	7 (12)	9 (64)	16 (52)	32 (56)
Unrelated to diabetes	1 (2)	2 (14)	1 (3)	4 (7)
Unknown	2 (3)	1 (7)	3 (10)	6 (11)
Total deaths	12 (100)	14 (100)	31 (100)	57 (100)

Forty-nine percent of all deaths in group I patients (1981-90) occurred in hospital while 51% occurred at home.

REASON FOR DEATHS IN PATIENTS WITH IRDM, NIDDM AND UNCERTAIN TYPE OF DIABETES IN GROUP II PATIENTS

9 (3.4%) patients died within one year of follow up. Two patient with IRDM died one for reasons unrelated to diabetes. One patient with NIDDM died of hypoglycaemic coma. Of the remaining 6 patients with diabetes of uncertain type, three died of acute metabolic complications of diabetes, two died of infections and chronic complications and one died of cancer. All deaths in group II patients occurred in the wards at Muhimbili Medical Centre. The mean duration of diabetes for the deceased was 3.3 months (median 1 month, range 0.25 - 12).

For the three types of diabetes it was as follows:

1. IRDM patients, 6.1 months (range 0.25 - 12 months)
2. NIDDM patients, one patient died after 10.0 months
3. Patients with uncertain type of diabetes, 1.2 months (median 1 month, range 0.5-2 months).

The mean duration of diabetes at death between IRDM and NIDDM patients was not significantly different for group I patients (1981-90).

Patients with uncertain type of diabetes had a significantly shorter mean duration of diabetes at death when compared with IRDM and NIDDM patients (Table 35).

Table 35: Mean duration of diabetes at death for group I patients

	IRDM	NIDDM	Uncertain diabetes	Overall	p-value IRDM vs NIDDM
Number of patients	12	14	31	57	
Mean duration (months)	37.5	40.0	9.8	22.8	0.8686
Median	36.0	36.0	4.0	5	
Range	3-84	2-96	1-96	1-96	

t=3.5646, p=0.0009 (IRDM vs uncertain)

IRDM patients died at a significantly lower mean age than those with NIDDM (Table 36).

Table 36: Average age at death for group I patients

	IRDM	NIDDM	Uncertain diabetes	Overall	p-value IRDM vs NIDDM
Number of patients	11	14	31	56	
Mean age (years)	37.7	52.0	41.5	43.4	0.0229
Median	40.0	50.5	40.0	45.0	
Range	12-61	33-71	14-99	12-99	

The mean age at death for group II patients was 60.6 years (median = 61, range = 41-70 years)

E. COSTS ESTIMATES

DIRECT COSTS

Table 37 shows that the average cost per patient from onset of symptoms to diagnosis was Tshs. 2213 (US $ 11). Patients with NIDDM incurred less cost compared to patients with the other two types of diabetes. The cost was very high for uncertain type of diabetes as two of the patients in this group were extensively investigated for pancreatic problems before diabetes was eventually diagnosed.

Table 37: Average diagnostic costs per patient in group II patients 1989-1990 (TShs)

		IRDM	NIDDM	Uncertain	Overall
Transport costs:	n	28	177	6	209
Patient	Mean	631	1958	1350	629
	Median	280	990	1400	240
	Range	80 - 2600	160 - 35500	600 - 2000	20 - 15000
Escort	n	7	16	1	24
	Mean	251	704	600	568
	Median	240	220	600	240
	Range	80 - 600	40 - 8060	600 - 600	40 - 8060
Cost of	n	30	219	6	255
Investigations	Mean	858	817	1283	833
	Median	600	600	700	600
	Range	400 - 3400	300 - 5500	400 - 4500	300 - 5500
Cost of Treatment	n	9	55	2	66
	Mean	3444	2405	24000	3201
	Median	1500	1500	24000	1550
	Range	500 - 10000	150 - 30000	3000 - 45000	150 - 45000
Total costs	n	31	220	6	257
	Mean	2457	1958	10283	2213
	Median	1700	990	2300	1100
	Range	400 - 10720	160 - 35500	1000 - 49500	160 - 49500

Average one year direct outpatient cost per one diabetic patient in 1989/90 was:

(a) For an IRDM patient: Tshs. 45784 (US $ 229)

Of this 68.2% was for purchase of insulin. Treatment of infections and chronic complications accounted for 13.2%, syringes, spirit and cotton swabs 13.5%, self home urine monitoring 3.5%, others 0.6%.

(b) For an NIDDM patient: Tshs. 13807 (US $ 69)

Of this 42.5% was used to buy oral hypoglycaemic drugs. Treatment of infections and chronic complications accounted for 48.8%, self home urine monitoring 4.0%, other tests 2.8% and the remaining outpatient costs were 0.9% (Table 38).

Table 38: Average one year outpatient costs for one diabetic patient (TShs)

		IRDM	% of Total costs	NIDDM	% of Total costs
Transport cost	n	87	0.5	279	1.7
	Mean	244		264	
	Median	80		80	
	Range	40 - 3200		40-10000	
Clinic costs:	n	88	0.0	312	0.1
Nurses' pay	Mean	13		11	
	Median	14		10	
	Range	1 - 32		1-64	
Doctors' pay	n	88	0.0	312	0.1
	Mean	23		20	
	Median	24		17	
	Range	1 - 56		1-112	
Urine/blood glucose tests	n	88	1.0	312	2.8
	Mean	462		397	
	Median	476		343	
	Range	14 - 1120		14-2240	
Home self-care:	n	92	3.5	322	4.0
urine glucose strips	Mean	1606		556	
	Median	1606		556	
	Range	1606 - 1606		556-556	
spirit/cotton wool	n	89	9.9		
	Mean	4706			
	Median	4800			
	Range	1800 - 6600			
syringes/needles	n	92	3.6		
	Mean	1664			
	Median	1664			
	Range	1664 - 1664			
Insulin/oral hypoglycaemic drugs	n	92	68.2	284	42.5
	Mean	31210		6655	
	Median	22163		5840	
	Range	11082 - 487559		912-30660	
Treatment of complications	n	43	13.2	119	48.8
	Mean	12934		18232	
	Median	10000		10000	
	Range	1500 - 45000		730-96725	
Total outpatient costs	n	92	100	322	100
	Mean	45784		13807	
	Median	40449		8583	
	Range	20067 - 496131		571-99448	

Average 1-year inpatient cost per patient for patients in group I was Tshs. 11581 (US $ 58) for an IRDM patient and Tshs. 6746 (US $ 34) for an NIDDM patient (Table 39).

Table 39: Average one year inpatient cost for one patient in group I, 1981-90 (TShs)

		IRDM	% of Total costs	NIDDM	% of Total costs	Overall	% of Total costs
Investigation	n	54	39.5	58	38.3	152	40.4
	Mean	4663		2627		5552	
	Median	1636		940		1795	
	Range	413 - 63800		315 - 26400		315-63800	
Oral hypoglycaemics	n	8	0.2	30	2.3	50	0.5
	Mean	147		303		228	
	Median	14		12		16	
	Range	6 - 1084		1 - 7293		1-72	
Insulin	n	53	7.9	32	1.9	118	5.9
	Mean	955		234		1048	
	Median	277		123		311	
	Range	15 - 19110		23 - 1021		15-19110	
Antibiotics	n	32	3.3	23	4.0	80	3.7
	Mean	656		690		954	
	Median	290		161		446	
	Range	26 - 6000		10 - 5000		10-8400	
Antihypertensives	n	2	0.4	14	3.3	22	1.4
	Mean	1356		940		1361	
	Median	1356		176		500	
	Range	12 - 2500		28 - 6270		12-6270	
Intravenous fluids	n	36	2.9	28	1.3	93	4.5
	Mean	521		181		1003	
	Median	344		114		344	
	Range	69 - 4650		39 - 620		39-4960	
Syringes/needles	n	54	5.1	51	2.3	143	5.1
	Mean	599		181		738	
	Median	214		77		214	
	Range	22 - 12750		6 - 1625		6-12750	
Other treatment	n	30	4.2	27	4.0	84	4.8
	Mean	898		586		1203	
	Median	163		182		292	
	Range	22 - 15000		11 - 3400		11-17500	
Meal & bed	n	54	19.0	59	24.7	152	22.0
	Mean	2238		1666		3019	
	Median	909		464		981	
	Range	111 - 42500		29 - 16500		29-42500	
Nursing cost	n	55	13.6	59	14.1	154	9.1
	Mean	1576		949		1240	
	Median	972		540		756	
	Range	144 - 8424		36 - 4788		36-8424	
Doctors' cost	n	55	3.8	59	3.9	154	2.5
	Mean	438		264		344	
	Median	270		150		210	
	Range	40 - 2340		10 - 1330		10-2340	
Total	n	55	100	59	100	154	100
	Mean	11581		6746		13558	
	Median	4842		2510		5144	
	Range	826 - 161414		397 - 59756		397-161414	

Average one year direct inpatient cost per patient for patients in group II in 1989-90 was:

(a) For an IRDM patient: Tshs. 20563 (US $ 103)

Of this 37.5% was for investigations done in the ward.

(b) For an NIDDM patient: Tshs. 10830 (US $ 54).

Of this, 39.9% was for investigations done in the ward (Table 40).

Table 40: Average one year inpatient cost for one patient in group II, 1989-90 (TShs)

		IRDM	% of Total costs	NIDDM	% of Total costs	Overall	% of Total costs
Investigation	n	25	37.5	44	39.9	76	37.1
	Mean	8324		4616		6187	
	Median	5840		2650		4500	
	Range	1040 - 31500		380 - 32200		380-32200	
Oral hypoglycaemics	n	3	0.5	29	1.3	33	0.9
	Mean	837		230		335	
	Median	192		80		90	
	Range	20 - 2300		5 - 1176		5-2300	
Insulin	n	24	7.1	14	7.7	44	7.0
	Mean	1632		2784		2015	
	Median	1200		674		890	
	Range	28 - 4979		61 - 19430		28-19430	
Antibiotics	n	11	6.2	18	5.7	34	7.0
	Mean	3124		1607		2614	
	Median	1400		820		1540	
	Range	600 - 17120		100 - 9570		100-17120	
Antihypertensives	n	1	0.3	10	1.3	13	0.8
	Mean	1500		669		807	
	Median	1500		205		265	
	Range	1500 - 1500		100 - 3700		100-3700	
Intravenous fluids	n	16	6.3	9	3.1	31	5.7
	Mean	2179		1744		2321	
	Median	1830		1550		1860	
	Range	620 - 4340		620 - 3000		620-5270	
Syringes/needles	n	25	8.2	34	3.3	64	5.3
	Mean	1822		500		1058	
	Median	875		150		540	
	Range	100 - 14000		25 - 3200		25-14000	
Other treatment	n	9	4.6	13	3.5	27	4.1
	Mean	2828		1362		1941	
	Median	500		200		350	
	Range	100 - 19200		15 - 10600		15-19200	
Meal & bed	n	25	24.8	44	29.7	76	27.7
	Mean	5506		3433		4608	
	Median	3500		1250		2500	
	Range	750 - 22500		250 - 22500		250-50000	
Nursing cost	n	27	3.7	47	3.6	81	3.4
	Mean	755		386		528	
	Median	504		180		360	
	Range	108 - 3240		36 - 3240		36-3240	
Doctors' cost	n	27	1.0	47	1.0	81	0.9
	Mean	210		107		147	
	Median	140		50		100	
	Range	30 - 900		10 - 900		10-900	
Total	n	27	100	47	100	81	100
	Mean	20563		10830		15633	
	Median	13954		4251		11154	
	Range	552 - 116478		416 - 87040		416-1164	

In 1989 - 90, US $ 2,721,151 were estimated to have been used for outpatient care of all diabetic patients above 15 years in Tanzania.

Treatment of chronic complications and associated illnesses consumed 30.8%. For purchase of insulin 32.2% was used and 24.3% was for oral hypoglycaemic drugs. Doctors' and nurses' costs accounted for only 0.2% (Table 41).

Table 41: Estimated one year costs of outpatient care of all diabetic patients in Tanzania in 1989/90*

	Average costs		
	TShs	US $	% of total costs
Transport	6,485,968	32,429	1.2
Clinic nursing costs	284,608	1,423	0.1
Clinic doctors' costs	514,244	2,571	0.1
Clinic urine/blood glucose tests	10,235,364	51,177	1.9
Self-care urine glucose strips	19,194,712	95,974	3.5
Self-care spirit/cotton wool	23,850,008	119,250	4.4
Self-care syringes and needles	8,433,152	42,166	1.5
Insulin	175,025,680	875,128	32.2
Oral hypoglycaemic drugs	132,328,020	616,640	24.3
Treatment of complications	167,878,364	839,392	30.8
Total outpatient costs	544,230,120	2,721,151	100.0

* The estimated prevalence of diabetic patients aged 15 years and over who were on treatment in Tanzania was 0.2% and the calculated total number of patients was 25492, 21.8% of whom were using insulin. One US $ = 200 TShs.

The one year cost for inpatient care of all admitted diabetic patients in Tanzania was estimated to be US $ 1,255,312. Of this, 40.4% was for inpatient investigations, 5.9% was for insulin, 3.7% was for antibiotics and 4.5% was for intravenous fluids. Nursing and doctors' costs contributed 9.1% and 2.5% respectively of the total inpatient costs (Table 42).

Table 42: Average one year costs of inpatient care of all diabetic patients in Tanzania in 1989/90.*

	Average cost		
	TShs	US $	% of total costs
Investigations	101,475,475	507,377	40.4
Oral hypoglycaemic drugs	1,370,796	6,854	0.5
Insulin	14,870,013	74,350	5.9
Antibiotics	9,177,120	45,886	3.7
Antihypertensives	3,600,384	18,001	1.4
Intravenous fluids	11,216,360	56,082	4.5
Syringes and needles	12,689,966	63,450	5.1
Other treatment	12,151,026	60,755	4.8
Meal and bed	55,179,117	275,896	22.0
Nursing costs	22,962,039	114,810	9.1
Doctors' costs	6,370,114	31,851	2.5
Total inpatient costs	251,062,410	1,255,312	100.0

* The estimated prevalence of diabetic patients aged 15 years and over who were on treatment in Tanzania was 0.2% and the calculated total number of patients was 25492, 21.8% of whom were using insulin. One US $ = 200 TShs.

To care for an IRDM patient for one year in Tanzania, US $ 287 were estimated to be needed. Of this 79.8% was for one year outpatient care.

One year care of an NIDDM patient needed US $ 103 in 1989/90. Of this 67.2% was for outpatient care (Table 43).

Table 43: The estimated average direct cost of one year care of a patient with diabetes in Tanzania in 1989-90

Variable		IRDM (% of total)	NIDDM (% of total)
Outpatient care	TSHS	45784 (79.8)	13807 (67.2)
	US $	228.9	69.0
Inpatient care	TSHS	11581 (20.2)	6747 32.8)
	US $	57.9	33.7
Total direct cost	TSHS	57365 (100)	20553 (100)
	US $	286.8	102.8

It was estimated that in 1989/90, to care for all diabetic patients above 15 years in Tanzania about US $ 3,976,463 would have been needed. Of this, 68.4% was for outpatient care and 31.6% was for inpatient care (Table 44).

Table 44: The estimated total direct costs of one year care of all diabetic patients in Tanzania 1989/90

	Total direct cost		
Variable	Tshs.	US $	%
Outpatient costs	544,230,120	2,721,151	68.4
Inpatient costs	251,062,410	1,255,312	31.6
Total costs	795,292,530	3,976,463	100

INDIRECT COSTS

For group I patients the average loss of work hours per year for IRDM and NIDDM patients was 347 hours and 140 hours respectively (Table 45).

Table 45: Work hours lost because of diabetes in group I patients, 1981-90

		IRDM	NIDDM	Overall
Patient visit hours/year	n	57	94	151
	Mean	25	19	21
	Median	18	12	14
	Range	1-326	1-134	1-326
Escort visit hours/year	n	5	6	11
	Mean	23	11	17
	Median	28	9	14
	Range	1-41	1-30	1-41
Admission hours	n	55	59	151
	Mean	350	211	276
	Median	216	120	168
	Range	32-1872	8-1064	8-1872
Total hours	n	60	102	202
	Mean	347	140	227
	Median	236	58	227
	Range	9-1912	0-1079	0-1912

In a period of one year, an IRDM patient in group II lost an average of 547 work hours because of diabetes while an NIDDM patient lost an average of 202 hours (Table 46).

Table 46: work hours lost because of diabetes in group II patients, 1989-90

		IRDM n=32	NIDDM n=222	Overall n=263
Patient's visit hours for diagnosis	n	31	215	251
	Mean	47	22	25
	Median	24	24	24
	Range	4-720	2-120	2-720
Escort visit hours for diagnosis	n	13	25	41
	Mean	35	24	32
	Median	12	24	24
	Range	6-216	2-168	2-240
Patient follow up visit hours per year	n	30	212	243
	Mean	32	23	24
	Median	24	16	18
	Range	6-192	2-216	2-216
Escort follow up visit hours per year	n	8	18	26
	Mean	26	23	24
	Median	25	16	20
	Range	7-48	4-77	4-77
Admission hours/year	n	27	47	81
	Mean	168	86	117
	Median	112	40	80
	Range	24-720	8-720	8-720
Excuse duties before diagnosis (hours)	n	23	84	112
	Mean	301	314	321
	Median	168	112	112
	Range	8-720	8-8640	8-8640
Excuse duties during follow up (hours)	n	7	14	21
	Mean	430	243	325
	Median	240	112	168
	Range	48-1440	24-1440	24-1440
Total hours	n	32	222	262
	Mean	547	202	252
	Median	386	59	76
	Range	16-2360	0-8705	0-8705

Total future healthy life days (HLDs) lost because of diabetes per patient was calculated to be 4100 days. Of this 69% is lost due to premature mortality (Table 47).

Table 47: Indirect costs of diabetes: future healthy life days (HLDs) lost per patient because of premature death, disabilities and acute illnesses associated with diabetes in group I patients during the 8 years of follow up.

Reason for lost days	IRDM n (%)	NIDDM n(%)	Uncertain n(%)	Overall n (%)
Premature death	1997 (55.1)	949 (39.7)	8885 (96.8)	2832 (69)
Disability before death	18 (0.5)	93 (3.9)	37 (0.4)	60 (1)
Chronic disability	1571 (43.3)	1332 (55.7)	219 (2.4)	1183 (29)
Acute illness	40 (1.1)	15 (0.6)	34 (0.4)	26 (1)
Total HLDs	3626 (100)	2390 (100)	1974 (100)	4100 (100)

DIABETES COST ESTIMATES FOR THE USA

Total outpatient costs in the USA in 1987 were estimated at US $ 1.7 billion (Table 48).

Table 48: Summary of outpatient costs of diabetes in the United States in 1987[47]

	Units attributed to diabetes	Price per unit ($)	Total cost (US $ millions (%))
Physician visits attributed to diabetes	13,385,442	27.82	372.4 (21.6)
Physician ordered lab. tests			
- Glucose testing	6,839,961	21.0	143.6 (8.3)
- HbA1C	1,465,706	17.50	25.6 (1.5)
- Glucose tolerance	1,465,706	26.00	38.1 (2.2)
Oral hypoglycaemic prescriptions	20,574,000	14.28	293.8 (17.0)
Insulin prescriptions	14,404,000	14.23	205.0 (11.9)
Syringes	1,394,640,910	0.20	278.9 (16.0)
Cotton swabs	1,394,640,910	0.02	27.9 (1.6)
Self administered glucose tests	279,885,097	0.83	232.3 (13.5)
Self administered urine tests	1,102,046,552	010	110.2 (6.4)
Grand Total			1727.8

Source: Fox NA, Jacobs J. Direct and Indirect Costs of Diabetes in the United States in 1987. American Diabetes Association, Alexandria, VA, 1988.

Total costs of diabetes in USA were estimated at $ 20.4 billion for 1987. Direct medical costs accounted for 47.1% of total costs; indirect costs accounted for 52.9% of the total (Table 49).

Table 49: Total cost of diabetes, in the USA in 1987[47]

	Total costs $ millions	Percent of total cost
DIRECT COSTS:		
Institutional: hospitals, nursing homes	7,871.4	38.6
Outpatient	1,727.8	8.5
INDIRECT COSTS:		
Short-term morbidity	141.9	0.7
Long-term disability	3,143.2	15.4
Mortality	7,488.8	36.8
TOTAL COST	20,373.1	100.0

Table 50 shows that the institutional cost of diabetes care was 82% of the total direct cost in USA while it was only 31.6% for Tanzania. The outpatient direct cost of diabetes care was 68.4% of the total direct cost in Tanzania while it was only 18% for USA.

Table 50: Total direct cost of diabetes in USA in 1987 compared to Tanzania in 1989-90 (US $, millions)

	USA US $ (%)	Tanzania US $ (%)
Institutional hospitals, nursing homes	7,871.4 (82)	1.3 (31.6)
Outpatient	1,727.8 (18)	2.7 (68.4)
Total	9599.2 (100)	4.0 (100)

DISCUSSION

The group I patients in this study were part of a larger prospective study of all newly diagnosed patients seen at Muhimbili Medical Centre between May 1st 1989 to April 1987 and followed up for 22 - 94 months to April 1989. They have been used in calculating the direct cost of follow up and healthy life days lost due to diabetes because of their long follow up period. The patients in group II seen between September 1989 and October 1990 were used in estimating the cost involved in the diagnosis of diabetes because this information could not be obtained from the 1981/82 patients.

Types of diabetes

The proportion of patients in this study requiring insulin for adequate control (19.8%) was similar to that found in the 6 years prospective study (21.8%).[2] These findings are similar to the 24% reported by Gatling et al in a study of 846 diabetic patients registered with general practitioners in Poole, England.[80]

When patients diagnosed in 1981-82 were compared with those diagnosed in 1989-90, there was a significantly higher proportion with IRDM (29.7%) in the former group than in the latter (12.2%). Several reasons could account for the difference between the two groups. It could be that more strict selection of treatment modalities is now being practised. In the past, the development of ketoacidosis was an indication for permanent treatment with insulin. But now some patients are treated with oral hypoglycaemic drugs even after recovering from ketoacidosis. Previously, it was also thought that most patients who were diagnosed diabetic before the age of 40 years required insulin. But now we appear to be seeing more patients who are controlled with oral hypoglycaemic drugs at a much earlier age. It is also possible that as these newly diagnosed diabetic patients survive longer there will be a higher demand for insulin as their pancreases fail more and more. These could be some of the reasons for high insulin utility in the group I patients.

In other studies done in Tanzania, much higher rates of insulin use were reported [81-83]. This could be due to selection bias as patients from clinics were included in the studies. Patients requiring insulin are less likely to default from seeking treatment, thus raising the proportion of insulin requiring diabetic patients among clinic attenders. It was also possible that some patients may have been treated unnecessarily with insulin.

Whether a patient requires insulin or not is an important consideration in the care of diabetic patients, especially in the developing world, because of the problems of supply and cost of insulin and the requirements for its administration. In the present study, the direct costs for patients using insulin was more than thrice the direct costs of those on oral drugs.

Age

The mean ages of the patients were 43.0, 48.8 and 46.0 years for the IRDM, NIDDM and

uncertain groups of patients respectively. This shows that patients with diabetes requiring insulin present at a later age in tropical than temperate countries and patients with diabetes not requiring insulin at an earlier age. The decline in the number of patients aged over 55 years in the two studies may reflect the short life expectancy of people in developing countries, with many of those at risk of developing diabetes having already died. As life expectancy increases, the prevalence of NIDDM will also increase. The paucity of patients below twenty years of age may reflect the rarity of insulin dependent diabetes in this population. However, many patients in this age group would present in severe diabetic ketoacidosis and Rwiza et al[84] have shown that such patients are often not diagnosed.

Sex

At least twice as many men as women had diabetes in this study. Most studies from tropical Africa have indicated that males are more commonly affected than females.[2,81,83,85-87] In community based studies in rural Tanzania a male to female ratio of 1.6:1 was found among patients with diabetes not requiring insulin.[1] This ratio is similar to 1.5:1 which was reported in the prospective study of patients with non-insulin dependent diabetes in the United Kingdom.[88] In South Africa, on the other hand, a number of studies have shown a female excess.[89-92]

Education and occupational status

In this study, it was found that 32% of the patients were unable to read or write or had only attended adult literacy classes or received instruction on reading the Koran. This observation is important when considering education for the patients,an important aspect of good diabetes management. Of the 50% employed men, 58% were in the low income group. Of the 12% employed females, 81% were in the low income group. These observations, disprove the longstanding belief that, in developing countries, diabetes affects only the "urban bourgeois class".

The clinical course of diabetes

Only 78 (38%) of the 202 patients diagnosed in 1981/82 were seen within one year of this study. The possible reasons for loss to follow up are many and include death, change of residence, resolutions of symptoms, economic difficulties and pursuit of a permanent cure from a different doctor or traditional healer. Similar high rates of loss to follow up have been noted in other studies in developing countries. Corrigan and Ahren in 1987 reported that 315 (47.9) of 658 patients seen over a ten years period between 1974 and 1984 in Mwanza, Tanzania continued to attend the diabetic clinic regularly, the other 52% having died, been transferred or lost to follow up.[83] Greenwood and Taylor[95], observed that 60% of 600 patients registered over a nine year period at the diabetic clinic in University College Hospital, Ibadan, Nigeria were lost to follow up. In another report from Zimbabwe, out of 107 patients admitted to Harare Central hospital in 1971, nine (8.4%) died before discharge

and 6 years later 93 of the 98 surviving patients were traced, but of these 38 (41%) had died.[97] Mechanisms for patient follow up are limited, hospital medical staff are frequently overworked and there are no family doctors in most developing countries.

In the larger prospective study done at Muhimbili Medical Centre, Dar es Salaam, 1981-89,[2] the five year survival rates for 272 patients with diabetes requiring insulin, 825 with non-insulin dependent diabetes and 153 with diabetes of uncertain type were 59.5%, and 81.8% and 43.0% respectively. The 5-years survival rate for all 1250 newly diagnosed diabetic patients in that study was 71%. Similar or even lower survival rates have been reported from various African countries.[96-98]

In this study, it was observed that 31 (78%) of the patients with uncertain type of diabetes, 12 (20%) with insulin requiring diabetes and 14 (14%) with non-insulin dependent diabetes were dead within 8 years of follow up. It appears that the mortality rates observed in this study were lower than in the previous prospective study.[2] This could be explained by the fact that 23 files of the patients who were supposed to be included in this study were not available, and were thus replaced by the next available files. Probably most of the lost files were of the dead patients who were then replaced by live patients.

The prognosis of diabetic patients is much better in developed countries. In Denmark, for example, 40% of patients with IDDM survive for more than 40 years.[99] The life expectancy of patients in developed countries with diabetes who do not require insulin, is on average, several years less than that for people without diabetes, but few die within five years of diagnosis.[18]

Causes of death in diabetic patients

Of the 57 group I patients who had died in the present study 26.3% died because of acute metabolic complications of diabetes. Infections and other chronic complications accounted for 56.1% of the deaths. A similar situation was observed in the previous prospective study done at Muhimbili Medical Centre,[2] In that study 26 (20.7%) patients died of acute metabolic complications and 39 (30.9%) patients died of infections. Acute metabolic complications accounted for 25.4% deaths in Ethiopia[100] and 31.7% deaths in Nigeria[86] while infections caused 19.1% and 15.2% of the reported deaths in these countries respectively. Similar situation was found in many other developing countries.[40,101].

In the USA, infections and diabetic coma now account for only 5.9% and 1% respectively of the mortality[102] and in Japan the corresponding figures are 9% and 4.7%.[103] Reports from Europe give similarly low figures. Turnbridge[104] found that ketoacidaemia was the major cause of death in 15% of diabetic patients dying under the age of 50 years. In USA 79% of diabetic patients die from cardiovascular and renal diseases.[105]

Medium and long-term complications

In the present study 64% of the patients with diabetes duration of about 8 years developed one

or more complications. Similarly high rates were observed in other studies in African countries.[85,92] It is necessary to note that the rates of the various complications reported in this study represent the minimum of the actual rates as it only considered the complications documented in the cases notes.

Thirty one percent of patients in this study developed infections (diabetic foot and hand 11%, recurrent abscesses 11% and pulmonary tuberculosis 9%). Gangrene with amputation occurred in 2%. Similarly high rates of infections and foot gangrene were observed in other African countries.

Pulmonary tuberculosis alone affected 8.6% and 8.1% of the studied patients in Ethiopia[106] and Nigeria[101] respectively. Lower rates of pulmonary tuberculosis were reported from South Africa[89,109] and Zimbabwe[87]. Foot gangrene was reported in 3.8% in Nigeria[108] and 1.9% in Ethiopia[106]. Lower rates were reported by other studies in African countries[89,101,107].

Hypertension was noted in 23% of the patients and cerebrovascular accidents in 4%. Only one patient developed acute myocardial infarction. Similar rates of hypertension were reported from Nigeria[86,101]. Much higher rates were reported from other African countries. Gill and Huddle[109] reported a rate of 34.9% while Morley et al[89] found a rate of 50% in South Africa. Hypertension was also reported in 39.2% in Zambia [110] and 30% in Zimbabwe[87].

In developed countries, cardiovascular disease, especially ischaemic heart disease is the main cause of morbidity and death.[4,92] Ischaemic heart disease is rare in African diabetic patients as noted in this study and in many reports from other African countries.[92,109,110]

Eye complications were reported in 28% (retinopathies, mainly background retinopathy in 10%, cataracts in 15% and blindness in 3%) of the patients. In another report from Muhimbili Medical Centre, Mafwiri and Pollitt using a slit-lamp found lens opacities at varying stages of maturity in 202 (48.9%) of 413 patients with mean duration of diabetes 4.8 ± 5.3 years. Fourteen (3.6%) of 388 patients in whom fundoscopy was performed had proliferative retinopathy (unpublished observations). Similar rates were reported from Nigeria[95,101,108]. Much higher rates were reported from other African countries. Lester[106] reported a rate of 57.1% for retinopathies and 40% for cataracts in Ethiopia. Morley et al[89] reported a rate of 21.8% and 32.4% in South Africa respectively. In Zambia a rate of 34.8% and 13% respectively was reported[111]. Although diabetes is one of the commonest causes of blindness in the Western world it is still unusual to see a patient in Africa with blindness due to diabetic retinopathy. In African diabetic patients blindness, or severe visual impairment, due to cataract is much more common.

Neuropathy is one of the commonest complication experienced by diabetic patients. Neurological complications were evident in 27% of the patients (neuropathy and paraesthesia in 18% and impotence in 9%). Similar rates were reported from Zambia[112] and Nigeria[101]. Higher rates were reported from other African countries. In Nigeria, rates of 49.2% were

reported by Osuntokun,[86] 58.3% by Greenwood and Taylor.[95] Lester reported rates of 46.7% and 9.4% in Ethiopia.[105,107] A rate of 50% was reported from South Africa.[113]

Nephropathy (persistent proteinuria or end stage renal failure) was found in 7% of the patients. Higher rates have been reported from other African countries. Proteinuria was found in 30% of Ethiopian diabetic patients with diabetes for more than 15 years and in 39% of Zambian diabetic patients with duration of diabetes of 14 years or more.[92,106,114]

Infections (affected 65% of the patients) were the leading complications in the IRDM and pulmonary tuberculosis alone affected 25% of IRDM patients. Hypertension was diagnosed in only 12% of the IRDM patients with diabetes for about 8 years while 34% of the NIDDM (with diabetes for about 8 years) had hypertension, and it was the leading complication in them.

Of the newly diagnosed patients in this study, 38% had one or more complications). Hypertension was diagnosed in 19% of the NIDDM and 3% of the IRDM. Another report from Dar es Salaam indicated that hypertension was found in 26.7% of the newly diagnosed patients with non-insulin dependent diabetes.[2] Other complications found in the newly presenting patients in this study were: infections 14% (pulmonary tuberculosis 5%, diabetic foot and hand 5% and recurrent abscesses 4%) and retinopathies in 9% of IRDM patients and 1% of NIDDM patients. The occurrence of complications at onset could partly be explained by the long average duration from onset of symptoms to diagnosis which was 10 weeks for patients with IRDM, 12 weeks for patients with NIDDM, and 5 weeks in the uncertain type of diabetes. It has also been argued by Jarrett[56] that NIDDM and hyperglycemia might not be causally linked to a cardiovascular risk, but both conditions might be the consequence of a pre-existing, not yet identified, common genetic and/or metabolic basis.

Degree of control achieved

About 77% of the patients with diabetes for 8 years did not achieve good control during follow up period. This must have contributed to the poor prognosis and occurrence of various complications in diabetic patients as it was noted above.

Utilisation of health care services

In this study it was found that the average number of outpatient visits to the diabetic clinic in 1989/90 was 3.2 per year in the newly diagnosed patients and 2.6 in those with diabetes for 8 years. These visits only indicate the rate of utilisation of health care services for conditions related to diabetes alone. Utilisation of health care facilities among diabetic patients for other health problems were not considered in this study. Also the number of outpatient visits to the diabetic clinic found in this study is the minimum number as it only considered the documented hospital visits. Patients frequently came to the clinic for prescriptions. These visits were not included in the above figures. As it was mentioned in the introductory part, the

average number of outpatient visits for all health problems in the general population was found to be 2.5 per year in 1988.[5,8] These findings therefore suggests that there is increased utilisation of health care services among diabetic patients in Tanzania when compared to the general population.

In 1989/90 the admission rate among the diabetic patients was 31% in the newly diagnosed patients and 77% in patients with diabetes for 8 years. The overall admission rate was 54%. The estimated admission rate in the general population in 1989 was calculated to be 9%.[5,8] Therefore, it can be concluded that the admission rate was 6 times higher in diabetic patients than in the general population.

It was also noted that the admission rate was higher in IRDM patients than in NIDDM patients. Twenty seven (84%) of IRDM patients among the newly diagnosed patients had been admitted at least once while the corresponding figure for NIDDM patients was only 48 (21%). For those with diabetes for 8 years, 56 (93%) of IRDM patients had been admitted at least once while the corresponding figure was 60 (59%) of NIDDM patients.

The readmission rate was higher in IRDM patients than in NIDDM patients. About 56% of IRDM patients with diabetes for 8 years were readmitted twice or more while the corresponding figure for NIDDM patients was 18%. Also 15% of the newly diagnosed IRDM patients had been readmitted twice or more often compared with only 5% of the NIDDM patients.

The average duration of admission of newly diagnosed diabetic patients in 1989/90 was 14.7 days per year. The average duration of admission for newly diagnosed IRDM was 21 days per year and 10.7 days per year for NIDDM patients. The corresponding figure in the general population was estimated to be 7.6 days in 1989.[5,8] Hence, the duration of admission of a diabetic patient in Tanzania is almost twice as long as that of the other patients.

A similar pattern of high health care use has been observed in the United States, where a major study using 1977 data from the National Medical Expenditure Survey found that the average health care utilisation costs among people with diabetes (for all causes - not just diabetes) were about three times higher than for the non-diabetic population.[4] In Scandinavia[4], NIDDM patients were found to use 2 - 3 times more hospital bed days than a control group in 1987. Both the British and United States studies found extra resource usage among people with diabetes to be particularly high among younger age groups, where people with IDDM are concentrated, and to taper off among older age groups with their heavy preponderance of NIDDM.[4]

DIABETES COST ESTIMATES

Limitations of the study

Before one discusses diabetes cost estimates found in this study, problems and limitations

encountered during the process should be pointed out. A study on economic burden of any disease in Tanzania, as in other developing countries, is likely to come up with a gross estimate whose results are an underestimate. Tanzania like any other developing country has a problem of having proper costing data when compared to developed countries. Most of the costing data in Tanzania depends on information which is available in patients' files but the filing system is poor and the rate of losing documents is high. Patients files are incomplete most of the time.

To get cost estimates of diabetes care we had to rely mainly on the incomplete patients' files, the patients' memory and our experience of the management of diabetic patients in various situations.

Another problem was lack of current price lists for various drugs and other equipments at the Central Medical Stores. Prices thus used in this study were lower than the current market value. It was also difficult to get the exact prices on the market from the private pharmacies and hospitals in the city. Low prices were quoted by owners of private hospitals and pharmacies. Lack of price control also causes great fluctuations of market prices . Availability of drugs and other equipments from the government facilities was very irregular and shortages were frequent. An ideal situation of regular supply of drugs and other equipments was assumed so as to get minimum cost estimates required for reasonable care of a diabetic patient.

For calculation of inpatient costs of diabetes water and electricity charges were not included, as it was not possible to estimate these charges per patient. Costs borne by the family when a diabetic patient was admitted were also omitted.

DIRECT COSTS OF DIABETES CARE IN TANZANIA

Total direct costs of diabetes care in Tanzania

This study has confirmed that costs of diabetes care in Tanzania make this disease a major economic as well as medical problem. To have cared for all diabetic patients in Tanzania in the year 1989/90 about Tshs. 795,292,530 (US $ 3,976,463) would have been required. Excluding costs for transport (born by the patients themselves) and self home glucose monitoring (not presently done) from the total direct costs of diabetes care, then the actual government expenditure on diabetes care in 1989/90 was Tshs. 769,713,714 (US $ 3,848,569). This implies that 0.2% (diabetic patients who were on treatment) of the Tanzanian population 15 years and above used about 8.1% of the total budgeted government health expenditure, which was Tshs. 9,481,676,460 (US $ 47,408,382.3) for the year 1989/90.

Tanzania experienced a combination of external shocks, inappropriate domestic policies and long-run under-performance since the early 1970's which has produced chronic economic

disequilibrium. Evidence of strain in public expenditures in Tanzania is widespread. Particularly notable are the following:-

a) **Underfinancing of Government Operations.** Most programmes of the Government are seriously underfunded, typically receiving about one third of the supply vote needed to perform functions at the level they were designed.

b) **Declining real salaries.** The purchasing power of public sector salaries is now far below the level of the early 1970's. The real value of the minimum wage is now about one third that prevailing in 1970's and that of middle and senior civil servants even less.

c) **Social services under pressure.** Basic social services, such as health, education and water supplies, which were extended to the bulk of the population in the 1970's are now under tremendous pressure. Most water supply schemes have broken down or operate with frequent interruptions. Schools at all levels are deficient in essential supplies and equipment and the quality of education has fallen sharply. Without the provision of key recurrent support by donors, basic health services in Tanzania would probably collapse.

d) **Neglected maintenance.** Allocations for maintenance have failed to keep pace with inflation and virtually all programmes have broken down, illustrated by deteriorated roads, blocked drainage systems broken water supplies, unserviceable equipment and collapsing buildings.

e) **Stagnant development programmes.** All projects now experience severe implementation delays, and few projects in the Public Investment Programme (PIP) reach completion and make the transition to effective operation.

f) **Burden of the parastatal sector.** Instead of generating resources, the parastatal sector has drained them.

g) **Financial and management weakness of Local Government.** Local Government which is responsible for the delivery of basic service in the social sectors, is in dire financial constraints, with programmes funded at even lower levels than Central Government.

h) **Rising government indebtedness.** The indebtedness of the Government, both external and domestic, has been rising sharply, and debt servicing is now a major component of the Government's budget, reducing the resources available for programme expenditures.

i) **Increased dependence on external financing.** External funding of the development budget has been rising steadily since the early 1970's as recurrent budget surpluses have turned into deficits. Donors now contribute to recurrent budget programmes, through direct supply of consumable materials such as essential drugs and school textbooks.

j) **Weak domestic revenues.** Poor economic performance has effected the tax base, particularly sales tax on local manufactures, where capacity utilisation has fallen to around 25%.

Having reviewed the tremendous constraints on public expenditures, one can imagine their implications on diabetic patients with their high health care demands. It is almost impossible for the government to meet even the minimum requirements for diabetes care.

Similarly high rates of diabetes expenditure have been observed in developed countries. In 1986/87 it was estimated that in the United Kingdom people with diabetes accounted for something over 1% of the total population but consumed between 4 - 5% of health care resources.[4]

In 1986/87 the total direct health care costs that could be identified amounted to £ 484 million in England and Wales. The full cost of diabetes to the National Health Service in the United Kingdom in 1989 was estimated to be around £ 1 billion.[4]

In the United States, a recent study by Fox and Jacobs[47] revealed that the 2.7% of the United States population with diagnosed diabetes consumed about 5% of US $ 500 billion spent on health care overall in 1987.

Studies on the economic burden of diabetes care in developing countries are rare. The only study from the developing countries which gives light on the total economic burden of diabetes care is the Guam study in the territory of Guana in 1976.[3] In that study the total economic burden (direct and indirect) of diabetes was estimated to be US $ 3 million of which the direct costs were about 20% and the indirect costs were about 80%. Our estimates of the total direct costs in Tanzania appears to be very much higher compared to those in the Guam study. The following reasons could account for the difference: the 14 years time interval between the two studies with increasing inflation rates, the increasing prevalence of diabetes in the developing countries with the increasing life expectancy and modernisation of life style. Increased rate of diagnosis either because of increasing incidence, or increased accuracy of diagnosis or increased awareness among the people and different modes of treatment could also account for the difference.

Total direct outpatient and inpatient costs of diabetes care in Tanzania

In this study the total direct outpatient costs of diabetes care was estimated to be Tshs 544,230,120 (US $ 2,721,151) which was 68% of total direct costs of diabetes care in Tanzania. Inpatient costs accounted for 32% of total direct costs.

In the USA in 1987, direct outpatient costs were US $ 1727.8 million which was only 18% of total direct costs. The direct inpatient costs in USA in the same study amounted to US $ 7871.4 million, 82% of the total direct costs of diabetes care.[47] The differences in the percentages of the inpatient and outpatient costs between the two countries may be explained by the sophisticated inpatient care found in USA, absence of nursing home care in Tanzania and the underpayment of medical staffs in Tanzania compared to those in USA.

Similarly, the aggregate cost of diabetes in England and Wales in 1986/87 was estimated at £

484 million. The largest single element of cost again as in USA, was inpatient care, which was estimated at £ 298 million, which was again considered to be an underestimate by 20% or more because of under-reporting of diabetes in routine hospital information systems.[4]

Of the total direct outpatient costs estimated for Tanzania, insulin and oral hypoglycemic drugs accounted for 56.5%, treatment of complications and associated illnesses 30.8% and syringes, spirit, cotton wool, urine glucose strips for self testing 9.4%. In USA cost estimates for outpatient care were distributed as follows: 30% for insulin, syringes and cotton swabs, 22% for physician visits, 20% for self administered glucose and urine tests, 17% oral hypoglycemic drugs, and 12% for outpatient investigations. It is interesting to note that the outpatient physician and nursing cost in Tanzania was only 0.2% and outpatient investigations costs was only 1.9% of the total outpatient direct costs. This reflects the underpayment of medical staff and the very few outpatient investigations done at diabetic clinics in Tanzania.

For the inpatient costs, investigations alone accounted for 40.4% of all the inpatient costs in Tanzania, and it was a leading inpatient cost. Urine testing done four times per day on the inpatients contributed the biggest share on the inpatient investigations charges. Meals and lodging were the next leading inpatient costs (22%), followed by insulin (5.9%). Antibiotics accounted for 3.7% and intravenous fluids (4.5%). The distribution of inpatient costs in Tanzania cannot be compared to those in the developed countries as they were differently analysed.

Direct outpatient and inpatient costs of one diabetic patient in Tanzania

This study also looked into costs of caring for an IRDM patient as compared to an NIDDM patient in 1989/90. The average direct outpatient costs of an IRDM patient in Tanzania was estimated as Tshs 45,784 (US $ 229) while a similar cost for NIDDM patient was Tshs. 13,807 (US $ 69). This implies that outpatient care of an IRDM patient in Tanzania is more than thrice as costly as that of an NIDDM patient.

The figures indicate that purchase of insulin alone accounted for more than 68.2% of total outpatient costs in the IRDM patient, while treatment of chronic complications and infections accounted for 48.8% in the NIDDM patient and that of oral hypoglycaemics 42.5%

Preliminary cost estimates for diabetes case management in a developing country, based on international prices of essential drugs and Malawi hospital cost data, suggested that the cost of treating IDDM or IRDM patients will be dominated by their need for insulin at an estimated cost of over US $ 100 per diabetic patient per year.[3]

Similar insulin cost dominance was observed in this study which amounted to US $ 156 per year. In Malawi estimates of a one year cost of oral hypoglycemic drugs per patient was approximately US $ 25 which is comparable to the Tanzania estimate of US $ 33 especially if

the time interval between the two estimates is taken into account.

Looking at the inpatient direct costs for the patients diagnosed in 1981/82, the average expenditure on an IRDM patient was Tshs. 11,581 (US $ 58) while the average expenditure on an NIDDM patient was Tshs. 6746 (US $ 34). Again the ratio of the average inpatient expenditure of IRDM patient to that of NIDDM patient was 1.7.

In the present study it was found that the total direct cost in 1989/90 for an IRDM patient was Tshs. 72,718 (US $ 364) while that of an NIDDM patient was Tshs. 22,808 (US $ 114). The outpatient costs accounted for 72% of the total costs in an IRDM patient while it was 53% in NIDDM patient.

A study done in France in 1984[76] found that medical consumption for the NIDDM patient was 5,892 francs which was slightly below the national average of 6,462 francs whereas the consumption for an IDDM patient was 19% (7,711 francs) above the national average. It was pointed out that the difference was principally due to pharmaceutical overconsumption among the IDDM relative to the NIDDM patient. It is interesting to note that medical consumption of a diabetic patient in France was comparable to the non-diabetic people. This could be explained by the presence of similar chronic illnesses in the general population in France which create a similar economic burden in overall health care expenditure.

In France, hospitalisations represented 2,617 francs (SD= 8,551), 33.9% of the medical consumption by IDDM patient while it was 2,363 francs (SD=8478), 40.1% of the medical consumption by NIDDM patient.[76] The percentages of outpatient and inpatients costs found in France for IDDM and NIDDM are almost similar to those estimated in Tanzania, with outpatient costs dominating over the inpatient costs.

It is interesting to note that the average one year expenditure of the IRDM and NIDDM patients are very much above the allocated per capita health expenditure in Tanzania for the year 1989/90 which was Tshs. 421 (US $2). The high discrepancy poses many questions. How did a diabetic patient or the government manage to supplement the extra needs? Assistance from different international organisations like DANIDA and UNICEF could fill the gap. The discrepancy could also account for the continued deterioration in health care offered to diabetic patients as well as the general population in Tanzania as was noted in the introductory part.

It has been noted that patients attending the Muhimbili Medical Centre diabetic clinic were often out of drugs for several days or weeks even months before the next visit. Patients were supplied with drugs only enough for one month while the time interval before the next appointment was 3 - 4 months. This is evidenced by the high rate of poor control of diabetes and the poor prognosis of diabetic patients. The chronic hyperglycaemia could account for the high expenditure on treatment of the various chronic complications and infections.

Availability of drugs and other equipments for self care is very erratic. For example, at the moment only urine glucose testing is done at the clinic. There are no facilities to test urine for ketone bodies or blood glucose estimation. Blood glucose is estimated only in very few patients with either features of acute metabolic complications or when urine results are doubtful. At the moment almost all the patients do not do self monitoring of urine and blood glucose. Some IRDM patients reported to use one syringe for more than three months, and, in some, insulin was injected without prior swabbing of the area to be injected as spirit and swabs were not available and the poor patients could not afford buying them from private pharmacies in the city. The situation is even more gloomy at the level of the villages, health centres, districts and regions.

INDIRECT COSTS

In the USA study of diabetes cost estimates in 1987, it was estimated that total indirect costs were US $ 10,773.9 millions which was 52.9% of the total economic burden of diabetes in USA.[47] Short term morbidity was estimated at US $ 141.9 millions (0.7%), long term disability was US $ 3,143.2 million (15.4%) and mortality costs were estimated at US $ 7,488.8 million (36.8%).

In the USA study, indirect costs were determined by applying the human capital approach i.e. by valuing human life according to the income stream produced by the employed individual during his or her lifetime.[47] The costs associated with short term morbidity were based on the average daily earnings obtained during labour force participation. Long-term morbidity and premature mortality costs were based on the life expectancy, earnings associated with labour force participation and imputed value of housekeeping services.

The human-capital approach was found to have some methodological problems in developing countries where the following problems exist:

1. a) High degree of unemployment and self employment in the developing countries.
   b) Incomes are not well measured: it is not simple to get somebody's income e.g. housewives, petty traders, etc.
2. Labour markets are not perfect, for the following reasons:
   a) Information on employment is not available for each person who looks for a job.
   b) Labour is not paid according to economic theory of wage equals marginal cost of labour.
   c) There is a lot of overemployment. Too many people are employed at one job and thus the labour input does not reflect the cost. The price which in economics is used as an indicator of efficiency (at least by theory) does not play its role in Tanzania and other less developed countries.

Hence monetary earnings were not used in this study to calculate the output lost due to illness

or premature death.

Comparison of the economic burden of diabetes care in Tanzania and the developed countries is also difficult for the following reasons:

a) The Tanzanian shilling is overvalued compared to the US dollar.

b) Cost figures are easy to determine in developed countries but not so in Tanzania.

c) Costing data is less available in Tanzania and other less developed countries.

Thus the costs obtained for developing countries are the minimum costs of a diabetic patient in these countries.

In the present study, the indirect costs were calculated in terms of future healthy life days (HLDs) or healthy life years (HLYs) lost by a diabetic patient due to premature death, disability before death, chronic disability and acute illnesses. The average age at onset of diabetes was found to be 44 years and the average age at death was 46 years. Life expectancy in Tanzania is approximately 53 years. The average case fatality rate after 5 years in Tanzania was found to be 29%.[2]

In the present study the rate of severe chronic disablement was found to be 14%. It was thus calculated that healthy life days lost because of diabetes per patient was 4100 days of which 69% was because of premature mortality. It should be appreciated that data on life expectancy by age groups for Tanzania which could be used for proper calculation of health life days lost per patient because of premature mortality was not available. The age specific life expectancy figures used in this study were calculated for Ghana in 1976, which then had a life expectancy at birth of 47 years. The life expectancy for Tanzania is presently 53 years. It is most likely, therefore, that the healthy life days lost were grossly underestimated. It was also estimated that for all diabetic patients in Tanzania a total of 359,016 person years were lost, again 69% of this was because of premature mortality.

HLDs lost per capita was not calculated in this study as the incidence of diabetes is not known for Tanzania. But when the number of the newly diagnosed patients in Dar es Salaam in 1989/90 was used to calculate the incidence, it was found that, the incidence was 2 patients per 10,000 people in Dar es Salaam. It was thus found that healthy life days lost per capita because of diabetes was 820 person days per 1000 people per year.

Similar calculations were done in Ghana where average age at onset was estimated as 40 years with 50% case fatality rate after 15 years and the average age at death of 55 years with 30% disablement before death. The total days of life lost were calculated as 217 per 1000 persons per year, of which 52% was due to premature death.[3]

Calculations of healthy life days lost because of diabetes from the two developing countries (Tanzania and Ghana) elaborates the importance of diabetes as a cause of premature mortality in developing countries. In many developing countries patients with IDDM may not survive onset because of poor or nonavailable care. The indirect costs of chronic disabilities

attributable to diabetes, therefore will be dominated by those associated with NIDDM.
In England and Wales in 1986[4] it was estimated that the number of future life years lost because of deaths due to either diabetes or its complications and associated illness was 261,000 person years. This was 3.5% of all years lost in England and Wales in 1986 from deaths from all causes. These figures cannot be compared with our figures as the total number of diabetic patients in the two countries is different. Also calculations done in England did not consider the percentage of healthy life days lost due to premature death when compared to healthy life days lost due to chronic disabilities and associated acute illnesses.

How might these costs be reduced?

To diagnose diabetes cost TShs 2,213, much of it for investigations. The patient had to make an average of 3.8 visits to health units before the diagnosis was established. At diagnosis already 13% of the patients had one of the chronic complications of diabetes, indicating diabetes of long duration. All these observations together call for education of both health care personnel and the public on the symptoms of diabetes, the expenses of which the Government should be able to afford.
Of the outpatient direct costs, apart from the cost of insulin and oral hypoglycaemic drugs, the cost of treating complications was the highest expenditure. Complications could be avoided or delayed by good diabetes care and this requires health personnel for teaching and self monitoring facilities for patients. This study has shown that the cost of personnel and urine glucose strips for home diabetes monitoring are relatively inexpensive, together accounting for less than 4% of the total expenditure. Educating diabetic patients has been shown to result in better control.[115]
Of the inpatient costs, the cost of investigations was highest. Much of these were accounted for by the routine 4 times a day urine test for glucose. These could be reduced without affecting patient care. Equally important is consideration of why patients are admitted in the first place. It has been shown that many admissions of diabetic patients are preventable.[116] Only 10% of the admission in the present study were due to conditions unrelated to diabetes. Good diabetes care should lead to reduced admission rates because of both acute and chronic metabolic complications.

CONCLUSION

The study has clearly demonstrated that the economic costs of diabetes care in Tanzania and any other developing country are quite extensive. People with diabetes are consistently heavy lifetime users of health care resources. Developing countries can hardly afford even the costs for minimum necessary care of the diabetic patients. There is a need for more extensive evaluations of the costs of diabetes throughout the country. Due to increasing economic difficulties which the country has been facing, the ability of the government to maintain its financial commitment to sustain the rapidly expanded health care system has declined. It is therefore important to learn more about alternative mechanisms for financing the health system, and adequate care of diabetic patients.

RECOMMENDATIONS

1. The physicians and all the doctors attending diabetic patients should be aware of the costs of all the tests which are done to their patients. They should be encouraged to avoid unnecessary tests such as routine blood glucose tests at the diabetic clinic, routine inpatient urine glucose tests, particularly the four times urine glucose tests per day to all diabetic patients.
2. The government should look into ways of increasing the nurses and doctors salaries. This may contribute to better management of the patients and thus improving their prognosis and outcome.
3. The government should encourage the establishment of various associations for people with chronic illnesses like the "Diabetes Association of Tanzania" whereby people can discuss and try to solve problems related to their illness.

   They should be encouraged to start projects which are affordable now and in the future i.e. which are viable, sustainable, acceptable by users to pay for them and run them.
4. More efforts are needed to initiate and maintain costing data for various diseases in Tanzania so that it is available when it is needed and so that the limited resources may be applied more cost effectively.

REFERENCES

1. McLarty DG, Swai ABM, Kitange HM, et al. Prevalence of diabetes and impaired glucose tolerance in rural Tanzania. Lancet 1989;1:871-5.
2. Swai ABM, Lutale J, McLarty DG. Diabetes in tropical Africa: A prospective study, 1981-7. Characteristics of newly presenting patients in Dar es Salaam, Tanzania, 1981-7. Br Med J 1990;300:1103-1110.
3. Vaughan P, Gilson L, Mills A. Diabetes in developing countries: its importance for public health. Health Policy and Planning 1989;4:97-109.
4. Laing W, Williams R. Diabetes: A model for health care management. London, Office of Health Economics 1989;92:32-49.
5. Planning Commission. Hali ya Uchumi wa Taifa katika mwaka 1989. Planning Commission, President's Office, Dar es Salaam, 1990.
6. The World Bank. The United Republic of Tanzania: Population, health and nutrition sector review, 1989.
7. Population Census 1988: Preliminary Results. Bureau of statistics, Planning Commission, President's Office, Dar es Salaam, 1989.
8. The World Bank. Staff appraisal report, the United Republic of Tanzania: Health and nutrition project 1990; Report no. 8217 - TA.
9. Ministry of Finance Vote Books 1980 - 1991 Dar es Salaam.
10. World Bank/Government of Tanzania. Tanzania Public Expenditure Review: Volume II: Technical Report, 1989.
11. Trowell HC, Burkitt DP, eds. Western diseases: their emergence and prevention. London: Edward Arnold, 1981;22-6.
12. Vink J de M, Angawa JOW. Prevalence of diabetes. East Afr Med J 1956;33:366.
13. Teuscher T, Rosman JB, Baillod P, et al. Absence of diabetes in rural west African population with a high carbohydrate/cassava diet. Lancet 1987;1:765-8.
14. Brown KGE. Analysis of admissions to the adult medical wards at Queen Elizabeth Central Hospital, Blantyre, Malawi. East Afr Med J 1975;52:509-28.
15. Barr RD. A two-year prospective analysis of emergency admissions to an adult medical unit at the Kenyatta National Hospital, Nairobi. East Afr Med J 1972;49:772-82.
16. Patel KM, Lwanga SK. A study of medical admissions to Mulago hospital, Kampala. East Afr Med J 1971;48:76-84.
17. WHO. International Statistical Classification of Diseases, Injuries and Causes of Death. 9th Revision. Geneva: World Health Organisation, 1975.
18. WHO. Diabetes mellitus: Report of a WHO Study Group. Technical Report Series No. 727. Geneva: World Health Organisation, 1985.

19. Abu-Bakare A, Taylor R, Gill GV, et al. Tropical or malnutrition-related diabetes: a real syndrome? Lancet 1986;1:1135-38.

20. Grabauskas VJ. Glucose intolerance as a contributor to non-communicable disease morbidity and mortality. Diabetes Care 1988;11:253-57.

21. Fuller JH, Elford J, Goldblatt P, et al. Diabetes mortality: new light on an underestimated public health problem. Diabetologia 1983;24:336-41.

22. Krolewski AS, Warrem JH, Lawrence IR, et al. Epidemiologic approach to the aetiology of type 1 diabetes mellitus and its complications. New Engl J Med 1987;317:1390-1398.

23. Bennett PH. Changing concepts of the epidemiology of insulin dependent diabetes. Diabetes care 1985;8:29-33.

24. Tarn AC, Thomas JM, Dean BM, et al. Predicting insulin-dependent diabetes. Lancet 1988;1:845-50.

25. Gamble DR. The epidemiology of insulin dependent diabetes, with particular reference to the relationship of virus infection to its aetiology. Epidemiologic reviews 1980;2:49-70.

26. Barratt-Connor E. Is insulin dependent diabetes mellitus caused by coxsackie virus B infection? A review of the epidemiological evidence. Reviews of Infectious Diseases 1985;7:207-15.

27. Diabetes Epidemiological Research International. Preventing insulin dependent diabetes mellitus: the environmental challenge. Br Med J 1987;295:479-81.

28. Reunanen A et al. Prevalence and ten year (1970 - 79) incidence of insulin dependent diabetes mellitus in children and adolescents in Finland. Acta Paed Scand 1982;71:893-99.

29. Patterson CC, Thorogood M, Smith PG, et al. Epidemiology of Type 1 (insulin dependent) diabetes in Scotland 1968-1976: evidence of an increasing incidence. Diabetologia 1983;24:238-243.

30. Rewers M, Laporte RE, Walczak M, et al. An apparent 'epidemic' of youth onset insulin dependent diabetes mellitus in midwestern Poland. Diabetes 1987;36:106-113.

31. Zimmet P. Type 2 (Non-insulin-dependent) diabetes - an epidemiological overview. Diabetologia 1982;22:399-411.

32. Godhes DM. Diabetes in American Indians: a growing problem. Diabetes Care 1986;9:609-13.

33. King H, Zimmet P, Pargeter K, Raper LR, Collins V. Ethnic differences in susceptibility to non-insulin-dependent diabetes: a comparative study of two urbanised Micronesian populations. Diabetes 1984;33:1002-1007.

34. Cheah JS, Tan BY. Diabetes amongst different races in a similar environment. In: Waldhouse IW Eds. Diabetes. Amsterdam Exerpta Medica 1979;512-16.

35. Marine N, Edelstein O, Jackson WPW, Yinik AI. Diabetes hyperglycaemic and glycosuria among Indians. Malays and Africans (Bantu) in Cape Town, South Africa. Diabetes 1969;18:433-445.

36. Poon-King T, Henry MV, Rampersad F. Prevalence and natural history of diabetes in Trinidad. Lancet 1968;1:155-160.

37. Mather HM, Keen H. The Southall diabetes survey: prevalence of known diabetes in Asians and Europeans. Br Med J 1985;291:1081-1084.

38. Mather HM, Verna NPS, Mehta SP, Madhu S, Keen H. The prevalence of known diabetes in New Delhi and London. Journal of the Medical Association of Thailand 1987;70(suppl):54-58.

39. Seneday M, Masti ML. Diabetes in Latin America. Journal of the Medical Association of Thailand 1987;70(suppl):77-8.

40. Lutalo SK, Mabonga N. Some clinical and epidemiological aspects of diabetes mellitus on an endemic register in Zimbabwe. East Afr Med J 1985;26:433-445.

41. Ahrèn B, Corrigan CB. Prevalence of diabetes mellitus in North Western-Tanzania. Diabetologia 1985;26:333-336.

42. Williams DRR. Hospital admissions of diabetic patients: Information from Hospital Activity Analysis. Diabetic Medicine 1985;2:27-32.

43. Alexander WD. Diabetes Care in a UK Health Region: activity, facilities and costs. Diabetic Medicine 1988;5:577-81.

44. Williams DRR, Fuller JH, Stevens LK. Validity of routinely collected hospital admissions data on diabetes. Diabetic Medicine 1989;6:320-24.

45. Macleod CA, Murchison LE, Russell EMR. Monitoring diabetic outcomes. Diabetic Medicine 1989;6:59-63.

46. Taylor A. Medical expenditures and insurance coverage for people with diabetes Estimates from the National Medical Care Expenditure Survey. Diabetes Care 1987;10,1:87-94.

47. Fox NA, Jacobs J. Direct and indirect costs of diabetes in the United States in 1987. American Diabetes Association, Alexandria, VA, 1988.

48. Harris MI. Ambulatory Medical Care for Diabetes, in Diabetes in America. US Department of Health and Human Services 1985.

49. Damsgaard E, Froland A, Green A. Use of hospital services by elderly diabetics: the Frederica Study of Diabetic and Fasting Hyperglycaemic Patients Aged 60-74 years. Diabetic Medicine 1987;4:317-22.

50. Damsgaard E, Froland A, Holm N. Ambulatory medical care for elderly diabetics: The Frederica Study of Diabetic and Fasting Hyperglycaemic Subjects Aged 60-74 years. Diabetic Medicine 1987;4:534-38.

51. Ward JD. Preventing the long term complications of diabetes. Proceedings of the Royal College of Physicians of Edinburgh 1988;18:146-153.

52. Dorman JS, Laporte RE, Kuller LH, et al. The Pittsburgh Insulin-dependent Diabetes Mellitus (IDDM) Morbidity and Mortality Study. Mortality Results. Diabetes 1984;33:271-76.

53. Brunner F et al. Renal Replacement Therapy in Patients with Diabetic Nephropathy, 1980-85. Nephrology Dialysis and Transplantation 1988;2:585-595.

54. Bale GS, Entmacher PS. Expected life of diabetics. Diabetes 1977;26:434-438.

55. Panzram G. Mortality and survival in Type 2 (non-insulin dependent) diabetes mellitus. Diabetologia 1987;30:123-131.

56. Jarrett RJ. Risk factors of macrovascular disease in diabetes mellitus. Horm Metab Res 1985;15(suppl):1-3.

57. Simanis JG. Health care expenditures: International comparisons, 1970-80. Social Security Bulletin 1987;50:19-24.

58. Sinamis JG, Coleman JR. Health care expenditures in nine industrialised countries, 1960-76. Social Security Bulletin 1980;43:3-8.

59. Rice DP. Estimating the cost of illness. Health Economic Series No.6. Washington, DC, U.S. Govt. Printing Office 1966, PHS Publ. No. 947-6.

60. Cooper BS, Rice DP. The economic cost of illness revisited. Soc Sec Bull 1976;39:21-36.

61. Rice DP, Hodgson TA, Kopstein AN. The economic costs of illness: a replication and update. Hlth. Care Fin. Rev. Fall. 1985;7:61-80.

62. Schelling TC. The life you save may be your own. In Problems in Public Expenditure Analysis. Chase SB (ed). Washington, DC. The Brookings Institute, 1968.

63. Mishan EJ. Evaluation of life and limbs: a theoretical approach. J Political Econ 1971;79:687-705.

64. Thomas J, Songer MPH. The Economics of diabetes care Pittsburgh, PA 15261 USA.

65. Sinnock P. Hospital utilisation for diabetes. In Diabetes in America, Diabetes Data Compiled 1984. The National Diabetes Data Group. Washington, DC, U.S. Govt. Printing Office, August 1985, NIH Pub. No. 85-1468.

66. Harris MI, Entmacher PS. Mortality from diabetes. In Diabetes in America, Diabetes Data Compiled 1984. The National Diabetes Data Group. Washington, DC, U.S. Govt. Printing Office, August, NIH Pub. No. 85-1468.

67. Palumbo PJ, Elveback LR et al. Diabetes mellitus: incidence, prevalence, survivorship and causes of death. Diabetes 1976;25:566-573.

68. Entmacher PS, Sinnock P, Bostic E, Harris MI. The Economic impact of diabetes. In Diabetes in America, Diabetes Data Compiled 1984. The National Diabetes Data Group. Washington, DC, U.S. Govt. Printing Office, August 1985, NIH Pub. No. 85-1468.

69. Medical care component of the consumer price index, 1940-77. Soc Sec Bull 1978;41:67.

70. Medical care component of the consumer price index for all urban consumers, 1977-84. Soc Sec Bull 1984;47:62.

71. Platt WG, Sudovar SG. The social and economic costs of diabetes: An estimate for 1979. Home Health Care Group, Ames Division, Miles Lab. Inc., Elkhart, IN 1983.

72. Miller LV. Socioeconomic impact of diabetes mellitus. In Diabetes Mellitus and obesity. Brodoff, Bleicher (eds). Baltimore, Williams & Wilkins, 1982.

73. Smeeding TM, Booton LA. Measuring and valuing the economic benefits of diabetes control. Proceedings of the 19th National Meeting Public Health Conference on Records and Statistics, August 23-24, 1983;p 80-85.

74. Policy Analysis, Inc. Evaluation of cost of illness. Ascertainment Methodology, Party II: Applications of Methodology to Ascertain Lifetime Economic Costs of Illness in an Incidence Cohort. Final Report to the National Centre for Health Statistics. DHHS Contract No. 233-79-2048, December 1981.

75. Johnson B. Diabetes - The cost of illness and the cost of control. An estimate for Sweden 1978. Acta Med Scand 1983;671(suppl):19-27.

76. Triomphe A, Flori YA, Costagliola D, Eshchwege E. The cost of diabetes in France. Health Policy 1988;9:39-48.

77. Jones RB, Hedley AJ. Adjusting follow-up intervals in a diabetic clinic: Implications for costs and quality of care. J Roy Coll Phys Lon 1986;20:36-39.

78. Morrow RH, Smith PG, Nimo KP et al. A quantitative method of assessing the health impact of different diseases in less developed countries. Ghana Health Assessment Project Team. Int J Epidemiol 1981;10:1:73-81.

79. SPSS Inc, Norusis MJ. SPSS/PC: SPSS for the IBM PC/XT/AT. SPSS Inc, Chicago, 1986.

80. Gatling W, Mullee M, Hill R. General characteristics of a community-based diabetic population. Practical Diabetes 1988;5:104-7.

81. Haddock DRW. Diabetes mellitus and its complication in Dar es Salaam. East Afr Med J 1963;40:288-94.

82. Ahren B. Diabetes mellitus at a rural hospital in North-Western Tanzania. Trop Geogr Med 1984;36:237-42.

83. Corrigan CB, Ahren B. Ten years experience of diabetes of a diabetes clinic in northern Tanzania. East Afr Med J 1987;64:772-80.

84 Rwiza HT, Swai ABM, McLarty DG. Failure to diagnose diabetic ketoacidosis in Tanzania. Diabetic Med 1986;3:181-83.

85. Belcher DW. Diabetes mellitus in Northern Ethiopia. Ethiop Med J 1970;8:73-84.

86. Osuntokun BO, Akinkugbe FM, Francis TI, et al. Diabetes mellitus in Nigerians: a study of 832 patients. West Afr Med J 1971;20:295-312.

87. Gelfand M, Carr WR. Diabetes mellitus in the African in Rhodesia. Cent Afr J Med 1961;7:41-48.

88. Multi-Centre Study. UK prospective diabetes study IV. Characteristics of newly presenting type 2 diabetic patients: male preponderance and obesity at different ages. Diabetic Med 1988;5:154-9.

89. Morley JE, Lowenthal MN, Asvat MS, et al. Problems experienced in a diabetic clinic for Blacks. S Afr Med J 1977;52:215-218.

90. Skene DJ, Dali P, Bam WJ, et al. Diabetes in a developing community. Epidemiology and management problems. S Afr Med J 1982;61:463-464.

91. McCance AJ, Playfair CJ. Obesity, hypertension and diabetes in a rural Kwazulu Hospital. Trop Doct 1987;17:92-94.

92. McLarty DG, Pollitt C, Swai ABM. Review: Diabetes in Africa. Diabetic Med 1990;7:670-684.

93. Giles GM. Diabetes in the tropics (discussion). Br Med J 1907;ii:1059.

94. Cantlie J. Diabetes in the tropics (discussion). Br Med J 1907;ii:1063.

95. Greenwood BM, Taylor JR. The complications of diabetes in Nigerians. Trop Geogr Med 1968;20:1-12.

96. Savige J, Martin FIR. Mortality and morbidity of diabetes in Papua New Guinea. Diabetologia 1982;23:136-7.

97. Castle WM, Wicks ACB. A follow up of 93 newly diagnosed African diabetics for 6 years. Diabetologia 1980;18:121-3.

98. Steel JM, Mngola EN. Diabetes in Kenya. Trop Doct 1974;4:184-7.

99. Deckert T, Poulsen JE, Larsen M. Prognosis of diabetics with diabetes onset before the age of thirty-one. I. Survival, causes of death and complications. Diabetologia 1978;14:363-70.

100. Lester FT. Diabetes mellitus in Ethiopians: mortality. Ethiop Med J 1984;22:61-66.

101. Kinnear TWG. The pattern of diabetes mellitus in a Nigerian teaching hospital. East Afr Med J 1963;40:288-294.

102. Marks HH, Krall LP. Onset, course, prognosis and mortality in diabetes mellitus. In Marble A, White P, Bradley RE, Krall LP Eds. Joslin's diabetes mellitus. Lea and Febiger, Philadephia, 1971;209-54.

103. Goto Y. Vascular complications in diabetes in Japan. Advances in metabolic disorders 1978;9:167.

104. Turnbridge WMG. Factors contributing to deaths of diabetics under 50 years of age. Lancet 1981;2:569-572.

105. Root HF. Prognosis in diabetes. Med Clin North Am 1965;49:1147-1161.

106. Lester FT. Long standing diabetes mellitus in Ethiopia: a survey of 105 patients. Diabetologia 1983;25:222-225.

107. Lester FT. The clinical pattern of diabetes mellitus in Ethiopians. Diabetes Care 1984;7:6-11.

108. Adetuyibi A. Diabetes in the Nigerian African. 1. Review of long-term complications. Trop Geogr Med 1976;28:155-159.

109. Gill GV, Huddle KR. Patterns and problems of diabetes in Soweto. Cent Afr J Med 1984;30:189-195.

110. Rolfe M. Macrovascular disease in diabetics in Central Africa. Br Med J 1988;296:1522-1525.

111. Rolfe M. Diabetic eye disease in Central Africa. Diabetologia 1988;31:88-92.

112. Rolfe M. The neurology of diabetes mellitus in Central Africa. Diabetic Med 1988;5:399-401.

113. Morley JE, Asvat MS, Klein C, et al. Autonomic neuropathy in Black diabetic patients. S Afr Med J 1977;52:115-116.

114. Rolfe M. Diabetic renal disease in Central Africa. Diabetic Med 1988;5:630-633.

115. Kaplan RM, Davis WK. Evaluating the costs and benefits of outpatient diabetes education and nutrition counselling. Diabetes Care 1986;9:81-86.

116. Scott RS, Brown LJ, Clifford P. Use of health services by diabetic persons. II. Hospital admissions. Diabetes Care 1985;8:43-47.