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THE SOCIETAL IMPACT OF DIABETES MELLITUS AND DIABETES CARE

Type 2 diabetes in Bangladesh year 2001

by

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FOREWORD

The present Working Paper is one in a series of three papers (WP 2005:4; WP 2005:5; WP 2005:6) on the societal impact of diabetes mellitus and diabetes care in Bangladesh. The work was initiated by Novo Nordisk A/S, Corporate Health Partnerships and conducted of a team consisting of the four authors. An external evaluation was made by an invited Critical Board. The team received a number of valuable suggestions from the board, and most of these are included. Still, the content of the final reports is the responsibility of the authors alone. The project was financed by Novo Nordisk A/S.
Two reports on type 1 and type 2 by the authors are available on request from Novo Nordisk A/S.

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Timetable for main phases of the project:

Calendar year 2002:	Initial planning and preparation of project protocols
	Development of epidemiological model data and cost structure
Calendar year 2003:	Using empirical data sets for validation and supplementary analyses
	First reporting of results
Calendar year 2004:	Final analyses and reporting

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EXECUTIVE SUMMARY

As part of a larger project aiming at assessing the societal impact of diabetes and diabetes care, this study presents a health economics assessment of Type 2 diabetes (T2D) in Bangladesh with reference to the calendar year 2001.

From epidemiological modelling four contrasting scenarios have been established: The *Current scenario* is assumed to reflect the real situation for T2D in Bangladesh. The *Worst scenario* represents the hypothetical situation where no treatment for diabetes is available and that there is no access to diabetes care. The scenario "Improved" represents a situation where there is unlimited access to care and treatment at otherwise similar conditions as in the *Current scenario*. And, the *Ideal scenario* that represents the hypothetical situation where T2D is not associated with any excessive risk of complications and mortality and where there is unlimited access to diabetes treatment and care.

Costs of treating T2D in Bangladesh have been estimated from available reports and 'ad hoc' enquiries, together with clinically based estimates. Costs are structured in healthcare resources, non-healthcare resources, patients´ time and informal caregivers´ time. Effects have been quantified in terms of patient-years, quality-adjusted patient-years and production value (income by working) with and without the value of household production included. These gains are not additive, however.

The table below summarizes the results. The total costs of current treatment and care of T2D in Bangladesh are relatively low. This reflects that currently only a limited fraction (about 23%) of the population has access to care and treatment because only a part of this population segment can afford it and only a limited free of charge healthcare exists. Accordingly, the *Current scenario* is closer to the *Worst scenario* than to the *Improved scenario*. The *Improved scenario* is more costly than the *Current scenario* (total costs increase by approximately 300%), but the increase in invested resources will produce high gains in terms of patient years and quality-adjusted person-years at an added cost of 915 DKK per patient year. This should be seen in relation to current cost per person year (compared to the worst case) which is equal to 940 DKK per patient year. The costs will be negated by increases in production value. The hypothetical *Ideal scenario* illustrates that should perfect treatment become available for all patients with T2D, the production value would be increased many-fold covering the associated increase in costs. Cost per patient year will increase marginally relative to the improved scenario, but the absolute cost of ideal treatment would be almost 8 times higher than the cost of current treatment. This additional cost would however be associated with production gains. When moving from the current towards the ideal scenario production gains will in absolute terms increase much more than the increase in costs associated with treatment. It should be underlined that these results are not net benefits because the related consumption from longer life expectancy is not included.

We conclude that the prevailing healthcare conditions for patients with T2D in Bangladesh are poor and that this results in bad health, reduced longevity, increased morbidity and mortality and associated low production value for these patients. Establishing access to care and treatment for all patients yields a net benefit since the extra costs are out-weighted by an increased number of patient-years and associated production value. Considerable further

gains in patient-years and production value would be the case, should it be possible to make treatment for T2D perfect as in the ideal scenario.

Table1 T2D in Bangladesh, year 2001, summary of costs of treatment and effects in contrasting scenarios, mill DKK, 2001 prices

Total costs and effects	Worst	Current	Improved	Ideal
COST Mill DKK				
Healthcare Resources	0	347	2,628	10,531
Non-Healthcare Resources	743	783	937	0
Patients´ time	202	202	343	79
Informal care-givers´ time	3	7	39	0
Total cost	**949**	**1,358**	**3,947**	**10,610**

EFFECTS				
Patients' life years unadjusted	2,584,017	3,019,487	5,849,760	10,092,920
Patients' life years treated	0	679,443	5,849,760	10,092,920
Patients' life years quality adjusted	1,976,773	2,360,110	4,912,431	9,588,274
Production value inclusive the informal sector Mill DKK	**7,010**	**8,839**	**21,731**	**57,520**
Registered as GDP Mill DKK	**3,855**	**4,861**	**11,952**	**31,636**

Numbers might not add up due to rounding.

Table 2 Socio-economic cost and gains in a comparison of scenarios. Mill DKK.

Differences between scenarios	Socio economic gains current vs worst	Socio economic gains improved vs current	Socio economic gains ideal vs current
COST (Mill DKK)			
Healthcare Resources	347	2,281	10,184
Non-Healthcare Resources	40	154	-783
Patients´ time	18	122	-142
Informal care-givers´ time	4	32	-7
Total cost	**409**	**2,589**	**9,252**

EFFECTS			
Patients' life years unadjusted	435,469	2,830,274	7,073,433
Patients' life years treated	679,43	5,170,317	9,413,476
Patients' life years quality adjusted	383,337	2,552,321	7,228,164
Production value inclusive the informal sector (Mill DKK)	**1,829**	**12,892**	**48,681**
Registered as GDP (Mill DKK)	**1,006**	**7,091**	**26,775**

Numbers might not add up due to rounding

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Table 3 Socio economic evaluation. Various scenarios compared. T2D in Bangladesh, 2001

Key Evaluation Figures	**Socio economic gains current vs. worst scenario**	**Socio economic gains improved vs. current scenario**	**Socio economic gains ideal vs. current scenario**
Net benefits human capital approach mill DKK	1419	10304	39430
Marginal cost effectiveness ratio DKK/patient year	940	915	1308
Marginal cost utility ratio DKK/ QALY	1068	1014	1280

(The net benefit from the human capital approach in table 3 include both the production value from the formal sector and the informal sector (the household sector.)

For comparison the figures in table 1 and 2 are shown in purchasing power parity (DKK and US$ PPP) below. The purchasing parity factor between the Bangladesh and Danish currencies/US $ is approximately 5, and we used the following exchange rate for 2001: 100 taka = 1.7 US$ or 8.5 PPP US$ (or 100 taka=15 DKK or 75 PPP DKK).

Table 4 T2D in Bangladesh, year 2001, Summary of costs of treatment and effects in contrasting scenarios Mill DKK, (PPP) 2001 prices

Total costs and effects	**Worst**	**Current**	**Improved**	**Ideal**
COSTS Mill DKK (PPP)				
Healthcare Resources	0	1765	13360	53541
Non-Healthcare Resources	3779	3982	4766	0
Patients´ time	1028	1121	1743	401
Informal care-givers´ time	16	37	199	0
Total cost	**4823**	**6905**	**20067**	**53943**

EFFECTS				
Patients' life years unadjusted	2,584,017	3,019,487	5,849,760	10,092,920
Patients' life years treated	0	679,443	5,849,760	10,092,920
Patients' life years quality adjusted	1,976,773	2,360,110	4,912,431	9,588,274
Production value inclusive the informal sector Mill DKK (PPP)	**35638**	**44936**	**110483**	**292439**
Production value Registered as GDP Mill DKK (PPP)	**19601**	**24715**	**60765**	**160841**

Numbers might not add up due to rounding.

Table 5 Socio-economic costs and gains in a comparison of scenarios, Mill DKK. (PPP) 2001 prices

Differences between scenarios	Socio economic gains current vs worst	Socio economic gains improved vs current	Socio economic gains ideal vs current
COSTS Mill DKK (PPP)			
Healthcare Resources	1765	11595	51776
Non-Healthcare Resources	203	784	-3982
Patients´ time	92	622	-719
Informal care-givers´ time	22	161	-37
Total cost	**2082**	**13162**	**47038**

EFFECTS			
Patients' life years unadjusted	435,469	2,830,274	7,073,433
Patients' life years treated	679,443	5,170,317	9,413,476
Patients' life years quality adjusted	383,337	2,552,321	7,228,164
Production value inclusive the informal sector Mill DKK (PPP)	**9298**	**65546**	**247503**
Production value Registered as GDP Mill DKK (PPP)	**5114**	**36051**	**136127**

Numbers might not add up due to rounding.

Table 6 T2D in Bangladesh, year 2001, Summary of costs of treatment and effects in contrasting scenarios Mill US$, (PPP) 2001 prices

Total costs and effects	Worst	Current	Improved	Ideal
COSTS Mill US$ (PPP)				
Healthcare Resources	0	212	1606	6435
Non-Healthcare Resources	454	479	573	0
Patients´ time	124	135	209	48
Informal care-givers´ time	2	4	24	0
Total cost	**580**	**830**	**2412**	**6483**

EFFECTS				
Patients' life years unadjusted	2,584,017	3,019,487	5,849,760	10,092,920
Patients' life years treated	0	679,443	5,849,760	10,092,920
Patients' life years quality adjusted	1,976,773	2,360,110	4,912,431	9,588,274
Production value inclusive the informal sector Mill US$ (PPP)	**4283**	**5401**	**13279**	**35149**
Production value Registered as GDP Mill US$ (PPP)	**2356**	**2971**	**7304**	**19332**

Numbers might not add up due to rounding.

Table 7 Socio-economic costs and gains in a comparison of scenarios, Mill US$. (PPP) 2001 prices

Differences between scenarios	**Socio economic gains current vs worst**	**Socio economic gains improved vs current**	**Socio economic gains ideal vs current**
COSTS Mill US$ (PPP)			
Healthcare Resources	212	1394	6223
Non-Healthcare Resources	24	94	-479
Patients´ time	11	75	-86
Informal care-givers´ time	3	19	-4
Total cost	**250**	**1582**	**5654**

EFFECTS			
Patients' life years unadjusted	435,469	2,830,274	7,073,433
Patients' life years treated	679,443	5,170,317	9,413,476
Patients' life years quality adjusted	383,337	2,552,321	7,228,164
Production value inclusive the informal sector Mill US$ (PPP)	**1118**	**7878**	**29748**
Production value Registered as GDP Mill US$ (PPP)	**615**	**4333**	**16361**

Numbers might not add up due to rounding

1. INTRODUCTION

Specific treatment for diabetes, including treatment by insulin and peroral agents, has been available in the developed world for almost 80 years. Together with a constant improvement of the knowledge of how to prevent and manage the complications of diabetes this has had a huge impact on the survival of people with diabetes and, in particular, the quality of life of people with diabetes. Despite this, diabetes still represents a serious disease. Whereas insulin treatment is an absolute requirement for preserving life in Type 1 diabetes (T1D), insulin treatment is important for improving metabolic control in patients with Type 2 diabetes (T2D) for whom alternative treatment has failed, or where access to peroral antidiabetic agents may be limited.

In contrast to the long-term availability of insulin in the developed world insulin has not been available for the majority of the population in the developing world not to mention the lack of medical infrastructure and healthcare, awareness, doctors, nurses etc. Thus the survival, quality of life and ability to be productive is heavily impacted by these issues.

It is generally believed that the prevalence of T2D is increasing worldwide (1). Improving prognosis will add to an increasing prevalence of T2D. Since T2D represents by far the quantitatively most important type of diabetes (1) T2D represents a large burden for patients and society.

Novo Nordisk A/S has launched a project aiming at studying various aspects of the societal impact of diabetes and diabetes care. The first report in this series is dealing with the general methodological considerations behind the project. The subsequent reports concern T1D and T2D, respectively in a developed nation, exemplified by Denmark, and T1D in a developing nation, exemplified by Bangladesh.

The present report concerns a health economics appraisal of T2D in a developing nation, using Bangladesh in the calendar year 2001 as framework. Specifically, we aim at establishing a model for a developing nation characterised by limitations in the treatment and care for patients with T2D, with estimation of patient-years (with and without adjustment for quality of life) and costs. We then establish contrasting scenarios, representing both a hypothesised alternative with no access to care and treatment at all, as well as an alternative with unlimited access to care and treatment, and – finally – a purely hypothetical scenario in which appropriately treated T2D confers no excessive mortality and morbidity. Each of these hypothetical scenarios is then contrasted with the scenario for the current (actual) situation, providing the basis for evaluation of effects and benefits.

2. OUTLINE OF METHODOLOGY – SCENARIO BUILDING

The study focuses on T2D in Bangladesh, with reference to the year 2001. In addition to the scenario representing the current situation for T2D in Bangladesh year 2001, three contrasting scenarios have been created to investigate the impact of different levels of availability of treatment and care in T2D and the clinical outcome in T2D as well as the costs related to the health states arising from such assumptions. Each scenario is related to year 2001 and outlines a specific situation, affecting the actual size of the population of people with T2D (the prevalence), which has further implications for the amount of resources consumed during the year concerned.
The scenarios of interest may be characterised as follows:

Current scenario

This scenario is supposed to reflect the current situation concerning T2D in Bangladesh, year 2001. This situation is characterized by restricted care both in terms of the number of people that have access to treatment and the level of insulin, medication and form of treatment offered to those that have access to some form of care. The scenario, representing the key reference scenario, is based on estimates of patient-years actually experienced during the calendar year 2001 in Bangladesh. For the *Current scenario*, it is assumed that the population of T2D patients forms two groups. One group of patients (22.5%) with access to diabetes treatment and care; this group consists of an estimated fraction of 10% of the population who can afford to buy insulin or tablets, attend routine control visits to general practitioners and specialists and perform home glucose monitoring as needed. Another group is the 12.5% of the population that live close to some clinics where free care is offered to people without funds. The care, medication or insulin dose offered to this group is on average not an optimal level. All remaining patients are assumed to have no access to treatment and care with accompanying higher complication and mortality rates.

Worst scenario

This scenario is supposed to reflect the situation for T2D in Bangladesh, year 2001, if treatment and care in T2D had never been available. The scenario is based on estimates of patient-years experienced during the calendar year 2001 under this assumption.

Improved scenario

This scenario has been established to investigate the consequences of possible and realistic improvements in diabetes care (with implications for the number of patient-years and corresponding distributions by age group and complication status). This scenario is based on the same demographical model as the *Current scenario*, but with the assumption of unlimited access to treatment and care for all patients with T2D, **on the same level as in the current scenario.** Thus the scenario does not encounter optimal or sufficient care but unlimited access to a low level of care. It should be stressed that in the *Improved scenario* all rates of morbidity and mortality are kept identical with those rates applied to the patient-

segment with access to care under the *Current scenario*. The *Improved scenario* is based on estimates of patient-years experienced during the calendar year 2001 under this assumption.

A variant of the improved scenario is presented to illustrate what the cost level would be in Bangladesh if the country were able to put the same level of resources (in PPP terms) in health care per patient year as currently available in a country like Denmark. This scenario assumes that more resources are available for diabetes treatment than currently available in Bangladesh but the issues concerning organization, ability to comply and life style are not optimal. Thus it is not assumed that the complications are absent or treatment outcome is better than in the improved scenario. The results are presented in section 5. Results.

Ideal scenario

This scenario is supposed to reflect a situation where T2D – when appropriately treated – neither causes excessive mortality nor excessive morbidity. By implication this assumes that there is unlimited access to treatment and care for all patients.

Compared to the improved scenario the treatment outcome in the ideal scenario is assumed to be optimal. All patients have a full dose of insulin (15 K pr year), access to blood glucose monitoring and routing diabetes control. Further it implies that people with diabetes have a life style that ensures optimal compliance. This may be difficult to imagine because the economic situation in Bangladesh is associated with a variety of health problems. The assumption here is that it is possible for people with diabetes through perfect self management to live with the disease without any additional complications caused specifically by diabetes. Thus people with diabetes in Bangladesh have the same probability of suffering from a number of other health problems existing in Bangladesh but diabetes does not propose a specific cause of complications or death.

As described in the first methodology report, such improvements in diabetes care concerns a range of items including the enhancement of communication between people with the condition and their health care professionals; the improvement of communication and coordination among all healthcare professional groups; the promotion of effective self-management; the removal of patient and healthcare professional barriers to effective therapy; and, enabling improved psychosocial support for people with the condition (2). The case, though, is not straight forward in a developing country. This is because there are so many other issues than diabetes conditions that do impact the basic conditions of life. Therefore any measure focusing on a single disease will have a limited impact. This is also true for measures that rest on the existence of healthcare institutions, basic literacy and schooling as well as that affordability and individual surplus in every day life "to do the right thing" is available.

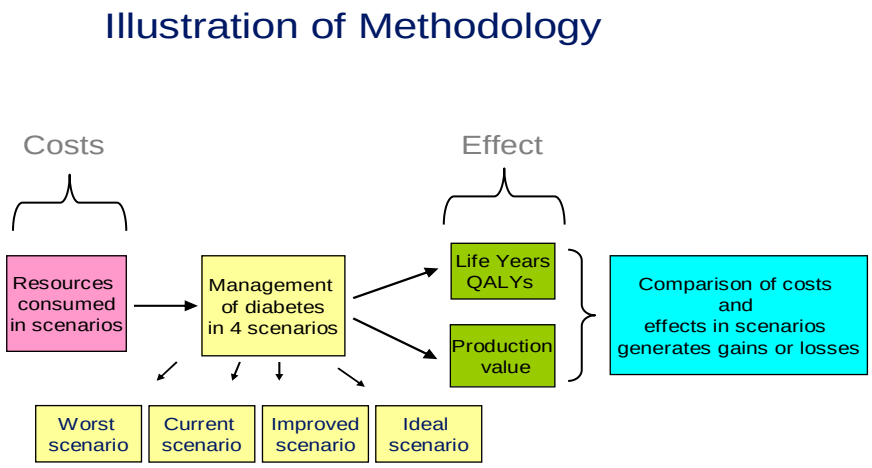
Thus, this scenario may, with due reservation, be used as a reference to what the potential is of further gains in productivity when compared with the *Current scenario*. The epidemiological modelling under this scenario uses longevity in the general population to obtain the hypothetical numbers of patient-years (all belonging to the class of no complications). Thereby, the number of patient-years estimated under this scenario is adjusted for the mortality level in the general population.

It should be stressed that the current population of patients with T2D in Bangladesh has obtained its size and age composition as a consequence of limits to possible access to insulin treatment and other types of treatment and care during the preceding decades. Therefore, a comparison of patient-years experienced under the contrasting scenarios mentioned reflects the cumulative effect of access to treatment and care over previous decades and cannot be interpreted as an isolated effect of treatment during the year 2001.

Strategy of analysis

Fig. 2.1 illustrates the strategy of analysis for each scenario

Fig.2.1 Strategy of analysis



In summary, our study is based on scenarios and for each of them, estimates of the population of people with T2D by age and complication status, and the associated costs and productivity items. Using the *Current scenario* as the reference, each of the other scenarios are evaluated with respect to

- the number of patient-years experienced with T2D
- the number of quality of life-adjusted patient-years experienced with T2D
- the cost of medical interventions in the hospital system and outside
- the cost consequences of informal care by relatives and other informal care-givers.
- the cost consequences of visits to GPs and specialists for patients and relatives,
- the foregone income from time lost due to sickness and reduced productivity by patients with T2D.

These items will be dealt with in accordance with up-to-date methodology in epidemiology and health economics, as reviewed in the first report of this series.

3. EPIDEMIOLOGICAL DATA

Epidemiological modelling

The epidemiology of T2D in Bangladesh is largely unknown, although the International Diabetes Federation has published estimated prevalence figures referring to the year 2000 and 2003 (1, 3). These figures have been obtained from surveys, performed in populations which are assumed to have similar ethnic and socio-economic profiles to the population of Bangladesh (4). Furthermore, in the published data no distinction has been made between different levels of access to care and associated variability in prevalence.

Due to the shortage of reliable empirical data, epidemiological modelling has been done for the purpose of the present study. For each scenario, the number of patient-years estimated to be experienced during the year 2001 has been modelled using prevalence estimates by means of the key indicators shown in table 3.1. Adjustments for upgrades from one age group to the next have also been incorporated on the basis of best available clinical evidence.

Table 3.1 Key indicators by age group used in the epidemiological modelling

	Age group				
	0-14	15-39	40-64	65+	Overall
Population size (in mill.)	55	60	15	5	135
Incidence rate (per 1000 person-years)	0.05	2.5	27.5	25.0	4.8
Mortality rates (per 100 patient-years)					
• *Worst*	5.0	13.0	25.0	50.0	24,8
• *Current*, no treatment and care	5.0	13.0	25.0	50.0	24.8
• *Current* with treatment and care	3.0	5.0	7.0	20.0	9,9
• General population	1.0	2.0	3.0	7.5	4.6

This produces estimates of age-specific prevalence numbers referring to the year 2001. These numbers have been used as estimates of person-years experienced with T2D in Bangladesh during 2001 within each scenario.

The *Worst scenario* is identical for the sub-set of patients without access to treatment in the *Current scenario*, but applied to the whole population of Bangladesh.

The *Current scenario* is characterized by restricted care both in terms of the number of people that have access to treatment and the level of insulin, medication and form of treatment offered to those that have access to some form of care. For the *Current scenario*, it is assumed that the population of T2D patients forms two groups. One group of patients (22.5%) with access to diabetes treatment and care; this group consists of an estimated fraction of 10% of the population who can afford to buy insulin, attend routine control visits to general practitioners and specialists and perform home glucose monitoring (only applied to patients treated with insulin) as needed and the 12.5% of the population that live close to some clinic where free care is offered to those without funds. The care, medication or insulin dose offered to this group is on average not an optimal level. All remaining patients are assumed to have no access to treatment and care on a daily basis with accompanying higher mortality rates.

The *Improved scenario* is a modification of the *Current scenario* in the sense that unlimited access to treatment and care is assumed. This scenario thus is identical to the sub-part of the *Current scenario* that has access to daily treatment, care and home blood glucose monitoring as needed, and with identical morbidity and mortality rates.

For the *Ideal scenario*, mean duration (and hence mortality) has been assumed to follow the general population values for given age-at-onset. This ensures that the patients in this scenario have mortality levels identical with those of the general population. Furthermore, by assumption all patient-years have been assigned to the complication state without any impairment, i.e. state 0 (see below).

Assignment of patient-years to complication status

Both the costs of treating T2D and the quality of life are strongly associated with the presence of long-term (chronic) complications of diabetes. There is no routine data available in Bangladesh that permits a characterisation of the patient population regarding complication status. Therefore, attempts have been made in the present study to divide the prevalence population (stratified by age groups) of patients with T2D in Bangladesh for 2001 in three distinct categories of complication status, as indicated in table 3.2.

Table 3.2 Delineation of complication status

Complication status	Patient profile of complications
State 0: no signs of chronic complications; no impairment in daily living function	No signs of complications present
State 1: Signs of minor/early chronic complications; no or only minor (insignificant) impairment in daily living function	Retinopathy, not including proliferative retinopathy; *and/or* microalbuminuria; *and/or* light neuropathy without open ulceration;
State 2: Presence of chronic complications, with significant impairment in daily living function	Overt nephropathy, incl. end stage renal disease; *and/or* proliferative retinopathy *and/or* blindness; *and/or* history of stroke and/or myocardial infarction; *and/or* history of amputation (regardless of level)

Distribution of patient-years by scenario, age and complication status

Table 3.3 shows how the numbers of patient life-years during the calendar year is assumed to distribute by complication status in the various contrasting scenarios. Due to lack of available routine registration data, these distributions have been established on clinical judgment, guided by extrapolations from relevant literature. Table 3.3 consists of 4 sections; the first concerns the total number of people with diabetes in the *Current scenario*. The share of people with diabetes with access to treatment (22.5%) is distributed among 85% on tablets and 15% on insulin. On average these people do not receive the optimal dose of oral anti-diabetic medication or insulin. In the *Improved scenario* it is assumed that all people with diabetes who need treatment have access to the current level of treatment and some form (although not the optimal level) of oral anti-diabetic medication or insulin. In the *Ideal scenario* it is assumed that all people with diabetes have access to the optimal daily dose of insulin, blood glucose monitoring, treatment etc. In the *Ideal scenario* the share of people on tablets and insulin is 50% in the respective groups.

Table 3.3 Estimated patient-years by current age and complication status in contrasting scenarios

Scenario: "Current"					
Complication status	0-14	15-39	40-64	65+	Total
State 0	1,455	103,026	211,245	69,276	385,002
State 1	6,297	399,970	765,046	238,403	1,409,716
State 2	5,560	350,586	664,546	204,077	1,224,769
Total	13,312	853,581	1,640,837	511,756	3,019,487

Worst scenario					
State 0	660	39,919	70,047	18,576	129,201
State 1	6,598	399,185	700,466	185,759	1,292,009
State 2	5,939	359,267	630,420	167,183	1,162,808
Total	13,197	798,370	1,400,933	371,517	2,584,017

Improved scenario					
State 0	8,606	657,492	1,243,341	423,624	2,333,063
State 1	3,586	394,495	1,087,924	564,832	2,050,837
State 2	2,152	262,997	777,088	423,624	1,465,860
Total	14,344	1,314,984	3,108,353	1,412,080	5,849,760

Ideal scenario					
State 0	15,710	1,737,292	4,305,618	4,034,300	10,092,920
State 1	0	0	0	0	0
State 2	0	0	0	0	0
Total	15,710	1,737,292	4,305,618	4,034,300	10,092,920

4. COSTS STRUCTURE, EFFECTS AND METHODS OF VALUATION

Overview

There are several types of costs involved in the care and management of T2D for both the individual and the healthcare system. Moreover, survival may involve need of treatment for later complications. These types of costs are automatically included in the present study, as we have chosen a one-year window and thereby included patients who may be at all possible stages in the life-course of their illness.

With regard to *costs of treatment* we follow the US Panel (5) and distinguish between costs of using

- healthcare resources
- non-healthcare resources
- patients´ time
- informal care-givers´ time

Concerning *effects* we use three approaches:

- (patient) life years gained
- quality of life gained
- production value gained (both from the formal as well as the informal sector measured in monetary units)

The three approaches should be seen as alternative ways of expressing the effects rather than additive measures as there may be overlaps between them.

It should be stressed that all cost items have been estimated as those additive costs that may be considered attributable to the condition of diabetes. Thus, costs that would have been insured by other diseases and conditions have not been included.

Before reviewing the establishment of the specific costs structure and its corresponding valuation, it is appropriate to comment upon some particular issues of relevance for health economics studies in a developing country like Bangladesh, such as the necessity of including economic activity which is not registered in a monetary market economy.

Economic conditions

The economic relations in a developing country are quite different from a well developed industrialised, market-based economy. A substantial part of production is not fully registered in monetary terms. One reason is that the institutional framework for registering production activities, for instance a universal income tax system, does not exist. Another reason is that a large part of the basic production and consumption activities takes place in a barter economy without monetary transactions and, finally, the household sector plays an important economic role. In order to neither over- nor underestimating the socio-economic consequence of healthcare improvements, two different concepts for production value are applied; a narrow concept based on production registered as GDP and a broader concept in which the value of household production and other production in the informal sector is included.

To take account of such characteristics of the economy in a developing country we distinguish between the

- formal and informal production sectors
- workforce and unemployment
- productivity and income levels for formal and informal workers
- cash income and barter economy
- distribution and valuation of time for working and nursing (distinguishing between formal and informal caregivers).

Access to healthcare is characterised by

- urbanisation/rural areas
- physical access to healthcare
- financial affordability

Still, the methods used in valuation of costs are basically the same as in the report on Denmark and as described in the report about methodology.

Statistics show that the richest 20% of the population has an average income which is 5 times that of the 20% poorest group. (Income ratio of highest 20% to lowest 20%= 4.9 (6). Approximately 83% of the population live on less than 2 $ a day and approx 35% live below the national poverty line (7).

This study is based on the current average level of income in Bangladesh and as far as possible on local Bangladesh price data, sometimes expressed in US $. The average GDP is 350 US$/capita when converted to US $ by the official exchange rate. When expressed in purchasing power parity (PPP) (see below), it is equivalent to 1750 $ PPP GDP per capita (or 4.8 $ per capita a day) in 2001 (7b, 8).

To make the results more comparable with international data and, in particular, healthcare costs in the developed world, selected prices and results are also shown PPP. All price data and results in this study which are not explicitly denominated PPP are in local price levels. When expressed in PPP $, the Bangladesh income and price level should be increased by approximately 5 (7). When converted to DKK, the official exchange rate of 8.32 DKK/US $ should be corrected to 8.42 DKK/US $ to take into account that the purchasing power of US $ was about 2% higher in Denmark than in the US in 2001 (9).

Thus, 100 taka =1.7 US $ (2001 exchange rate) = 8.5 PPP-US$, 100 taka = 15 DKK (2001) = 75 PPP-DKK.

(A table summarizing the unit price and cost data in US$, US$ (PPP), DKK, DKK (PPP) can be found in Appendix 1.)

Access to healthcare

Our model differentiates between those that can afford to pay for healthcare and those that receive free healthcare. The analysis is based on the assumption that 22.5% of the population has real access to diabetes care. The estimated figure consists of 10% who can afford to pay for healthcare and 12.5% who has access to free healthcare. The background for the assumption is as follows: Only 10% are assumed to have an income that enables them to pay for healthcare services and medication at the current prices in Bangladesh (7c). They pay for healthcare from private or public hospitals. The rest of the population cannot afford to pay for healthcare and only receive treatment if there is a free (public or private) healthcare centre. A number of free clinics primarily in the urban areas and in the districts around Dhaka are offering treatment for people without means to pay. These clinics (10) estimate that they are in contact with approximately 50% of the people with diabetes in the urban areas. Approximately 25% (7d) of the population lives in urban areas and, consequently, an estimate of 12.5% (50% of people in the urban areas) of the total population with diabetes has physical access to a diabetes clinic. People living in rural areas do generally not have access to clinics or healthcare.

The formal and informal sector of economic activity

Two different economic sectors are assumed to exist side by side: The formal sector based on monetary flows where people are working for wage income, and an informal sector based on barter and household production. Besides household production like subsistence farming and care-giving the large informal sector includes trading and small-scale production. A large part of the average consumption is based on production from the informal sector and is therefore not registered as contributing to GDP.

About 45% the population is assumed to be working in the informal sector with household production that is essential for the survival and basic needs of the family. The background is as follows: An estimate of the size of the formal versus the informal sector is made by looking at the age distribution of the population (population below 15, between 15 and 65, and above 65), and combining this with the official figures for the workforce and for unemployment. The classical way of looking at the workforce can be problematic in a developing country because people above 65 years and some children between 10 and 15 years are probably part of the workforce. In contrast some of the richest 10% are non-productive because domestic servants do all the housework.

The official figure of 64.1 m people registered in the ***official workforce*** in 1998 (8) (scaled to 67 m in 2001) amounts to 50 % of the population in Bangladesh and to 90% of the group between 15-65 years (75 m people (7)). The total population of 135 m people is distributed as follows: people aged 15-65 (75 m people) amounts to 56% of the population; those below 15 and above 65 amounts to approx 41% (55 m people) and 4% (5 m people), respectively (11, 7). We assume that the ***real workforce*** includes people registered in the official workforce, the majority of those above 65 years who are physically able to work (all in complication group 0) and a share of those below 15 years (10% of those in complication group 0).

Although unemployment officially is registered to 35% of the workforce (8), there is no general unemployment benefit as well as no general old-age pension. Consequently, survival demands some kind of productive activity of the unemployed and old aged people with no other income. Assuming that the unemployed workforce (the unemployed population constitutes 35% of the official workforce or some 23 m people) work in the informal sector together with people above the age of 65 (5 m) and an arbitrary selection of 10% of the population under 15 (6 m), the result is an ***informal workforce*** of 34 m people. The ***formal workforce*** amounts to 44 m people (the 65% employed of the official workforce). The total ***real workforce*** is therefore assumed to amount to 78 m people. Thus 57% of the 135 m population is assumed to be productive.

Level of income in the formal sector and informal sector

In the following sections we distinguish between the per capita income in the population and the per capita income of productive people. The average income level in the formal sector has been set equal to the average GDP per active person in the formal sector equivalent to US$ 1056 (GDP for year 2001 Bill US$ 46/44 m persons in the formal workforce). This is based on the assumption that the value registered in the GDP is the result of economic activities in the formal sector.

It is assumed that the productivity in the informal sector is lower than in the formal sector and consequently the income is lower. An underlying assumption is that the productive population in the informal sector is equivalent to the poorest 45% of the population and that all income is used to cover basic needs.

We have not been able to find hard core data to estimate the income level in the informal sector. Instead we have looked at different sources of information about living standard, poverty and income inequality in Bangladesh to find a benchmark for the income level in the informal sector. We decided to use a study made by the World Bank and the Asian Development Bank (12) (see appendix 3 for two additional examples). According to the World Bank/Asian Development Bank study "one of the major differences distinguishing the income earning strategies of the poor from the rich is their tremendous high reliance on daily wage income". Data from the study shows that 50% of the population in year 2000 was poor measured by an upper poverty line based on cost of basic needs (CBN) of approx 719 taka pr person per month (based on geographic regions ranging from 582-971 taka per person per month). Measured by a lower CBN poverty line of approx 580 taka per capita per month (based on geographic regions ranging from 510-694 taka per person month) 34 % of the population was extremely poor. These statistics indicate an available per capita income in the informal sector between 580 and 719 taka per month (The average is 650 taka) equivalent to the cost of basic needs for 35-50% of the poorest part of the population. To be applicable as a measure for the average income for the productive part of the population in the informal sector this level must be scaled. As each of the 78 m people in the workforce supports 57 m people outside the workforce the average per capita figures must be divided with a factor 0,57 to find the average income of the productive population. Dividing 650 with 0,57 is equivalent to 1140 taka per month. This level is equivalent to 2/3 of the GDP (US$ 233 per year).

Informal care-giving

An important non-healthcare cost is nursing. There are almost no formal nursing facilities in Bangladesh to take care for people in complication group 2. This places a large burden on the informal care-givers to care of people with high levels of complications, disabilities and dying patients. Especially low income, informal care-givers are assumed to be burdened as they provide nursing for people who cannot afford to pay for healthcare, thus assumed to be in a highly disabled state. A key element in the *Improved scenario* compared to the *Current* is the reduction of non-healthcare resources as the number of people in need of nursing is reduced. This has important implications for the time resources released for essential household production in the informal sector.

Relation between healthcare improvements and economic growth

Studies show that there is a relation between improved health and economic growth. There is a growing consensus that investments in health pay off productively leading to an assumption that improved economic activity from better healthcare will reinforce the ability to fund healthcare systems.

The WHO (13) has estimated that each 5 years' improvement in life expectancy is associated with a increase in economic growth of about 0.3-0.5% per year providing other growth factors are equal. We have used these results to calculate the size of the increase in GDP which could be achieved in Bangladesh as a consequence of the increased survival in the *Improved scenario*.

Assuming that improvement of the life expectancy is general for the whole population, between 0.3% and 0.5% increased growth will accumulate to 6% to 10% over a period of 20 years. The period of 20 years has been selected because the assumed improvement in life expectancy in the *Improved scenario* is achieved during a period of 20 years. We have only calculated the effect on the production value of the diabetes population as a sensitivity.

Costs structure and valuation

The details of the valuation of items of costs and production value applied to the scenarios are shown in table 4.1. The resulting costs structure and its application to the various categories of patient-years are summarised in table 4.2, referring to the *Current scenario*. Specific comments to the individual items are given below when relevant.

Table 4.1 Valuation of costs items and productive value, with applications to scenarios
*(*A table showing the unit costs in US PPP and DKK PPP can be found in Appendix 1.)

	Unit cost / information	*Current*	*Worse*	*Improved*	*Ideal*
Healthcare resources					
Hospitalisation DKK per admission day	US$ 18.9 DKK 158	Access: 22.5%	Access: 0%	Access: 100%	Access: 100%
Treatment with insulin (1000 units)	US$ 7.9 DKK 66	Access :22.5% (15% of treated patients)	Access: 0%	Access: 100% (15% of treated patients)	Access: 100% (50% of treated patients)
Treatment with oral anti-diabetics	US$ 0.03 DKK 0.3	Access :22.5% (85% of treated patients)	Access: 0%	Access: 100% (85% of treated patients)	Access: 100% (50% of treated patients)
Treatment with other drugs (DKK per year)	US$ 6 DKK 50	Access: 22.5%	Access: 0%	Access: 100%	Access: 100%
Visits to GP/specialist (DKK per visit)	US$ 2 DKK 17	Access: 22.5%	Access: 0%	Access: 100%	Access: 100%
Home monitoring (DKK per year)	US$ 117 DKK 976	Access: 10%)	Access: 0%	Access: 100% (15% of treated patients)	Access: 100% (50% of treated patients)
Non-healthcare resources					
Nursing by informal caregivers (1/3 of their productive value/time per year)	US$ 77 US$ 391 (PPP) DKK 641 DKK 3257 (PPP)	Patient-years in complication state 2	All patient-years are in complication state 2.	Patient-years in complication state 2	Not applied

Patients´ time,					
Loss of production value during routine controls (½ day)	US$ 0.9 US$ (PPP) 5 DKK 8 DKK 40 (PPP)	22.5% of all productive persons	NA (type 2)	all productive persons	Not applied
during hospital admissions (per day)	US$ 1.9 US$ (PPP) 10 DKK 16 DKK 79 (PPP)	22.5% of all productive persons	NA (type 2)	All productive persons	
10% related to discomfort during 50% of work time	US$ 0.2 US$ (PPP) 1 DKK 1,6 DKK 8 (PPP)	All productive persons in complication group 1.	All productive persons in complication group 1	All productive persons in complication group 1	Not applied
Informal caregivers´ time					
Loss of production for relatives during routine control and admissions of children (DKK per day)	US$ 0.32 US$ (PPP) 1.6 DKK 2.66 DKK 14 (PPP	Applied to patient-years in age 0-14 and for people in complication group 2	Not applied	Applied to patient-years in age 0-14 and for people in complication group 2	Applied to patient-years in age 0-14
Production value/socio-economic data					
GDP : US$ income per capita (formal sector)	US$ 686 US$ 3,487 (PPP) DKK 5,707 DKK29,015(PPP)	51% of type 2 patients are productive (ages above 15 years except in complication. state 2)	48% productive patients	65% of type 2 is productive (ages above 15 years except in complication state 2)	99% type 2 is productive (ages above 15 years)
US$ income per capita (informal sector) 2/3 of GDP/capita:	US$ 233 US$ 1,167 (PPP) DKK 1,941 DKK 9,870 (PPP)				

Table 4.2 Overview of costs structure and its application to categories of patient-years

Cost and productivity pr patient year

			Number of units *per patient-year* by current age group and complication state:											
			0 - 14			15 - 39			40 - 64			65+		
Item	Unit	Cost per unit (unscaled DKK	0	1	2	0	1	2	0	1	2	0	1	2
Healthcare Resources														
Hospitalization	Cost pr day	158	0	0	3	0	0	3	0	0	3	0	0	3
Medication with insulin	1000 units of insulin	66	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5
Medication with oral antidiabetics	One day's treatment	0,3	182,0	182,0	364,0	182,0	182,0	364,0	364,0	364,0	364,0	364,0	364,0	364,0
Medication with other drugs	One year´s treatment	50	0,00	0,00	1,00	0,00	0,00	1,00	0,00	0,00	1,00	0,00	0,00	1,00
Routine diabetes controls	One average visit	17	1	5	10	1	5	10	1	5	10	1	5	10
Home monitoring	One year´s activities	976	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Non-Healthcare Resources														
Annual cost for nursing assistance in the home, full-time (1/3 of informal care givers time)	One year´s cost	641	0,000	0,000	0,998	0,000	0,000	0,998	0,000	0,000	0,998	0,000	0,000	0,998
Patients´ time														
Loss of production value during routine controls. Abseenteism	Cost per day of visit	8	1	0	0	1	5	0	1	5	0	1	0	0
Loss of production value during admissions	Cost per working day	16	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Loss of production value related to discomfort during work (-10%)	Cost per working day	1,56	0	0	0	0	115	0	0	115	0	0	0	0
Informal care-givers´ time														
Loss of production value during routine controls. Abseenteism	Cost per day of visit	2,66	1	5	10	0	0	10	0	0	10	0	0	10
Production value														
Income by working (formal sector)	One year' s aver. income	5.707	0,10	0,00	0,00	1,00	1,00	0,00	1,00	1,00	0,00	1,00	0,00	0,00
Income by working (informal sector)		1.941												

Healthcare resources

Healthcare resources consist of costs of hospitalisation, treatment with insulin and other drugs, and visits to general practitioners and specialists.

Hospitalisation costs

It has not been possible to find any average costs data based on aggregated data on total national hospitalisations costs divided by the actual days in hospital and number of actual treatments carried out. Instead costs data from various sources has been gathered and used to check the validity of the estimates that we have created. The activities only apply to the subset of the population with access to care and treatment (assumed 22.5%).

The different figures are as follows:

- First part of a Health Facility Efficiency study (14) found the following average costs (in 1999) : 66 taka per outpatient day visit in Thana Health Complexes and 55 taka in District hospitals; 521 taka per inpatient day in Thana health complexes and 182 taka in district hospitals
- Data gathered from Mirpur general hospital (See appendix 2) show that the cost of a hospital bed is between 72 taka for a bed in ward and 615 taka for a VIP cabin while a bed in a private hospital range between 300 and 2500 taka. The median of the information from the private hospital is 1400 taka pr bed (see appendix 2). The study also shows that approximately 1/3 of the cost is covered by income from patients' fees.
- A third study from Gonoshastathaya Kendra Hospital, Savar (15), presents a cost pr patient day of 525 taka (Gynaecology and Obstetrics). The cost of hospital activities related to gynaecology and obstetrics is considered less costly compared to treatment of diabetes related hospitalisation.

This illustrates that the cheapest bed in a ward (72 taka or 1.26 $) costs more than the available income for 34% of the population who live on less than 1 $ a day and 60% of the available income for (78%) 83% of the population who live on less than 2 $ a day.
Our model differentiates between those who can afford to pay for healthcare and those who receive free healthcare. Statistics show that the richest 10% of the population has an average income which is 6-7 times that of the poorest group (7)
It should also be noticed that typically a share of the hospital beds is reserved for patients who cannot afford to pay. Two important issues must be mentioned. The price may be underestimating the real cost of the service provided because only a share of the patients cover the full cost from their pay thus the government is providing the missing funds or it could illustrate that the service provided is very limited and basic.
Based on the frequency of hospital admission across patient groups (see table 4.2) used in this study, 980 hospital beds are assumed to be occupied by type 2 patients on a yearly basis. The total number of hospital beds in Bangladesh is approx 37,000 (11)

On the basis of the above cost information we (rather arbitrarily) use a cost of a hospital bed of 521 taka in 1999 prices scaled to 600 taka in 2001 prices equivalent to 10.5 US$ for free hospital admissions, and 1400 taka (2001) for those that can afford to pay equivalent to approximately US $ 24.7 for hospital admissions covered by a patient fee. This results in an average price of 960 taka or US$ 16,8 when the weights for patients that can afford to pay/cannot afford to pay is applied. 15% is added to take account of the depreciation and capital cost of healthcare facilities leading to an average price of 1103 Taka or 18.9 US$ per hospital day (158 DKK (2001).

Other healthcare costs

The estimates are based on local assessments as reviewed in internal reports (16). Furthermore, specific 'ad hoc' enquiries have been performed in Bangladesh by consultant companies (see Appendix 2).

Cost of insulin consumption

From inquiries at Birdem and at private pharmacies (see appendix 2) the following insulin prices have been obtained. The table shows that the prices vary substantially.

Table 4.3 Cost of insulin consumption

	US$	units	US$ pr year	US$ pr KU	DKK pr KU	Source*)
Disposable Syringes with needles/pc	0.11	364	40.0	2.7	22.2	Novo internal data
Disposable Syringes with needles/pc	0.03	364	10.9	0.7	6.1	3 -5ml Birdem
Disposable Syringes with needles/pc	0.09	364	32.8	2.2	18.2	1-10 ml pharmacies
Disposable Syringes with needles/pc	0.12	364	43.7	2.9	24.2	1-10 ml pharmacies
Disposable Syringes with needles/pc	0.26	364	94.6	6.3	52.5	20 ml pharmacies
Human Insulin/day (40 iu/day)	0.37	364	134.7	9.0	74.7	Novo internal data
Human Insulin/day (40 iu/day)	0.13	364	47.3	3.2	26.2	pharmacies 1
Human Insulin/day (40 iu/day)	0.18	364	65.5	4.4	36.3	pharmacies 2
Human Insulin/day (40 iu/day)	0.21	364	78.1	5.2	43.3	Average
Human Insulin/day (40 iu/day) plus disposable syringes with needles/pc	**0.32**	**364**	**118.1**	**7.9**	**65.5**	**Average including syringes**

*) See appendix 2 for background, pc: piece and iu: international units, 40 are the average optimal dose per day.

Depending on the patients' income the cost of insulin and hospitalisation range from free of charge to 100%. The cost of insulin varies considerably in Bangladesh. The highest prices from pharmacies are on a level that limits the affordability even among the 10 % that is assumed to be able to pay for their own health care. Prices from pharmacies range from US$ 0.13-0.18 for a daily dose of 40 iu to US$ 4.2 for 40 iu. Internal NN price information points to a price level of 0.37 US$/40 iu. Table 4.3 shows that an average price based on the lower-end information is 0.32 $ inclusive syringes. This price is equivalent to 66 DKK/KU.

To verify this, another calculation was performed on the basis of an estimated market value data as follows: According to IMS the total market of insulin in Bangladesh has a value of approximately 50 mill. DKK. The total market in units is estimated to approx 800 MU (16). The average value of this gives 63 DKK/KU which is very close to the above mentioned lower end average of 66 DKK/KU.

Our estimate is based on an average of 66 DKK (7.9 US$) per K-units insulin (1000 units). Only the 10% richest part of the total population of diabetics (approximately 44% of the people who has access to healthcare) is assumed to use insulin on a regular basis. The 12.5%, assumed to visit free clinics, use insulin only if they receive it in a free clinic. Using this average price and assuming a consumption of 7.5 K-units of insulin per patient-year (at an average of 20 units per day the annual cost of insulin for a patient-year is DKK 491 (59 US$)). In the *Improved scenario* it is assumed that every body in need has access to a low level of insulin (7,5 K-units per patient-year). In the *Ideal scenario* it is assumed that all diabetic patients consume 15 K-units per patient year, which is considered the optimal level of insulin consumption.

In the *Current scenario* it is assumed that 15% of type 2 patients with access to healthcare are treated with insulin and 85% with anti-diabetic oral medication. In the *Ideal scenario* 50% is assumed to use insulin and 50% oral anti-diabetics.

Cost of oral medication

Prices on oral medication vary considerably depending on the origin of the product and whether it is a generic product or not. It is assumed that the majority of the market is dominated by the cheap products (80%) while 15% uses a medium priced product and 5% uses an expensive product. The price levels of the expensive products are equivalent to the Danish price level for similar products.

Table 4.4 Cost of oral medication

Products	Tablets	mg per tablet	taka	taka/tablet	day dose tablets	taka/day
Daonil	10	5	3	0.3	2	0.42
Metformin	1	850	3	3	2.4	7.06
Metformin	1	500	2	2	4	8.00
Glucophage	1	850	12.5	12.5	2.4	29.41
Glucophage	1	500	7.5	7.5	4	30.00
Average	80% Daonil, 15% metformin, 5% glucophage)					2.53

Based on survey information from Bangladesh (see appendix 2)

Table 4.5 Average cost of oral medication

Average	Prices per day	Annual cost full dose (365 days)
Taka	2,53	925
DKK	0,3	103

Routine visits at General Practicians (GP) and specialists

The data used for estimating the cost of a routine visit to the general practitioners was obtained through various enquires by consultants (Appendix 2) and supplemented by internal Novo Nordisk information (16). The items included:

- Cost of GP visits
- Cost of specialist visit

Table 4.6 Cost of visits to GP and specialists

Consultations	US$	Source*)
GP consultations pr visit	0.86	Mirpur General hospital, Dhaka
GP consultations pr visit	1.75	Mirpur General hospital, Dhaka
GP consultations pr visit	2	Novo internal data
Specialists pr visit	5.18	Mirpur General hospital, Dhaka
Specialists pr visit	6.9	Mirpur General hospital, Dhaka
Specialists pr visit	6	Novo internal data
Average		**Distribution of visits**
Average GP consultations	1.5	90%
Average specialist consultations	6.0	10%
Costs per visit	**2**	

*) See appendix 2

An average has been calculated on the basis of available data and is based on 10% specialist visits and 90% GP visits. The average cost is 2 US$ or 17 DDK. Visits to GPs also cover the cost of outpatient visits (free visits as well as visits covered by fees) in hospitals. On average each patient visits an outpatient health facility 4-5 times a year. This is a result of irregular access to insulin and other treatment that lead to acute complications and illness. The average figures cover larger variations in visit frequency between different age and complication groups.

Home blood glucose monitoring

Prices related to consumption and costs of strips/meters have been obtained through a survey performed by consultants (appendix 2) and supplemented with internal Novo Nordisk data (16).

The approximate annual costs are shown in table 4.7.

Table 4.7 Selected costs of blood glucose meter and strips by source

	US$	Life time (years)	Per year	Source*)
Blood glucose meter	60.8	3	20.3	Novo Nordisk internal data
Blood glucose meter	60.5	3	20.2	Birdem
Blood glucose meter	69.1	3	23.0	Birdem
Blood glucose meter	65.7	3	21.9	pharmacies
Blood glucose meter	69.1	3	23.0	pharmacies
	US$	units	Per years	
Blood glucose Strip/pc	0.48	200	96	Novo Nordisk internal data
Blood glucose Strip/pc	0.47	200	94	Birdem
Blood glucose Strip/pc	0.35	200	70	Birdem
Blood glucose Strip/pc	0.41	200	82	pharmacies
Blood glucose Strip/pc	0.48	200	96	pharmacies
Urine Strip/pc	0.04	200	8	Novo Nordisk internal data

*) See appendix 2, pc: piece.

Table 4.8 Average cost of blood glucose meter and strips

Average	US$	DKK
Average Blood glucose meter	**21.7**	**180.3**
Average Blood glucose strip/pc	**87.6**	**728.8**
Urine strip/pc	**8**	**66.6**
price per patient pr year	**117.3**	**975.7**

The average cost of using a glucose meter per year has been calculated to US$ 117.3 (DDK 976) based on an expected life of the glucose meter of 3 years. It is assumed that among those with access to healthcare only the 15% type 2 patients who are treated with insulin on a regular basis perform home monitoring and – on average – such patients perform a blood glucose measurement 4 times a week (200 strips pr year). In the *Improved* and *Ideal scenario* all insulin using patients perform blood glucose measurements on a regular basis.

The cost of time resources and production value

The value of time is based on the human capital approach. Thus, the production value and use of time resources is measured by the average income from working. No hard national statistical income data are available from Bangladesh and, therefore, an estimate is made from two income levels shown in the table below. Table 4.9 summarises the income elements from the formal sector and the informal sector. In the formal sector it is assumed that the income level is equivalent to GDP per active person in the formal sector capita level (US$ 1,056). The weight of the formal sector is 55%. In the informal sector the income level is assumed to be 2/3 of the GDP per capita (Us$ 350) and based on a 45% weight. The background of the weights is described in the section "Formal and informal economic activity". The average income level is calculated to US$ 686 or US$ 3,487 (PPP).

Every time a productive person with diabetes in complication group 0 and 1 visits a doctor or is admitted to a hospital there will be a loss in terms of the value of time in paid or unpaid production. This loss is included in the calculation as described below. It is assumed that visiting a clinic or a doctor takes half a working day both for a patient and for relatives that accompany a child, an elderly person or a disabled person (typically complication group 2).

- Average daily income (formal sector): DKK 24 (3 US$)
- Average daily income (informal sector): DKK 5 (0.64 US$)
- Loss of income during admission: A full day income pr admission day
- Loss of income during routine control (DKK pr day): 50% of a day's income.

Table 4.9 Level of income by sector. Bangladesh 2001.

For the year 2001	Formal sector	Informal sector	Average income by working
Distribution by sector	55%	45%	100%
2001 DKK	DKK 8,788 (24 DKK/day) DKK 44,680 (PPP)	DKK 1,941 (5.3 DKK/day) DKK 9,870 (PPP)	DKK 5,707 (16 DKK/day) DKK 29,015 (PPP)
2001 US$	US$ 1,056 (3 US$/day) US$ 5,370 (PPP)	US$ 233 (0.6 US$/day) US$ 1,186 (PPP)	US$ 686 (1.9 US$ (3,487) (PPP)
Assumptions	GDP per active person in formal sector	2/3 of GDP per capita	Average

Productive persons in complication group 1 are assumed to suffer from 10% reduced productivity during 50% of the working time as a consequence of discomfort from the diabetes condition.

Non-healthcare resources: costs of nursing

Formal nursing in public institutions of patients with severe complications is not typical in Bangladesh. Nursing of patients takes primarily place in the home through the efforts of relatives and family. The cost of nursing is measured by the value of time of people in the informal sector. In a household with a severely disabled diabetic person (complication group 2) it is assumed that 1/3 of the productive time of a home-maker has to be dedicated to assistance to the patient in need.

- Value of informal time per year: 2/3 of GDP per capita US$ 350 = 233 US $ or 1186 PPP US$ or 1941 DKK = 9,870 PPP-DKK.
- Informal care-givers' time allocated to nursing: 1/3
- Cost of informal nursing pr year: DKK 641 (US$ 77) or in PPP-DKK 3257 (US$ 391)

Assessment of quality of life effects

The effect from having T2D is expressed on the basis of numbers of patient-years experienced under the contrasting scenarios. We have furthermore attempted to perform an adjustment of the patient-years, using a generic (non-disease specific) quality of life (QoL) questionnaire; the EQ-5D (17). The reason for choosing EQ-5D is that it has been extensively validated with acceptable results in a wide range of countries, although at the present moment we do not know to which extent it is valid in Bangladesh. Yet another reason for choosing the EQ-5D is that the instrument yields an index (in contrast to profiles). This makes it possible to directly generate Quality-adjusted Patient Life Years (QALYs), a measure that makes it possible to include changes in QoL into health economic calculations. This is not possible from profiles as they only present QoL in different categories and not as a single number, which is necessary in order to adjust patient-years for quality.

EQ-5D identifies the quality of life of a person on a preference based scale between 0 (death/worst imaginable health state) and 1 (best imaginable health state). So, any kind of health state can then be translated into a numerical value between 1 and 0. This number can then be used to adjust the length of a person's life with this health state, into a health status measure, which is a number of quality-adjusted patient-years (QALYs). An effect measure is gain in QALYs. In practice the number of patient-years or months lived in this state will be multiplied by the number representing the health state. If a person has a reduced health state e.g. limited mobility due to a car accident, then the value of this health state may be e.g. 0.64. The quality-adjusted value of five years lived in this state is then 5 x 0.64 = 3.20 i.e. 64% of the value of 5 years lived with full health.

Specifically EQ-5D operates in five dimensions; *Mobility*, *Personal care*, *Usual daily activities*, *Pain/discomfort*, and *Anxiety/depression*. Within each dimension, score 1 means no problems at all while score 3 means severe problems. By means of regression analysis, as suggested by Greiner et al. (17), all possible compound scores have been assigned a value between 0 and 1, with the value 0 indicating lowest possible level of QoL and the value 1 indicating maximal QoL.

A group of selected diabetes nurses have translated a number of typical diabetes health states into the descriptive health states as used in the EQ-5D questionnaire. This way, we obtained EQ-5D weights to a number of health states that are typical for diabetes patients. According to these results we have used the QoL-coefficients of 0.95, 0.85 and 0.65 for patient-years experienced in complication states 0, 1 and 2, respectively.

The coefficients obtained for quality-adjustment of diabetic patient-years in Denmark have been applied without further adjustment to the patient population of Bangladesh. This approach is discussed in the methodology report and in the discussion section of the present paper.

5. RESULTS

Costs

Tables 5.1, 5.2, 5.3 and 5.4 show the detailed estimates of costs in the four scenarios *Current*, *Worst*, *Improved* and *Ideal*, respectively.

Particularly for the *Current scenario*, key results are summarised below in fig. 5.1 and fig. 5.2.

Fig. 5.1a T2D in Bangladesh, year 2000, Current scenario. Total costs (mill. DKK) by main categories according to age groups.

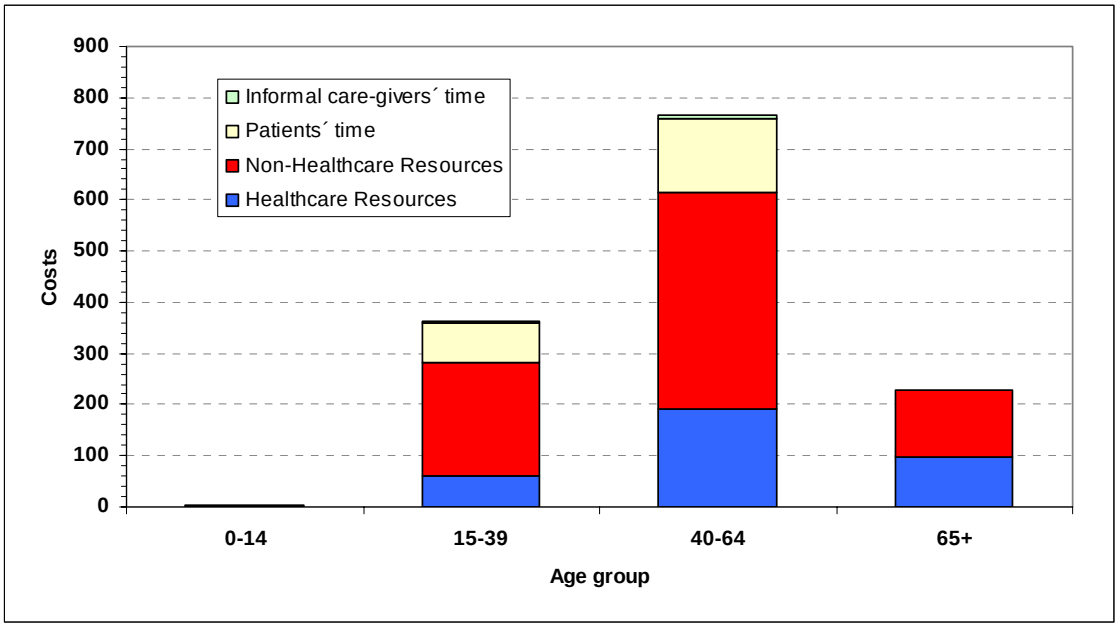


Fig. 5.1b, T2D in Bangladesh, year 2000, Current scenario. Total costs (mill. DKK) by main cost drivers in health care costs according to age groups.

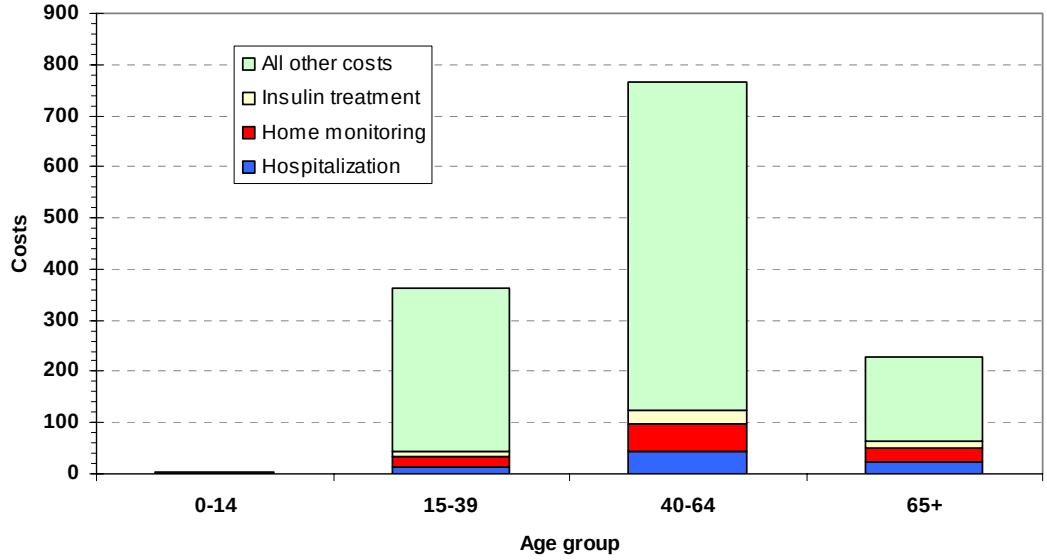


Figure 5.1a shows that total costs are dominated by non health care cost in all age categories. This is a reflection of the character of type 2 diabetes where no or less than optimal treatment do not cause immediate death. Instead a high level of complications becomes a burden on families through the need for informal nursing. Figure 5.1b shows that overall hospitalisation costs amount to between 2% and 11% of the total costs, relatively largest for the age group 64+ years. The age group 40-64 years has the highest total cost (Fig. 5.1). The relative large share of home monitoring is not a reflection of wide spread application of blood glucose monitoring but only that monitoring appliances are expensive. The largest cost item in figure 5.1.b is "all other cost" consisting primarily of informal nursing of people in complication group 2.

Fig. 5.2a T2D in Bangladesh, year 2001, Current scenario, total costs (mill. DKK) by main categories according to complication status.

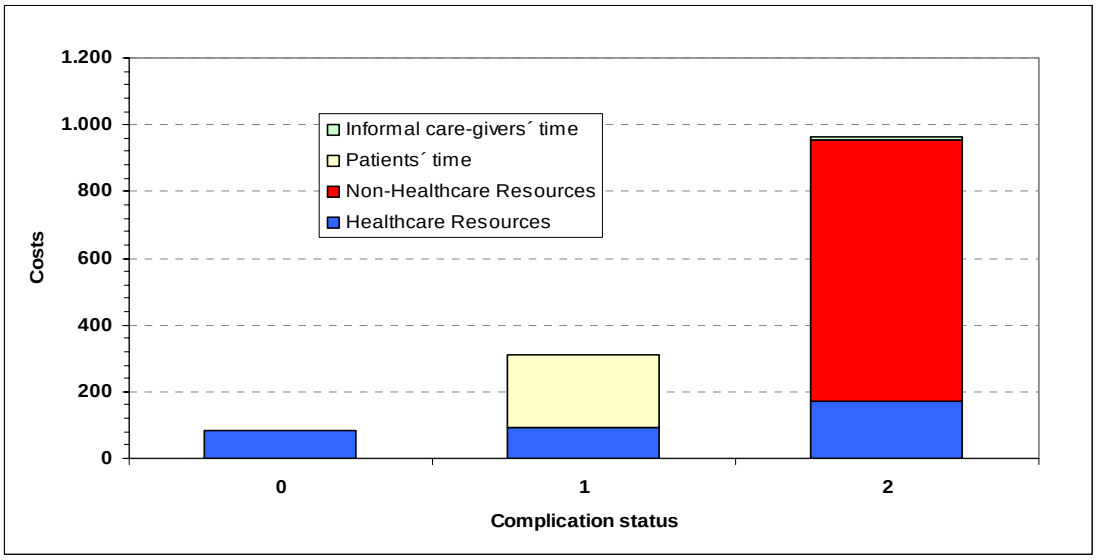


Fig. 5.2b T2D in Bangladesh, year 2001, Current scenario, total costs (mill. DKK) by main cost drivers in health care according to complication status.

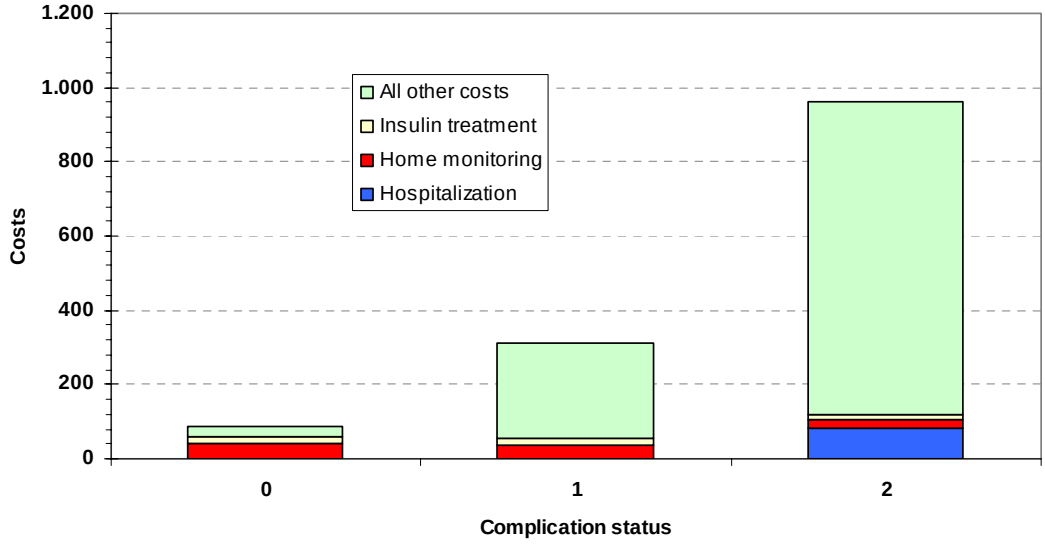


Fig. 5.2a illustrates the total costs by complication status. The patient-years experienced in complication group 2 (with severe impairment) carry by far the highest cost. Non health care costs are only present in complication group 2 where it also dominates. In complication group 1 patients time is an important factor because the majority of the patients to some extent are employed and diabetes therefore result in loss of production value during visits at the GP or during days of lower productivity. Because of the low level of access to diabetes treatment and care in the *Current scenario*, complication group 2 has number of patient-years almost equal to that of complication group 1 while patients years in complication group 0 is only around 1/3 of the patients in either group 1 or 2. Total health care costs are dominated by rare but expensive home monitoring followed by hospitalisation and finally insulin consumption.

Table 5.1 to 5.4 summarises the cost in the four different scenarios for age groups, complication groups for cost types. For instance in the current scenario (table 5.1) the most costly subgroup in terms of health care resources (Mill DKK 92) are people aged 40-64 with a high level of complications (comp 2). This is also the group that have the highest non health care costs (Mill DKK 425) or more than 4 times the health care costs. The same applies for the worst and the improved scenario.

Table 5.1 Details of costs under the scenario "Current", by age group and complication status. All values in mill. DKK

	Total	0 - 14			15 - 39			40 - 64			65+		
		0	1	2	0	1	2	0	1	2	0	1	2
TOTAL	***1.358,2***	***0,2***	***0,1***	***3,8***	***19,0***	***89,4***	***253,0***	***48,4***	***194,8***	***520,9***	***17,2***	***27,3***	***184,0***
Healthcare Resources	***347,2***	***0,2***	***0,1***	***0,2***	***18,8***	***14,0***	***26,7***	***48,0***	***50,5***	***92,0***	***17,0***	***27,3***	***52,2***
Hospitalization	81,2	0,0	0,0	0,1	0,0	0,0	12,7	0,0	0,0	43,6	0,0	0,0	24,8
Medication with insulin	50,1	0,1	0,0	0,0	4,9	3,0	2,0	10,9	9,5	6,8	3,9	5,2	3,9
Medication with oral antidiabetics	55,3	0,0	0,0	0,0	3,0	1,8	2,4	13,1	11,4	8,2	4,6	6,2	4,6
Medication with other drugs	8,6	0,0	0,0	0,0	0,0	0,0	1,3	0,0	0,0	4,6	0,0	0,0	2,6
Routine diabetes controls	52,6	0,0	0,0	0,0	1,1	3,3	4,4	2,4	10,7	15,2	0,9	5,8	8,7
Home monitoring	99,4	0,1	0,1	0,0	9,8	5,9	3,9	21,6	18,9	13,5	7,7	10,2	7,7
Non-Healthcare Resources	***783,2***	***0,0***	***0,0***	***3,6***	***0,0***	***0,0***	***224,2***	***0,0***	***0,0***	***424,9***	***0,0***	***0,0***	***130,5***
Annual cost for nursing assistance in the home, full-time (1/3 of informal care	783,2	0,0	0,0	3,6	0,0	0,0	224,2	0,0	0,0	424,9	0,0	0,0	130,5
Patients´ time	***220,4***	***0,0***	***0,0***	***0,0***	***0,2***	***75,4***	***0,0***	***0,4***	***144,3***	***0,0***	***0,1***	***0,0***	***0,0***
Loss of production value during routine controls. Abseenteism	10,9	0,0	0,0	0,0	0,2	3,5	0,0	0,4	6,7	0,0	0,1	0,0	0,0
Loss of production value during admissions	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Loss of production value related to discomfort during work (-10%)	209,5	0,0	0,0	0,0	0,0	71,9	0,0	0,0	137,6	0,0	0,0	0,0	0,0
Informal care-givers´ time	***7,3***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***	***2,1***	***0,0***	***0,0***	***4,0***	***0,0***	***0,0***	***1,2***
Loss of production value during routine controls. Abseenteism	7,3	0,0	0,0	0,0	0,0	0,0	2,1	0,0	0,0	4,0	0,0	0,0	1,2
Production value	***8.838,5***	***0,8***	***0,0***	***0,0***	***588,0***	***2.282,6***	***0,0***	***1.205,6***	***4.366,1***	***0,0***	***395,4***	***0,0***	***0,0***
Income by working	8.838,5	0,8	0,0	0,0	588,0	2.282,6	0,0	1.205,6	4.366,1	0,0	395,4	0,0	0,0

Table 5.2 Details of costs under the Worst scenario, by age group and complication status. All values in mill. DKK

	TOTAL	0 - 14			15 - 39			40 - 64			65+		
		0	1	2	0	1	2	0	1	2	0	1	2
TOTAL	***948,7***	***0,0***	***0,0***	***3,6***	***0,0***	***73,3***	***230,7***	***0,1***	***128,7***	***404,8***	***0,1***	***0,0***	***107,4***
Healthcare Resources	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***
Hospitalization	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Medication with insulin	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Medication with oral antidiabetics	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Medication with other drugs	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Routine diabetes controls	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Home monitoring	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Non-Healthcare Resources	***743,3***	***0,0***	***0,0***	***3,6***	***0,0***	***0,0***	***229,7***	***0,0***	***0,0***	***403,1***	***0,0***	***0,0***	***106,9***
Annual cost for nursing assistance in the home, full-time (1/3 of informal care	743,3	0,0	0,0	3,6	0,0	0,0	229,7	0,0	0,0	403,1	0,0	0,0	106,9
Patients´ time	***202,3***	***0,0***	***0,0***	***0,0***	***0,0***	***73,3***	***0,0***	***0,1***	***128,7***	***0,0***	***0,1***	***0,0***	***0,0***
Loss of production value during routine controls. Abseenteism	4,5	0,0	0,0	0,0	0,0	1,6	0,0	0,1	2,7	0,0	0,1	0,0	0,0
Loss of production value during admissions	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Loss of production value related to discomfort during work (-10%)	197,7	0,0	0,0	0,0	0,0	71,8	0,0	0,0	126,0	0,0	0,0	0,0	0,0
Informal care-givers´ time	***3,1***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***	***1,0***	***0,0***	***0,0***	***1,7***	***0,0***	***0,0***	***0,4***
Loss of production value during routine controls. Abseenteism	3,1	0,0	0,0	0,0	0,0	0,0	1,0	0,0	0,0	1,7	0,0	0,0	0,4
Production value	***7.009,7***	***0,4***	***0,0***	***0,0***	***227,8***	***2.278,2***	***0,0***	***399,8***	***3.997,6***	***0,0***	***106,0***	***0,0***	***0,0***
Income by working	7.009,7	0,4	0,0	0,0	227,8	2.278,2	0,0	399,8	3.997,6	0,0	106,0	0,0	0,0

Table 5.3 Details of costs under the scenario "Improved", by age group and complication status. All values in mill. DKK

	TOTAL	0 - 14			15 - 39			40 - 64			65+		
		0	1	2	0	1	2	0	1	2	0	1	2
TOTAL	***3.946,9***	***2,5***	***1,3***	***3,1***	***189,8***	***223,2***	***375,1***	***413,9***	***663,7***	***1.108,2***	***141,0***	***220,9***	***604,1***
Healthcare Resources	***2.627,8***	***2,4***	***1,2***	***1,6***	***184,7***	***136,9***	***199,9***	***404,2***	***425,6***	***590,6***	***137,7***	***220,9***	***322,0***
Hospitalization	346,4	0,0	0,0	0,5	0,0	0,0	62,1	0,0	0,0	183,6	0,0	0,0	100,1
Medication with insulin	431,3	0,6	0,3	0,2	48,5	29,1	19,4	91,7	80,2	57,3	31,2	41,6	31,2
Medication with oral antidiabetics	470,6	0,4	0,2	0,2	29,1	17,5	23,3	110,0	96,3	68,8	37,5	50,0	37,5
Medication with other drugs	73,3	0,0	0,0	0,1	0,0	0,0	13,1	0,0	0,0	38,9	0,0	0,0	21,2
Routine diabetes controls	450,1	0,1	0,3	0,4	10,9	32,6	43,4	20,5	89,9	128,4	7,0	46,7	70,0
Home monitoring	856,2	1,3	0,5	0,3	96,2	57,7	38,5	182,0	159,2	113,7	62,0	82,7	62,0
Non-Healthcare Resources	***937,4***	***0,0***	***0,0***	***1,4***	***0,0***	***0,0***	***168,2***	***0,0***	***0,0***	***496,9***	***0,0***	***0,0***	***270,9***
Annual cost for nursing assistance in the home, full-time (1/3 of informal care	937,4	0,0	0,0	1,4	0,0	0,0	168,2	0,0	0,0	496,9	0,0	0,0	270,9
Patients´ time	***342,7***	***0,1***	***0,0***	***0,0***	***5,1***	***86,4***	***0,0***	***9,7***	***238,1***	***0,0***	***3,3***	***0,0***	***0,0***
Loss of production value during routine controls. Abseenteism	76,2	0,1	0,0	0,0	5,1	15,4	0,0	9,7	42,5	0,0	3,3	0,0	0,0
Loss of production value during admissions	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Loss of production value related to discomfort during work (-10%)	266,6	0,0	0,0	0,0	0,0	70,9	0,0	0,0	195,6	0,0	0,0	0,0	0,0
Informal care-givers´ time	***39,1***	***0,0***	***0,0***	***0,1***	***0,0***	***0,0***	***7,0***	***0,0***	***0,0***	***20,7***	***0,0***	***0,0***	***11,3***
Loss of production value during routine controls. Abseenteism	39,1	0,0	0,0	0,1	0,0	0,0	7,0	0,0	0,0	20,7	0,0	0,0	11,3
Production value	***21.730,9***	***4,9***	***0,0***	***0,0***	***3.752,3***	***2.251,4***	***0,0***	***7.095,8***	***6.208,8***	***0,0***	***2.417,6***	***0,0***	***0,0***
Income by working	21.730,9	4,9	0,0	0,0	3.752,3	2.251,4	0,0	7.095,8	6.208,8	0,0	2.417,6	0,0	0,0

Table 5.4 Details of costs under the scenario "Ideal", by age group and complication status. All values in mill. DKK

	TOTAL	0 - 14			15 - 39			40 - 64			65+		
		0	1	2	0	1	2	0	1	2	0	1	2
TOTAL	***10.610,0***	***16,2***			***1.788,9***			***4.545,6***			***4.259,2***		
Healthcare Resources	***10.531,0***	***16,1***			***1.775,3***			***4.512,0***			***4.227,7***		
Hospitalization	0,0	0,0			0,0			0,0			0,0		
Medication with insulin	4.960,5	7,7			853,9			2.116,2			1.982,8		
Medication with oral antidiabetics	479,7	0,4			45,2			224,1			210,0		
Medication with other drugs	0,0	0,0			0,0			0,0			0,0		
Routine diabetes controls	166,7	0,3			28,7			71,1			66,6		
Home monitoring	4.924,0	7,7			847,6			2.100,6			1.968,2		
Non-Healthcare Resources	***0,0***	***0,0***			***0,0***			***0,0***			***0,0***		
Annual cost for nursing assistance in the home, full-time (1/3 of informal care	0,0	0,0			0,0			0,0			0,0		
Patients´ time	***78,9***	***0,1***			***13,6***			***33,7***			***31,5***		
Loss of production value during routine controls. Abseenteism	78,9	0,1			13,6			33,7			31,5		
Loss of production value during admissions	0,0	0,0			0,0			0,0			0,0		
Loss of production value related to discomfort during work (-10%)	0,0	0,0			0,0			0,0			0,0		
Informal care-givers´ time	***0,0***	***0,0***			***0,0***			***0,0***			***0,0***		
Loss of production value during routine controls. Abseenteism	0,0	0,0			0,0			0,0			0,0		
Production value	***57.519,9***	***9,0***			***9.914,8***			***24.572,3***			***23.023,9***		
Income by working	57.519,9	9,0			9.914,8			24.572,3			23.023,9		

A summary of costs is presented in table 5.5. The costs in the *Current scenario* are higher than the estimated costs in the *Worst scenario*, i.e. the hypothetical situation without access to treatment and care. However, the costs under the *Improved scenario* are much higher than under the *Current scenario*, a natural consequence of the general access to healthcare in the *Improved scenario* compared to the limited access for 22,5% of people with diabetes in the *Current scenario*. This illustrates that the current situation for T2D in Bangladesh is closer to the *Worst scenario* than to the *Improved scenario*. The costs under the *Ideal scenario* shows that an ideal treatment would require much higher expenditure than in the *Improved scenario* due to almost twice the number of people surviving (patients years) in the *Ideal scenario* compared to the "Improved" scenario.

Table 5.5 Summary of costs of treating T2D in the contrasting scenarios

Summary table Mill DKK	**Worst**	**Current**	**Improved**	**Ideal**
Healthcare Resources	0	347	2,628	10,531
Non-Healthcare Resources	743	783	937	0
Patients´ time	202	220	343	79
Informal care-givers´ time	3	7	39	0
Total cost	**949**	**1,358**	**3,947**	**10,610**

In the table a distinction is made between the patient life years (unadjusted) and patients' life years treated (unadjusted). The distinction is created to highlight the number of people in the current and worst scenarios that do receive treatment versus those that do not receive treatment.

Effects

Table 5.6 also summarises the estimated numbers of patient-years and QALYs, as well as the productivity (income by working) under each of the scenarios.

Table 5.6 Summary of effects (patient-years and production value) in the contrasting scenarios

Summary table	**Worst**	**Current**	**Improved**	**Ideal**
Patients' life years unadjusted	2,584,017	3,019,487	5,849,760	10,092,920
Patients' life years treated	0	679,443	5,849,760	10,092,920
Patients' life years quality adjusted	1,976,773	2,360,110	4,912,431	9,588,274
Production value inclusive the informal sector Mill DKK	**7,010**	**8,839**	**21,731**	**57,520**
Registered as GDP Mill DKK	**3,855**	**4,861**	**11,952**	**31,636**

Many more patient-years are estimated for the *Current scenario* as compared with the *Worst scenario*. This is accompanied by a higher production value in the *Current scenario* than in the *Worst scenario*. The number of patient-years, QALYs and the production value are higher in the *Improved scenario* as compared with the *Current scenario*, as is the production value. It is also noteworthy that under the *Ideal scenario* (assuming T2D diabetes is a disease totally free of specific complications, assumed treated appropriately) considerably more patient-years – with accompanying higher production value – would be experienced. The cost of improving diabetes care from *Current* over *Improved* to *Ideal* is covered several times by the increase in production value.

Health economics assessment

The estimated costs and effects, as reviewed above, have been summarised in a simple health economics evaluation as shown in table 5.7. Each of the hypothetical scenarios *Worst*, *Improved* and *Ideal* has been contrasted with the *Current scenario* in terms of differences.

It is evident that the increased costs for the *Current scenario*, as compared with the *Worst scenario*, must be seen against a substantial gain in patient-years. The gain in production value exceeds the amount of increased costs.

Under the assumptions specified, the gains in patient-years, QALYs and production value, respectively, are substantial in the scenario "Improved" and the gain in production value is much higher than the additional healthcare resources needed to accomplish these gains.

The difference between the *Current scenario* and the *Ideal scenario* may be viewed as the potential further gains that might be expected, should the treatment of diabetes reach perfection. According to the estimates, the higher level of costs would yield a substantial further gain in patient-years and accompanying production value. When seen from the rest of the society, it should be noticed however, that the increased number of patient years also entails higher consumption by the patients.

Table 5.7 Summary results of various scenarios compared.

	Socio-economic gains *Current* vs. *Worst*	**Socio-economic gains *Improved* vs. *Current***	**Socio-economic gains *Ideal* vs. *Current***
COSTS Mill DKK			
Healthcare Resources	347	2,281	10,184
Non-healthcare Resources	40	154	-783
Patients´ time	8	122	-142
Informal care-givers´ time	4	32	-7
Total cost	**409**	**2,589**	**9,252**
EFFECTS			
Patients' life years (unadjusted)	435,469	2,830,274	7,073,433
Patients' life years treated (unadjusted)	679,443	5,170,317	9,413,476
Patients' life years quality-adjusted	383,337	2,552,321	7,228,164
EFFECTS Mill DKK			
Production value inclusive the informal sector	1,829	12,892	48,681
Registered as GDP	1,006	7,091	26,775

Results from various types of health economic evaluations are shown in table 5.8.
Net benefit of the *Current scenario* as compared to the *Worst scenario* based on only productive gains is 1,829 minus 409 mill. DKK = 1,419 mill. DKK when the human capital approach is used to value the gains in years. The figure 1,829 mill. DKK includes the value of household production. Use of the human capital approach implies that benefits are measured in terms of productive gains only, disregarding the value of life. When the *Improved scenario* is compared to the *Current scenario*, the net benefit increases to 10,304 Mill DKK. The corresponding figure increases to 39,430 Mill DKK when the *Ideal scenario* is compared to the *Current scenario*. Positive Cost-Benefit figures imply that the productive gains from gains in life years do outweigh the cost increase when contrasting each of the alternative scenarios with the "*Current" scenario*. As described in the methodology report and discussed in the discussion section non of these measures take into consideration the issue of increased consumption as a derived effect of an improved health outcome.

The marginal cost-effectiveness ratio is calculated as net costs per added patient-year gained. The ratios for the three comparisons are 409,000,000/435,469 = 940; 915 and 1,308 DKK/patient year respectively. All the cost-effectiveness ratios are positive, implying increased costs as well as gains in patient-years when contrasting each of the alternative scenarios with the "Current" scenario. Finally, the cost-utility ratios show the added cost of obtaining an added quality-adjusted patient-year. The ratios for the three comparisons are 409,000,000/383,337 =1,068; 1,014 and 1,280 DKK/QALY, respectively. As the gains of patient-years are quality-adjusted, the gains in QALYs are lower than the gains measured in pure patient-years and, consequently, the costs per QALY are higher than the cost per patient-year.

Table 5.8 Health economic evaluation. Various scenarios compared. T2D in Bangladesh, 2001

Key Evaluation figures	**Socio economic gains current vs. worst**	**Socio economic gains improved vs. current**	**Socio economic gains ideal vs. current**
Net benefits human capital approach mill DKK	1,419	10,304	39,430
Marginal cost effectiveness ratio DKK/patient year	940	915	1,308
Marginal cost utility ratio DKK/ QALY	1,068	1,014	1,280

(The net benefit from the human capital approach in table 5.8 include both the production value from the formal sector and the informal sector (the household sector.)

Relationship between life expectancy and economic growth
Following the study by WHO (13) estimating that each 5 year improvement in life expectancy is associated with a increase in economic growth in about 0.3-0.5% per year other growth factors being equal the increase in GDP that could be achieved in Bangladesh as a consequence of the increased survival in the *Improved scenario* is between 6% and 10% over a period of 20 years. If we calculate the effect on the production value of the diabetes population it is equal to 23-24 Bill DKK. This sensitivity should be compared to the production value of 21.7 Bill DKK in the *Improved scenario* in table 5.6. It should be underlined that since diabetes in the improved scenario still is a chronic disease added patient-years amongst these patients will not entail the same level of productivity gains as for persons whose life-expectancy is prolonged in a state of perfect health.

Sensitivity analysis: 25% higher average income.

In the base case of this study the average level of GDP pr capita of US$ 1,056/233 in the formal/informal sectors respectively (on average US$ 686) have been used to calculate the production value of people with diabetes. This level may be on the conservative side. A sensitivity based on 25% higher average income level (US$ 1,320/291 in the formal/informal sectors or on average US$ 831) is presented below. The results are presented in the table below for the key evaluation figures and can be compared to the key evaluation figures in table 5.8 above.

Table 5.9 Sensitivity Analysis (+25% higher average income)

Key Evaluation figures	**Socio economic gains current vs worst**	**Socio economic gains improved vs current**	**Socio economic gains ideal vs current**
Net benefits human capital approach mill DKK	1,803	13,007	49,767
Marginal cost efficiency ratio DKK/patient year	949	924	1,304
Marginal cost utility ratio DKK/QALY	1,078	1,024	1,276

(The net benefit from the human capital approach in table 5.9 include both the production value from the formal sector and the informal sector (the household sector.)

The net benefit is impacted in this sensitivity. The rise in production value with 25% impacts the net benefit ratios to rise slightly more than 25% because the survival rate as well as ability to work is improved substantially in the improved and ideal scenarios compared to the current scenario. The cost side of the calculation are impacted only through the impact on the value of non health care cost (informal nursing). Thus the cost efficiency and cost utility ratios are only impacted marginally through increased value of informal nursing. This example illustrates that the base case is quite robust.

Sensitivity analysis: Consideration in relation to the level of costs in the improved scenario

A variant of the improved scenario is presented here to illustrate the cost level generated in Bangladesh if the country where able to put up the same level of resources (in PPP terms) in health care pr patient year as currently available in a country like Denmark. The current Danish cost level represents an advanced version of the *improved scenario* for Bangladesh based on a higher level of technology and treatment opportunities and adequate medication/insulin, but organization, ability to comply and life style are not optimal (thus it is not an ideal scenario).

The purpose of the *variant* is to show what level of health care cost[1] that the different levels of estimated diabetes population in the improved and ideal scenario in Bangladesh would generate if conditions were closer to the current Danish health care system.

It should also be emphasized that the figures shown below in table 5.10 in this *"variant of the improved scenario"* cannot be compared to the level of production value in the scenarios, because they are dependant on the local economic conditions. The purpose of this variant is to show what level of cost that the estimated diabetes population in Bangladesh would generate with conditions as in the Danish health care system.

The *variant of the improved scenario* assumes more adequate treatment levels to be available in Bangladesh than assumed in the original improved scenario. The number of patient-years in a *variant of the improved scenario* would be closer to that of the *ideal scenario than to the improved scenario* (closer to 10.1 Mill patient-years in the *ideal scenario* than of 5.8 Mill as in the *improved scenario*), because of a more adequate treatment offered, but we do not know more precisely where and therefore we calculate a range within which the number of patient-years in the *variant of the improved scenario* will be.

The current level of health care costs for type 2 in Denmark is estimated to DKK 16,500 (see report 3 in this series) (18). This level include cost of hospitalization, treatment of complications, medication with insulin and other drugs, blood glucose monitoring, routine visits to GPs and specialist, and physiotherapy. If this level is adjusted to the local level of costs in Bangladesh with a PPP factor of 5 the annual cost per patient is DKK 3,300. If this level of costs where applied for *the variant of the improved* scenario in combination with the patient-years (Mill 5.8) in *the improved scenario* the total health care cost would be Mill DKK 19,304 or 8 times higher than in the *improved scenario* (Mill DKK 2,628) as shown in table 5.10.

Table 5.10 Sensitivity analysis: Health Care Costs

	Improved Scenario	**Ideal scenario**
Mill patient years	5.8	10.1
Scenario health care cost Mill DKK	2,628	10,531
Danish level of health care cost (DKK 3,300) Mill DKK	19,304	33,307

[1] The non health care costs and time lost for patients and relatives in the improved scenario as presented earlier in this study is not considered in this sensitivity analysis, because it is a function of the insufficient level of treatment assumed in the improved scenario.

By doing this a comparison can be made to the ideal scenario that assumes that a perfect treatment and life style is available in Bangladesh on the basis of provision of a level of medication so that diabetes do not incur complications or cost of hospitalization. The ideal scenario represents an outer limit for what maximum socio economic gains that could be reached if people with diabetes had the opportunity and ability to comply with the recommendations for keeping the disease at an absolute minimum. The health care cost of *the ideal scenario* was 10,531 Mill DKK. The savings associated with *the ideal scenario* if it is compared to the *variant of the improved scenario* is Bill DKK 8.7 (=Mill DKK 19,304-10,531) if savings in ***health*** care costs are taken into account. The cost in the *variant of the improved scenario* based on the number of patient-years in *the ideal scenario* would be Mill DKK 33,307 (=DKK 3,300 * 10.1 Mill patient years) and the savings compared to the ideal scenario Bill DKK 22.8 (Mill DKK 33,307-10,531)

The cost level in the *cost variant of the improved scenario* would then range between Bill DKK 19.3 and 33.3 depending on the number of patient years (ranging from Mill 5.8 to 10.1) and the savings compared to the ideal scenario between Bill DKK 8.7 to 22.8.

6. DISCUSSION

Overall considerations

In the present study many assessments have been based on assumptions and information of less than optimal reliability. We have studied available information on healthcare expenditure, number of hospital clinics, hospital beds, income levels and any health sector information that was available to ensure that our assessment was made as realistic as possible. We believe that the final results provide a realistic picture within the given frameworks and scenarios. Our experiences also underline that studies of the present kind are developed in a continuous process and there is still a need for further development and validation in the future.

The study design

This study presents as a health economic analysis of the standard types of evaluation - cost-effectiveness analysis (CEA), cost-utility analysis (CUA) or cost-benefit analysis (CBA). Some of the controversial issues related to either of the standard types of evaluation are relevant to our study and, therefore, some of our reservations are discussed in the following

First, the comparison of the current situation to the *Worst scenario* involves a rather big change in the society whilst most economic evaluations - at least of the CEA type - are made for smaller changes. Second, whereas the *Worst scenario* is not totally irrelevant for a developing country, the *Ideal scenario* may seem somewhat artificial, particularly in the context of a developing country.

It is important to emphasis that the richest are those who already have access to care, have the highest productive value, are most likely to comply with treatment, are most likely to become old enough to develop type 2 diabetes. It was discussed whether it would be relevant explicitly to divide the model into the 10% richest, the 10% poorest with free access and the remaining 80% without access to care and to analyse these groups in two separate models. We choose to model these aspects through implicit distinction between the rich and poor but in one model. It might be relevant in a deeper analysis to make analyses in two distinctly different models.

The results demonstrate that the current conditions for managing T2D in Bangladesh are poor, partly due to lack of access to basic treatment, incl. insulin, for a substantial part of the population. Improvements yielding equal access to treatment and care for all patients with T2D is costly but will be accompanied by somewhat larger gains in production value compared to the *Current scenario*. It is conceivable that as a consequence of such improvement, some adjustments will take place at a macro level in the society, but any conclusion would be rather speculative.

Funding of healthcare system improvements

The economic analyses of the "improved" and *Ideal scenario*s assume 100% access to (two different) healthcare systems for everybody in the country at current prices. The study has not taken into account that financing of such healthcare systems would require large economic adjustments and funds. Instead it is (rather unrealistic) assumed that a lump-sum is available for funding of the system. Further, an estimate regarding the impact on GDP growth from health improvements has been included in the study. A development of this (as a next step) is obviously to look into what the constraints are for expanding coverage and make an assessment of what investments are necessary.

Cost structure and valuation

To obtain cost estimates of the various medications and appliances used by patients and healthcare providers in treatment we have gathered data from hospitals and pharmacies selling insulin and devices, appliances for blood glucose monitoring, anti-diabetic tablets etc. These data are based on the companies' assessment of the daily dose of tablets, on internationally agreed norms for daily doses of insulin and yearly consumption for instance of strips for blood glucose monitoring. We have critically investigated the figures and, when necessary, amended the level of consumption to a level that we find realistic.

G*ains and losses in production value*

A major effect of treatment of T2D patients is gains in patient-years. A derived effect may be gains in terms of productive time and costs in terms of spending time by informal care-givers and increased income from working (production value). The valuation of these gains is controversial, and the issue is discussed in the following section as well as in Report no 1 (19).

It should be stressed again that the current population of patients with T2D has obtained its size and age composition as a consequence of any given (in the case of Bangladesh uneven) access to insulin treatment during many decades following the introduction of insulin in the early 1920´s. Therefore, a comparison of patient-years experienced under the contrasting scenarios mentioned reflects the cumulative effect of access or lack of access to insulin treatment over previous decades and cannot be interpreted as an isolated effect of insulin treatment during the year 2001.

Productivity in the informal and formal sector

Bangladesh has experienced economic growth since the nineties. Whether this growth is reflected in a rising living standard is still to be documented as it would depend on many factors. If the economic growth has lead to increased population growth the average living standard may not have improved markedly. In the long term, though, a continued reduction of infant mortality probably (as experienced in other parts of the world) will lead to a lower fertility pr woman and eventually to higher average living standards.

The GDP is used as an approximation for lack of data on Gross National Income. In a developing country this is not a big problem because the difference between Gross Factor Income, GFI and Gross Domestic Product, GDP is probably minor. The average income level in the formal sector has been set equal to the average GDP per capita and to 2/3 of the per capita GDP in the informal sector. This is based on an assumption that the most educated people who have access to modern technology work in the formal sector and, consequently, their productivity is higher. Based on a monetary valuation of the market value of labour and its contribution to the production it is assumed that the productivity in the informal sector is lower compared to the formal sector.

The shadow price of time spend in home production is based on the assumption that there is a free choice between working at the labour market or in household production at the margin. This implies that the monetary value of the informal production from working in the household sector as a minimum has the same value as working in the labour market because time spend in home production was the preferred choice. The value of production in the household sector (the informal sector) then becomes higher than in the formal sector because it involves an active choice between a monetary reward through income and the reward through utility from working in the household sector. The labour market, however, is definitely not perfect in the developing world, and even in industrialised modern economies the choice between homemaking and wage earning is not free.

As it appears we have simplified our analyses by using the human capital approach but extended the measurement of productive outcome to include the value of household production.

Derived consumption

An effect derived from increased number of patient years are the added consumption that these patients have. The issue is discussed in the methodology report (report 1 of this series) (19). Such derived consumption effects are not included in this study.

7. OVERALL CONCLUSION

We conclude that the prevailing healthcare conditions for patients with T2D in Bangladesh are poor and that this results in bad health, reduced longevity, increased morbidity and associated low production value for these patients. Establishing access to care and treatment for all patients is net beneficial in the sense that the extra costs are out-weighted by an increased number of patient-years and associated production value. Considerable further gains in patient-years and production value at the current level of costs would be the case, should it be possible to make treatment for T2D perfect.

8. REFERENCES

(1) International Diabetes Federation. Chapter 2 in *Diabetes Atlas (second edition)*. Brussels: The International Diabetes Federation, 2003

(2) DAWN (2002); Practical Diabetes International, Vol. 19 (6), pp. 187-192, 2002 The Oxford International Diabetes Summit: Implications of the DAWN study: 7-8 April 2002, Oxford, UK

(3) International Diabetes Federation. *Diabetes Atlas 2000*. Brussels: The International Diabetes Federation, 2000

(4) Data on Bangladesh from WHO/Dr G. Roglic.

(5) Luce BR, Manning WG, Siegel JE, Lipscomb J. Estimating cost in cost-effectiveness analysis. Chapter 6 in: Gold M, Siegel JE, Russel LB, Weinstein MC (eds.): *Cost-Effectiveness in health and Medicine*. NY and Oxford: Oxford University Press, 1996

(6) Asian Development Bank, (2000), (ADB 2000),

(7) UNDP Human Development Report 2003 on Bangladesh section 3, Note (7b) section 1 and 12). Note (7c) section 13. Note (7d), section 5 (HDR 2003)

(8)The World Fact book (WFB) 2002.

(9) OECD Health Data, 2003, (OECD 2003)

(10) Personal Communication with staff at Birdem

(11) Evidence for Health Policy (WHO, 2002) W3.whosea.org/eip/annexban.htm

(12) World Bank and Asian Development Bank (December 2002), Poverty in Bangladesh: Building on Progress Report No 24299-BD (WB and ADB 2002)

(13) WHO 2000, Ministerial Round Table: Health and poverty page 4 (WPR/RC51/10) (WHO 2000)

(14) Health Facility Efficiency study undertaken by the Ministry of Health in Dhaka

(15) McCord & Chowdhury (2003), International Journal of Gynaecology and Obstetrics 81 (2003) (83-92).

(16) World Partner Programme (WPP) – Bangladesh 2002, (Internal Novo Nordisk Report and data)

(17) Greiner et al. A single European currency for EQ-5D health status. Results from six-country study, in: The European Journal of Health Economics; 2003, 4' (3): 222 – 231

(18) Green A, Emneus M, Christensen T, Bjørk S. Socio economic impact of diabetes in Denmark Type 2, report 3 Novo Nordisk 2004

(19) Green A, Emneus M, Christiansen T, Bjørk S. The Societal impact of diabetes and diabetes care. Methodology. Health Economics papers 2005:4, University of Southern Denmark.

APPENDIX 1

Table A1. Valuation of costs items and productive value, US$ and DKK in local value and PPP

Item	Unit	(Unscaled DKK	Scaled DKK (PPP)	(Unscaled US	Scaled US$ (PPP)
Healthcare Resources					
Hospitalization	Cost pr day	158	801	19	96
Treatment with insulin	1000 units of insulin	66	333	8	40
Treatment with oral antidiabetics	One day's treatment	0,3	1	0,03	0,2
Treatment with other drugs	One year´s treatment	50	254	6	31
Routine diabetes controls	One average visit	17	84	2	10
Home monitoring	One year´s activities	976	4.961	117	596
Non-Healthcare Resources					
Annual cost for nursing assistance in the home, full-time (1/3 of informal care givers time)	One year´s cost	641	3.257	77	391,5
Patients´ time					
Loss of production value during routine controls. Abseenteism	Cost per day of visit	8	40	0,94	4,8
Loss of production value during admissions	Cost per working day	16	79	1,88	9,6
Loss of production value related to discomfort during work (-10%)	Cost per working day	1,56	8	0,19	1,0
Informal care-givers´ time					
Loss of production value during routine controls. Abseenteism	Cost per day of visit	2,66	14	0,32	1,6
Production value					
Income by working (formal + informal sector)	One year' s aver. income	5.707	29.015	686	3.487,4
Income by working (informal sector)		1.941	9.870	233	1.186,3

APPENDIX 2

TABLE 1 SHOWING SELECTED PRICES IN BANGLADESH RELATED TO DIABETES		
Item	Source: BIRDEM (non-government hospital run by an autonomous body). Largest diabetic hospital in Bangladesh. Total beds are 720	Source: pharmacies (where nothing else is indicated)
Human insulin/day (40 iu/day)	250 Tk ($ 4.32) (see table 3 below)	7.50 ($ 0.13) to 10.5 ($ 0.18) depends on the manufacturing company and country
Disposable syringes with needles/pc l	3 ml: 1.75 Tk ($ 0.03) 5 ml: 1.80 Tk ($0.03)	1-10 ml: 5 Tk ($0.09) to 7 Tk ($0.12). Market varies from place to place 20 ml: 15 Tk ($0.26) to 25 ($0.43). 50 ml: 10Tk ($0.17) to 15 ($0.26).
Blood glucose strips/pc	Two types of products with corresponding monitor meters: 27 Tk ($0.47) -The cost of this machine is Tk.3,500 ($60.47) 20 Tk ($0.35) - The cost of this machine is Tk. 4.000 ($69.11).	Prices vary from 24 Tk ($0.41) to 28 Tk ($0.48)
Blood glucose monitor meter	Tk.3,500 ($60.47) Tk.4,000 ($69.11)	Prices vary from 3,800 Tk ($65.65) to 4,000 Tk ($69.11)
Lancettes	Tk 5 ($0.09)	One pack with 100: 1,300 Tk ($22.46) (made in Germany) One pack with 100: 800 Tk ($13.82) (made in India).
Urine strips/pc		1.80 Tk ($0.03)
General Practician pr visits		Prices vary from 50 Tk ($0.86) to 100 ($1.73) (Source: Mirpur General Hospital, Mirpur 10, Dhaka)
Specialist pr visit		Prices vary from 300 Tk ($5.18) to 400 Tk ($6.91) (Source: Mirpur General Hospital, Mirpur 10, Dhaka)
Average cost of a public hospital bed pr day		A bed in a ward 72 Tk ($1.24) VIP cabin 615 Tk ($10.63) Single cabin 515 Tk ($8.9) The average is 400 Tk ($6.91) (Source: Mirpur General Hospital, Mirpur 10, Dhaka)
Average cost of a private hospital bed pr day	All BIRDEM: General ward bed Tk.370 ($6.39). Two bedded air-conditioned cabin Tk.850 ($14.69). Cabin A Tk 1,100 ($19). Cabin B Tk 1,300 ($22.46). Single cabin Tk 1,500 ($25.92). VIP cabin Tk 2,500 ($43.19). Thus average Tk 1,270 ($21.94).	Prices in other private hospitals vary from 300 Tk ($5.18) to 1,200 Tk ($20.73) and thus average is 750 Tk ($12.96)

These data have been collected by Cowi consult for Novo Nordisk in Bangladesh.

Pc: piece

TABLE 2 SHOWING SELECTED MACRO ECONOMIC INDICATORS FOR BANGLADESH		
Item	Source: World Bank (2002, where nothing else is indicated)	Source: various
Total healthcare budget Total healthcare budget (PPP)	USD 266.34 mill. (02/03, source: Ministry of Finance and Planning)	USD 410.85 mill. (2000, Asian Development Bank)
Healthcare budget/capita Healthcare budget pr capita (PPP)	USD 1.96 (calculated based on Ministry of Finance and Planning)	USD 3.03 (calculated based on Asian Development Bank)
GDP GDP (PPP)	USD billion 47.3 USD million 235,613	
GNI pr capita GDP pr capita GDP (pr capita) (ppp)	 USD 360 - population 135 million USD 350 USD 1750	 USD 1,483 (1999, source: UNDP)
GDP (pr capita) pr day GDP (pr capita) (ppp) pr day	USD 0.96 (calculated) USD 3.94 (calculated)	
Average wages income among the riches 10% of the population[2]		Income ratio of highest 20% to lowest 20%= 4.9 (Source: ADB, 2000)
Estimate of population that can afford to pay for healthcare[3]	Less than 20 per cent of total population (average 22.2 per cent of population with Diarrhoea are brought to a health facility. For Acute Respiratory Infection, the figure is 32.9 per cent. For the richest 20 per cent of population corresponding figures are 23.8% and 50.6%)	
Share of population with less than 1$/day (ppp)[4]		29.1 per cent (1992 ppp US$, source: UNDP)
Share of population under national poverty line	 34 per cent	

Table 3 Price documentation collected in Bangladesh by COWI consult October – December 2003.

Item	Name of the product	Name of the producer	Price
Human insulin (40 iu/day)	Mixtard 30HM	Novo Nordisk A/s, Denmark	250/=
	Actrapid HM	Novo Nordisk A/s, Denmark	250/=
	Insulatard HM	Novo Nordisk A/s, Denmark	250/=
	Humulin N	Lilly France S.A. France	350/=

Item	Name of the product	Name of the producer	Price
Disposable Syringes with Needles/ Pc	Dispovan	Hundustan Syringes & Medical Device Ltd. India	7.50/=

Item	Name of the product	Name of the producer	Price
Blood glucose strips/ pc	Glucomen Glyco	A. Menarini Diagnostics, Italy. www.menarini.com	27.60/=
	One Touch Basic Plus	Johnson & Johnson, USA	20.80/=

Item	Name of the product	Name of the producer	Price
Blood glucose monitor meter	Glucomen Glyco	A. Menarini Diagnostics, Italy. www.menarini.com	3,800/=
	One Touch Basic Plus	Johnson & Johnson, USA	3,500/=

Item	Name of the product	Name of the producer	Price
Lancettes /pc	Glucomen Glyco	A. Menarini Diagnostics, Italy. www.menarini.com	6/=
	One Touch Basic Plus	Johnson & Johnson, USA	4/=

Urine strips- no more used.

Hospitals: Prices ranging from Tk. 300 - Tk 1200. Both Mirpur General Hospital, Mirpur 10, Dhaka and Al-shafi hospital, Rokeya Sharoni, Dhaka offer this price range.

[2] Figure not available. The ratio reported can be used for approximation.
[3] Figure not available. The figures reported can be used for approximations.
[4] Note that the international standard is less than one dollar/day.

APPENDIX 3

Alternative information on income levels in the informal sector.

Approximately 83% of the population live on less than 2 $ a day, 36% live on less than 1$ a day – and 34% below the national poverty line (UNDP, Human Development Report 2003 on Bangladesh (HDR 2003)) (17). Using the average GDP of US$ 350 together with the above information about the living standard it is possible to estimate the average pr capita income in the poorest 45% of the population result to an average of US$ 99 pr capita (477 taka pr month) and in the richest 55% an average of US$ 646 pr capita. To be applicable as a measure for the average income for the productive part of the population in the informal sector this level must be scaled. As each of the 78 m people in the workforce supports 57 m people outside the workforce the average pr capita figures must be divided with a factor 0,57 to find the average income of the productive population. 99 and 646 US $ pr year in pr capita income becomes 174 and 1134 US$ pr productive persons in the respective groups.

Another statistics show that the richest 20% of the population has an average income which is 6 times that of the 20% poorest group (6). If we use the average pr capita income of US$ 350 in combination with this income distribution (see table 1) we find that the poorest 45% of the population have an average of US$ 193 pr capita and the top 55% have US$ 479 pr capita. Scaled to the income level of the productive population this results in 338 and 840 US$ pr productive person in the two respective groups.

Table 1

Income attributed to the richest 20%	43%
20%	21%
20%	15%
20%	13%
Income attributed to the poorest 20%	8%

(Source: Asian Development Bank (ADB), 2000)