ORIGINAL ARTICLE

# Estimating Per Capita Direct Costs Associated with Type 2 Diabetes: A Cross-Sectional Study in Yazd, Iran.

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## Abstract

**Objective:** Type 2 diabetes is amongst the most common chronic illnesses in Iran. Its prevalence is increasing and it has significant economic importance. The aim of this study was to estimate direct therapeutic and non-therapeutic costs of type 2 diabetes Patients Referred to the Diabetes Research Center of Yazd in 2012.

**Materials and Methods:** This cross-sectional study was carried out on 250 type 2 diabetes patients referred to Yazd Diabetes Research Center in 2012. Direct health costs were estimated from costs of physician visit, Nutrition counseling, Anti diabetic agent, Testing, Hospital inpatient care, imaging, wound, Cataract , Physiotherapy, dialysis and other costs included (Insulin ,Test tape), as well as direct costs of non-treatment including Cost of travel and accommodation and required data was gathered by questionnaire. Mann-Whitney Test, Kruskal -Wallis Test and T-test analysis was used to identify the Results.

**Results:** The total estimated cost of 250 type 2 diabetes patients in 2012 is 1369913472 rials, including 1258651472 rials indirect costs of treatment (91.87%) and 111262000 rials indirect non-therapeutic (8.1%). The per capita cost is 5479653 rials .The major parts of medical expenditures are hospital inpatient care (28% of the total medical cost), other cost include Insulin ,Test tape and etc(23% of the total medical cost), Cataract (10.96% of the total medical cost), imaging (9.77% of the total medical cost),prescription medications to treat the complications of diabetes (8.68%),physician visits (7.04%), Testing (6.31%), dialysis(2.6%), wound(2.1%), Physiotherapy (0.89%) and Nutrition counseling (0.18%).

**Conclusion:** This estimate highlights the substantial burden that diabetes imposes on society. Additional components of societal burden omitted from our study include intangibles from pain and suffering, resources from care provided by nonpaid caregivers, and the burden associated with undiagnosed diabetes.

**Keywords:** Type 2 diabetes, Direct costs, Economics

## Introduction

Type 2 diabetes, which is also known as non-insulin-dependent or late onset diabetes, is the most common form of diabetes, and affects around %85- 90% of diabetes patients (1) People can expand Type 2 diabetes at any age, even during childhood. This form of diabetes is forcefully genetic in origin, but lifestyle factors such as excess

weight, inactivity, high blood pressure and poor diet, are its progression risk factors. Nevertheless, the burden of Type 2 diabetes falls disproportionately on older adults, minority ethnic groups and those from lower socio-economic backgrounds. The disease usually begins with insulin resistance, a condition in which fat, muscle, and liver cells do not use insulin properly (2).

The number of people suffering from diabetes worldwide was estimated by the WHO at 135 million in 1995. This figure was projected to more than double by the year 2025, the causes being ageing of the population, unhealthy diet, a sedentary lifestyle and subsequent obesity (3).

In relative terms about 2.1%of the world's population have diabetes, a number which is expected to increase to 3.0% by 2010 (4).It is estimated that more than 10% people are affected by diabetes in Iran and the evaluated prevalence of diabetes on age of 30 years and above in Yazd is 16% (5).Diabetes UK reports that one in 10 people admitted to hospital have diabetes and nearly 15% of deaths per year are caused by diabetes.

Type 2 diabetes affects 85–90% of those with diabetes and is caused by the body not effectively using the insulin it produces because its cells are resistant to the function of the insulin (6).The total economic burden of diabetes in the U.S. was estimated at $218 billion in 2007, (7) Medical expenses for people with diabetes are over two times higher than those for people without diabetes (8).

Type2 diabetes is cause of approximately %85- 90% of all cases of diabetes in the world. Furthermore its increasing health impact the economic burden of diabetes is enormous. A study conducted by the World Bankfound that of 1,362 million DALYs lost to all illnesses in 1990, 7.97 million DALYs (0.59%) were lost to diabetes (9).

In the USA diabetes is known to be a major source of morbidity, mortality and economic expense (10).The International Diabetes Federation (IDF) projections show that the health care expenditures on diabetes will account for 11.6% of the total healthcare expense in the world in 2010 (11).

The report of American diabetes Association the total estimated cost of diagnosed diabetes in 2012 is $245 billion, including $176 billion in direct medical costs and $69 billion in reduced productivity. The largest components of medical expenditures are hospital inpatient care (43% of the total medical cost), prescription medications to treat the complications of diabetes (18%), anti diabetic agents and diabetes supplies (12%), physician office visits (9%), and nursing/residential facility stays (8%).

People with diagnosed diabetes incur average medical expenditures of about $13,700 per year, of which about $7,900 is attributed to diabetes. People with diagnosed diabetes, on average, have medical expenditures approximately 2.3 times higher than what expenditures would be in the absence of diabetes (12).

According to a study by Barquera, There was a significant increase in the prevalence of diabetes from 1994 to 2006 with rising direct costs (2006: outpatient US$ 717,764,787, inpatient US$ 223,581,099) and indirect costs (2005: US$ 177,220,390), and rising costs of complications (2010: Retinopathy US$ 10,323,421; Cardiovascular disease US$ 12,843,134; Nephropathy US$ 81,814,501; Neuropathy US$ 2,760,271; Peripheral vascular disease US$ 2,042,601) (13).

This study was performed to show direct costs of therapeutic and non-therapeutic of type 2 diabetes.

## Materials and Methods

This cross-sectional study was carried out in type 2 diabetic patients referred to Yazd Diabetes Research Center in 2012. Sample size was calculated with sample size calculation formula for limited population by assuming SD=4, d=0. 5 and α=0.05.

The sample was consisted of 250 participators including 231 type 2 diabetic patients referred to Yazd Diabetes Research Center and 19 Diabetes – Dialysis from Shahid Rahnemoon

Hospital (since incidence of kidney failure is 7%, therefore 19 patient were chosen). Demographic information of sample is demonstrated in table 1.

The required data was gathered by checklist. It was composed of 22 questions included: age, sex, duration of diabetes, type of treatment, state of residence, occupation, monthly income, type of insurance , disability insurance, costs of physician visit, nutrition consult, anti diabetic agent, laboratory tests, hospital inpatient care, imaging, wound, cataract , physiotherapy, dialysis , other costs included (Insulin) , travel and accommodation**. After completing check list by type 2 diabetic patients referred to Yazd Diabetes Research Center and 19 Diabetes – Dialysis from Shahid Rahnemoon Hospital, data were analyzed by the statistical package for the social sciences (SPSS) software, version 16.0. T-Test, Mann-Whitney Test and Kruskal -Wallis Test were used for data analysis.

## Results

In this study 250 type 2 diabetic patients (111 male, 139 female) were studied (Table 1).
Microvascular complications were diagnosed in 215 (86%): Neuropathy in 194(77.6%), retinopathy in 69 (27.6%), retinopathy treatment (LASER) in 68(27.2%) and angiography in 58 patients (23.2%). Macrovascular complications were diagnosed in 147 (58.8%): Hypertension in 121(48.4%), coronary heart disease in 58(23.2%), diabetic foot in 27 (10.8%), heart failure in 24(9.6%) and stroke in 5 patients (2%).

Microvascular complications were diagnosed in 119 (55.3%) female, 96 (44.7%) male and macrovascular complications were diagnosed in 80 (54.4%) female, 67 (45.6%) male. According to dialysis per week, patients were divided into 2 groups: 1) fourteen (5.6%) patients 3 times a week and, 2) five (2%) patients 2 times a week 2 times a week.

The cost estimate shown in Table 2. The total estimated cost of 250 type 2 diabetes in 2012 is 1369913472 rials, including 1258651472 rials in direct costs of therapeutic (91.87%) and 111262000 rials in direct costs of non-therapeutic (8.1%). The per capita cost is 5479653 rials. The major parts of medication costs are hospital inpatient care (28% of the total medical cost), costs included Insulin and etc (23% of the total medical cost), cataract (10.96% of the total medical cost), imaging (9.77% of the total medical cost), prescription medications to treat the complications of diabetes (8.68%),physician office visits

**Table 1. Demographic profile of the study population**

| Variable | Frequency (percent) | Total |
|---|---|---|
| **Sex** | | |
| female | 139 (55.6%) | 250 (100%) |
| Male | 111 (44.4%) | |
| **state of residence** | | |
| Native | 243 (97.2%) | 250 (100%) |
| Expatriate | 7 (2.8%) | |
| **occupation** | | |
| Free | 57 (22.8%) | |
| Housekeeper | 130 (52%) | |
| Employee | 17 (6.8%) | 250 (100%) |
| Working | 1 (0.4%) | |
| Retired | 41 (16.4%) | |
| Unemployed | 4 (1.6%) | |
| **insurance** | | |
| Social security | 158 (63.2%) | |
| Health care | 57 (22.8%) | |
| Armed forces | 8 (3.2%) | 250 (100%) |
| Other | 22 (8.8%) | |
| **insurance** | | |
| No | 5 (2%) | |

**Table 2. Describes the total Costs paid by patients for services (fee for service)**

| Costs | Minimum | Maximum | Sum |
|---|---|---|---|
| **Physician's visit** | 13500 | 5400000 | 88647100 |
| **Nutrition consult** | 14000 | 5400000 | 2372000 |
| **Anti diabetic agent** | 19150 | 2631990 | 109314620 |
| **Laboratory tests** | 50000 | 4000000 | 79467192 |
| **Hospital inpatient care** | 300000 | 70000000 | 349195000 |
| **Imaging** | 20000 | 20000000 | 123044560 |
| **Wound** | 40000 | 7000000 | 26480000 |
| **Cataract** | 135000 | 28000000 | 137995000 |
| **Physiotherapy** | 210000 | 7000000 | 11235000 |
| **Dialysis** | 4500000 | 7500000 | 32800000 |
| **Insulin** | 200000 | 7560000 | 298101000 |
| **Travel and accommodation** | 6000 | 21120000 | 111262000 |

(7.04%), testing (6.31%), dialysis (2.6%), wound(2.1%), physiotherapy (0.89%) and Nutrition counseling (0.18%).

Table 3 shows the costs of non- complicated patients in detail. The total estimated cost of non- complicated patients is 198633750 rials, and total cost of patients with complications is 1171279722 rials.

As shown in table 4 costs of dialysis and hospital inpatient care are very high for patients. On Mann-Whitney Test we found statistically significant association between macrovascular complications and costs of testing (*P*=.042), drug (*P*=.000), insulin, test tape (*P*=.053), travel and accommodation (*P*=.008). As well as On Mann-Whitney Test we found statistically significant association between microvascular complications and costs of drug (*P*=.001), insulin (*P*=.001), travel and accommodation (*P*=.040). Correlation was observed with duration of diabetes and costs of drug (*P*=.044), insulin, test tape (*P*=.017) (Table 5).

Results of this study showed that total estimated cost of 250 type 2 diabetes in 2012 is 1369913472 rials, including 1258651472 rials in direct costs of therapeutic (91.87%).

## Discussion

Diabetes mellitus is the most common

**Table 3. Describes the total Costs paid by non-complicated patients**

| Costs | Payment |
|---|---|
| **Physician visit** | 32455000 |
| **Nutrition consult** | 1277000 |
| **Anti diabetic agent** | 41581640 |
| **Laboratory tests** | 24589110 |
| **Insulin** | 87767000 |
| **Travel and accommodation** | 10964000 |
| **Sum** | 198633750 |

metabolic disorder and is prevalent in Yazd province, Iran (14). No study regarding the costs of diabetes has been conducted in this part of Iran; hence we decided to perform a cross-sectional study to record costs of diabetes. This study was conducted on 250 patients with type 2 diabetes.

The total estimated cost of 250 type 2 diabetic in 2012 is 1369913472 rials, including 1258651472 rials in direct costs of therapeutic (91.87%) and 111262000 rials in direct costs of non- therapeutic (8.1%). The per capita cost is 5479653 rials.

The total cost of diagnosed diabetes in 2012 has been estimated to be $245 billion in American, including $176 billion indirect medication costs and $69 billion in reduced productivity. The major parts of medication cost are hospital inpatient care (43% of the total medical cost) (12). This study showed that a hospital inpatient care cost constitutes the largest components of costs (349195000 rials, 28% of the total medical cost).

**Table4- Relation between Costs paid and Macrovascular and Microvascular Complications of type 2 diabetes**

| Variable | Macrovascular complications | | No macrovascular complications | | Mann-whitney test | Microvascular complications | | No microvascular complications | | Mann-whitney test |
|---|---|---|---|---|---|---|---|---|---|---|
| Costs | Mean | SD | Mean | SD | *P*-Value | Mean | SD | Mean | SD | *P*-Value |
| Physician Visit | 181500 | 819780.46 | 109500 | 376453.01 | 0.082 | 156000 | 726288.91 | 97500 | 202397.45 | 0.162 |
| Nutrition Counseling | 25000 | 28112.77 | 25000 | 135712.21 | 0.449 | 25000 | 108536.08 | 25000 | - | 0.899 |
| Drug | 436970 | 427607.91 | 284490 | 378608.73 | 0.001 | 402555 | 436102.81 | 249465 | 138129.86 | 0.001 |
| Testing | 250000 | 547030.99 | 228270 | 459930.69 | 0.042 | 238695 | 483715.71 | 240000 | 688079.04 | 0.526 |
| Imaging | 700000 | 2628677.43 | 430010 | 4033139.72 | 0.086 | 700000 | 3061277.46 | 135700 | - | 0.227 |
| Wound | 555000 | 1613410.28 | 560000 | 622253.96 | 0.771 | 555000 | 1558380.42 | - | - | - |
| Cataract | 4000000 | 9309508.55 | 1000000 | 3702054.04 | 0.156 | 250000 | 8162668.13 | 10500000 | 13435028.84 | 671 |
| Physiotherapy | 450000 | 2320923.36 | 350000 | 145028.73 | 0.355 | 450000 | 2193477.70 | 362500 | 194454.36 | 0.635 |
| Dialysis | 5000000 | 1116542.28 | - | - | - | 5000000 | 1116542.28 | - | - | - |
| Travel And Accommod | 120000 | 2200876.35 | 90000 | 787852.71 | 0.008 | 120000 | 1902504.36 | 80000 | 113826.02 | 0.040 |
| Hospital Inpatient Care | 3000000 | 5841199.72 | 2000000 | 19783054.13 | 463 | 2800000 | 10847409.34 | 1800000 | 1697056.27 | 0.385 |
| Insuli, Test Tape | 1902000 | 1043025.39 | 1462000 | 851037.60 | 0.053 | 1902000 | 998342.92 | 880000 | 586289.59 | 0.001 |

**Table 5. Correlation the Costs paid and duration of diabetes of type 2 diabetes**

| Costs | Duration of diabetes | |
|---|---|---|
| | R | P |
| Physician Visit | .068 | .309 |
| Nutrition Counseling | -.090 | .553 |
| Drug | .133 | .044 |
| Testing | .046 | .513 |
| Imaging | .046 | .552 |
| Wound | -.222 | .275 |
| Cataract | -.166 | .471 |
| Physiotherapy | -.061 | .859 |
| Dialysis | -.089 | .868 |
| Travel And Accommodation | .110 | .096 |
| Hospital Inpatient Care | -.016 | .908 |
| Insulin,Test tape | .175 | .017 |

In a study by Panos et al. reported inpatient costs are constantly higher than outpatient costs in 5 countries, due to increased medical care required with diabetes-related complications. The study estimates that in 2010, the direct cost burden of people with diabetes was highest in Germany, in part due to the greater diabetes population, at €43.2 billion, followed by the UK (€20.2 [£13.8] billion), France (€12.9 billion), Italy (€7.9 billion) and Spain (€5.4 billion) (15), and the study which was performed in U.S. - 2007 showed $218 billion cost (16).

This study represented that direct costs of therapeutic is 91.87% and non- therapeutic is 8.1%, as well as hospital inpatient care costs is largest components of costs (349195000 rials, 28% of the total medical cost).

The reason of difference in the estimated direct costs in this research and other studies may be due to their constituents For example, the difference in the costs of physician visit, drug and tests which account for the costs of manpower, equipment, consumables, transportation and etc, make these expenditures vary in different circumstances of time and place .In general, the factors which cause different results are as follows: health policy difference in different countries - differences in cost calculation methods and patient selection, goals, and the extent of research.

In a study by Mahdavi et al. reported the prevalence of End Stage Renal Disease (ESRD) has increased in Iran from 238.49.9 p.m.p. in 2000 to 357.63.8 p.m.p. in 2006 and costs of month delay dialysis is $1025.31 (17). In our study the mean age was 56.75 and most patients were too old .Also in this study women more than men were at risk of complications from diabetes so that microvascular complications was diagnosed in female 119 (55.3%), 96 (44.7%) male and macrovascular complications was diagnosed in 80 (54.4%) female, 67 (45.6%) male There was correlation between duration of diabetes and costs of drug, insulin and test tape.

Al-Maskari et al 2005 showed that costs increased 2.2 times with the presence of DM related complications for patients with microvascular complications, by 6.4 times for patients with macrovascular complications and 9.4 times for patients with both micro and macrovascular complications (18).

In this study we observed that total cost patients non- complications is 198633750 rials, As well as 1171279722 rials for total cost patients with complications.

Postpone in diagnosis can clearly increase complications and then lead to higher costs. Hypertension, disease duration, age and insulin dependences have multiplicative effect on patients' management costs which shows the impact of diabetes related late complications on the cost.

In a study in Australia.Total (direct plus indirect) health costs averaged $5360 per year. The cost for people with both complications was 2.4 times higher than in people non-complications (19).

Results of this study showed that the cost for people with both microvascular and macro-vascular complications was 5.8 times higher than in people without complications and cost hospital inpatient care in macro-vascular complications was higher than microvascular complications. As well as more costs of macrovascular complication comparing costs of microvascular complication.

This study showed that in costs related to physician office visits, drug , hospital inpatient care, other insurance, in nutrition counseling, testing, imaging ,wound costs, Armed forces insurance, in Cataract, Physiotherapy costs, health care insurance and in dialysis cost, Social security insurance are better and more effective.

In France, all patients suffering from long-term illnesses such as diabetes are under the control of long-term disease system; in addition, national health insurance in 2011 has considered new programs such as the telephone and Internet control (20). But it is not fully covered by insurance in Iran, which make reduction in early diagnosis of diabetes patients and finally excess of complications and costs.

Afkhami et al 2001. showed that prevalence of diabetes in Yazd is evaluated as 14.52%.(14)Now the evaluated prevalence of diabetes in Yazd is 16% .Since the estimated total economic cost of 250 type 2 diabetes in 2012 is 1369913472 rials, so the estimated cost for 176000 type 2 diabetes is 9644190844 rials. Amini et al 1996. Showed that Women of diabetes care the compared with men were at a disadvantage (21).

This study showed more complication in women than in men, high costs in type 2 diabetic patients were observed. As well as this study highlights the large economic burden of diabetes and its complications on the individual and the health care system.

**Limitation of the Study**
1- Missing data over the time.
2-Lack of hospital costs.

**Recommendations:**
1. There is an urgent need to obtain evaluations of the current preventive and control actions taking place in the country.
2. More resources must be directed to diabetes prevention and on translational research; currently it represents only a minor amount of the total diabetes costs.
3. Our analysis suggests that society, insurers, policy makers and other stakeholders could invest up to these amounts in screening, education and prevention efforts in an effort to reduce this costly and traumatic sequel of noncompliant diabetes patients.

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