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Cost of Diabetes mellitus management in a tea plantation–economic evaluation from provider's perspective

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A B S T R A C T

In 2013, 8.56% of Indian population was diabetic. Diabetes affects the productive age group in developing countries and has serious economic implications. The mean diabetic related expenditure per patient in India in 2013 was Rs. 5237. To determine the costs involved in the management of diabetes mellitus from provider perspective and to quantify the contribution of individual components to the total costs. A partial economic evaluation was done from the provider's perspective in tea estates. A structured data extraction form was used to document all expenditure by the estate authorities for the management of diabetes from 2007 to 2013. The direct costs studied included salaries, drugs, laboratory reagents, referrals, hospital bed costs, food, hospital running costs, surgical costs in diabetic patients. The total amount expended by the estate authorities on management of diabetes has increased from Rs. 80,080 in 2007 to Rs. 1,56,429 in 2013. In the year 2013, the cost per diabetic patient was Rs. 2005. Salaries (40.6%) and drugs (54.6%) were the top two major contributors to the total costs. The costs involved in the management of diabetes by the estate authorities have increased over the years.

Introduction

In 2013, the global prevalence of diabetes was 382 million which is expected to rise to 592 million in the year 2035.[1] Nearly 60% of the world's population with diabetes comes from Asia. India and China constitute the major diabetic population of Asia.[2] Diabetes is commonly regarded as one of the major causes for premature deaths worldwide. In 2013, 8.56% of the Indian population was diabetic.[3] It is estimated that the prevalence of diabetes in Southern India ranges from 2.1% to 13.2%.[4]

Diabetes Mellitus (DM) is condition associated with long term complications which affects the quality of life of the patient and health care expenditure.[5, 6] Health care costs can be studied from

patient's perspective and provider's perspective. In the United States of America, average health expenditure is 2.3-fold higher for people with diabetes than for people without the disease.[6] An average Indian in Indian Rupees (INR) with diabetes spends about US$ 575 (INR~ 35650) annually for diabetic care. Indirectly, it is estimated to cost another US$102 (INR~ 6324) or more annually in lost work-time while seeking and undergoing treatment. On extrapolating the direct and indirect estimates to the Indian population, the annual costs for diabetes could be US$ 31.9 billion (INR~2 lakh crores) in 2010. The mean diabetes related expenditure per person with diabetes for Indian population from patients perspective in 2013 was USD 84.419 (INR~ 5237.64).[7] The burden of diabetes complications affects the productive younger age group in developing countries, which has serious economic implications.[8]

In India 70% of the labour force is employed in agriculture sector. Plantation being a part of agriculture directly employs more than 2 million workers in the country. India's total export earnings of agriculture products is about 15% from crops like tea, coffee and rubber.[9] India is the largest producer (31%) and consumer of tea in the world. India's tea plantations are largely grouped into 2 regions – North East India and South India. Assam and West Bengal are the important states in North East India. Tamil Nadu and Kerala are the important southern states.[10]

According to Plantation Labour Act 1951 every plantation should provide and maintain a medical facility for its workers and their family members.[11] In India at tea plantation, workers work in a closed environmental set up where health care costs are maintained by the management. There are no studies done in developing countries with regards to this topic in a plantation setting. The objectives of the study were to determine the direct medical and non-medical costs involved in the management of diabetes mellitus from provider perspective and to quantify the contribution of individual components to the total costs.

Materials and Methods

The study was a retrospective record review study. The study was conducted in tea estates. The total population estimated including dependents of the estates was 2,916 as per the census 2013 in a study area. All the records and documents related to health care costs of the employee and their dependents are documented and well maintained in the hospital run by the estate management.

The study was conducted in January to March, 2014. Ethical approval for this study was obtained from the Institutional Ethical Committee and informed consent was taken from the plantation management. Total of 78 workers and their dependents diagnosed with type II diabetes from the year 2007 to 2013 were included in the study. Contract worker, those diagnosed with gestational diabetes and executives were excluded from the study.

The direct medical and direct non-medical costs were calculated. The direct medical costs taken into account were, drugs and reagents used in the laboratory to diagnose diabetes, referrals, surgeries done on diabetic patients and hospital bed cost. The actual cost of drugs and reagents used in the management of diabetes was calculated. The costs of referrals included payment made towards the hiring the ambulance for transportation and cost of care in the referral hospital for complication of diabetes. The direct non-medical costs were the salary of the personnel involved in the care of diabetes. The personnel costs were calculated based on the number of hours

spent on diabetic care per week and converted to yearly cost.

The following records of the diabetic patients were reviewed, OPD folder for details regarding diagnosis of diabetes, treatment details, complications, referrals, inpatients registers for admissions and treatment, drug profiling and indent register for costs of drug and reagent, yearly demographic report, weekly diabetic clinic registers and surgery record.

The data were coded and entered in Microsoft Excel and analysed using SPSS version 16. The total direct medical and non-medical costs expended for the care in diabetes mellitus by the plantation estate management were computed by adding the individual components of the respective costs. The individual components of the costs were expressed as proportions of the total cost. All costs were analysed as continuous variables. Data was checked for normality using normality tests and plots. Analysis was performed at univariate levels to study groups of relation between costs over time. Statistical test like linear regression and Spearman's correlation test were applied to know the significant associations between costs over time. A p value of <0.05 was considered a significant for all analyses.

Results and Discussion

The total population of workers and dependents in the estate has decreased from 3269 in 2007 to 2957 in 2013. There has been a 9.06 % fall in the total population of the estate over the years. The annual rate of population decline is 1.51% per year.

The total number of diabetic patients in the estate in 2007 was 27. This increased to 78 by the year 2013. Therefore the prevalence rate of diabetics among the general population of the estate increased from 0.8% in 2007 to 2.6% in 2013. The prevalence of diabetes among those aged more than 20 years has increased from 0.85% to 3.5% from 2007 to 2013. An average of 4.14 people per year are newly detected to be diabetic in the estate every year. The trend of the prevalence of diabetes in the population has been depicted in Figure 1.

Hypertension was the most common co-morbidity among the diabetics and peripheral neuropathy was the most common complication related to diabetes. Cardiovascular disease and infections like cellulitis and abscess were the most common reasons for referral.

The expenditure by the estate management for the care of diabetic patients shows a steady increase over the years. In the year 2007, a total amount of Rs 80,080/- was expended by the estate management for the care of diabetics. This amount has steadily increased over the years and the amount expended in the year 2013 was Rs 1,56,429/-. This translates to a 15.89% increase in expenditure towards care for people with diabetes every year. There is a strong positive correlation between the amount expended by the estate towards the care of diabetic patients and the number of diabetic patients (Spearmen's r coefficient = 0.82, $p = 0.023$)

The breakup of the different components of the cost also shows a change over the years. In 2007, a large proportion of the total costs (86%) were expended on direct non medical costs like personnel costs. This was followed by direct medical costs like drugs and reagents (11.4%). Over the years the expenditure on the different components of costs has changed drastically and shows a reverse trend. In 2013, more than half of the

expenditure (54.6%) on diabetes by the estate was on direct medical costs which include drugs and reagents, where as 40.6%. costs were expended for direct non medical costs like health care personnel.

The costs for referral of diabetic patients with complications also show a marginal increase from 2007 to 2013. The referral cost included the cost of transport via ambulance and treatment costs. Majority of the referrals were to secondary and tertiary care hospitals run by the government where all treatment and procedures are provided free of cost. In rare situations, where referrals were made to private health care settings, the costs incurred by the patient were reimbursed by the estate management. Cataract surgery costs fluctuate over the years depending on the number of camps organized by the estate management. The details of the breakup of the different components of costs expended by the estate management over the years have been depicted in Table 1.

The average cost per diabetic patient expended by the estate management for all years was Rs 2300/-. This has shown a declining trend from 2007 where it was Rs 2966/- per patient to Rs 2006/- in the year 2013. There is a negative correlation between the amount expended per patient with time (Spearman's r coefficient = – 0.871, p = 0.005). Linear regression analysis show that the cost per patient has decreased by Rs 170/- per patient per year (p = 0.01). Figure 2 depicts the declining trend in the cost expended per patient per year.

In India, the Plantation Labour Act, 1951 mandates every plantation to provide and maintain a medical facility for its workers and their dependent family members.[11] In a tea plantation setting, the workers work in a set up where all health care costs are borne by the estate management. Diabetes is a growing public health problem especially in developing countries like India. The increasing number of diabetic patients and the need for life-long medication and follow up can be translated into economic terms for the estate management. To the best of our knowledge our study is the first one that looks at the economic evaluation of care for diabetes mellitus in a plantation setting from a health care provider's perspective.

Our study shows a decline in the total population at the estate over the years. This can be attributed to migration of the younger generation from the plantains to the plains in search of more lucrative avenues of livelihood.

The prevalence of diabetes in the age group of 20 to 79 years in a tea plantation setting as of 2013 was 2.6% which was significantly lesser than the prevalence of DM in India (8.56%).The average age of the Indian population is around 28 years[12] where as the population in our study is slightly older (mean 35 years) due to migration of the younger generations to the plains. Despite the higher age distribution, the prevalence of diabetes in our study is lower than the national figures. This can be explained by the relatively better physical activity levels in hilly terrain and healthy dietary habits.

The results of our study show a steady increase in the prevalence of diabetes over the years. There has been a three-fold increase in the total number of diabetics between 2007 and 2013 which increased the total direct cost of diabetic care to the health provider from Rs. 80,080 in 2007 to Rs. 1,56,429 in 2013. This can be attributed to the weekly diabetic clinic started in the year 2009 as a part of the regular health services by the estate management.

Table.1 Break-up of the components of the total direct costs

Proportion of cost	Year						
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Total cost in INR	80,080	91,935	79,760	90,293	92,430	1,19,430	1,56,429
Direct medical costs In INR							
a) Drugs and reagent	9,129 (11.4%)	13,514 (14.7%)	10,209 (12.8%)	20,135 (22.3%)	27,636 (29.9%)	49,085 (41.1%)	85,253 (54.5%)
b)Cataract surgery	0	9,285 (10.1%)	239 (0.3%)	361 (0.4%)	554 (0.6%)	358 (0.3%)	156 (0.1%)
c) Referral	1601.6 (2%)	0	0	451 (0.5%)	554 (0.6%)	5,971 (5%)	7,195 (4.6%)
Direct non-medical costs							
d)Personnel	69,269 (86.5%)	69,227 (75.3%)	69,151 (86.7%)	69,164 (76.6%)	63,591 (68.8%)	63,536 (53.2%)	63,510 (40.6%)

This resulted in screening of the population for diabetes and hence the increase in the newly detected diabetics. Diabetes is a chronic disease that can lead to complications which may need referral to a tertiary care facility. In our study as the number of diabetic patients increase the costs of referral have also gradually increased from 2% in 2007 to 4.6% in 2013. Complications included peripheral neuropathy 13.2%, diabetic retinopathy 2.9% and Coronary Artery Disease (CAD) 1%. Compared to other studies in India where peripheral neuropathy 26.10%[15], diabetic retinopathy 17.6%[15] and CAD 21.4%[16]. CAD was one of the main reasons for referral to tertiary care centres. These referrals made a significant contribution to the costs incurred to the healthcare provider as a result of DM.

We found that the average cost per diabetic expended by the management was Rs. 2005.5 for 2013. This is lower when compared to Diabetic Study showing that the Mean diabetes related expenditure per person in India with DM was USD 84.41 (INR ~ 5237.64) for year 2013. Our study also showed a decrease in the average cost per diabetic patient over the years. This could be due to the fact that the personnel cost has decreased over the years as the existing staff managed the diabetic patients even when the number of patients increased.

In our study we found that in 2007 personal cost formed the major share. But in 2013, 54.5% expenditure was related to diabetic medication and lab reagent.

Figure.1 Prevalence of diabetes in the study population from 2007-2013

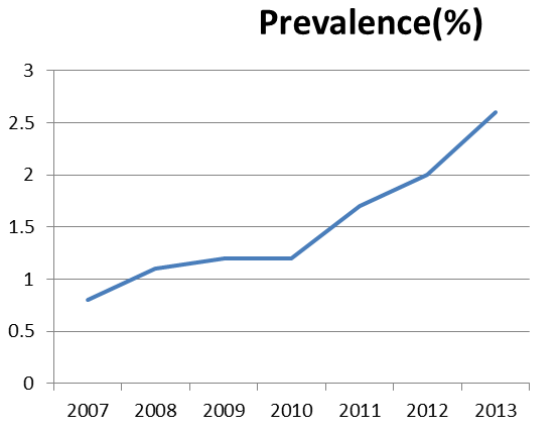
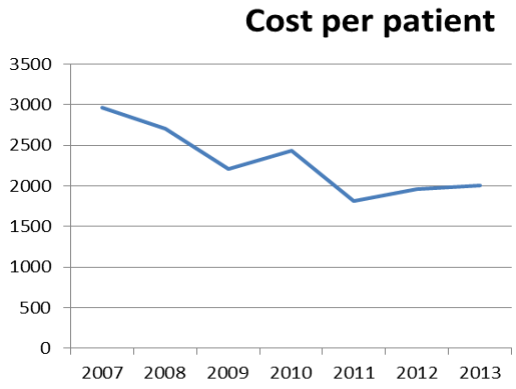


Figure.2 Trend in the Cost per diabetic patient in (INR) from 2007 -2013



Over the years, the proportion of costs spent on health care personnel gradually decreased with a proportional increase in the cost spent on medication and laboratory reagents. This difference in proportions can be explained by sharp increase in newly diagnosed diabetic patients since 2009 on starting weekly diabetic clinics in the estate hospital. These weekly diabetic clinics also ensured better control of sugars and better patient compliance. This also led to a proportional increase in the cost of reagents and drugs purchased. A study conducted in Colombia to estimate the direct cost borne by Ministry of Health and societal perspectives showed that 47% of the direct cost was contributed only by drugs[14].

The limitation of the study was the non-availability of sufficient records to calculate indirect costs. The indirect costs such as work loss due to diabetes, care giver costs and productivity losses of the workers couldn't be calculated. The paucity of data in the field of economic evaluation of diabetes calls for the more research in this field especially in developing countries like India. This in turn will allow better understanding of the effects of the disease, define management strategies and appropriate resource allocation.

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