

What are the direct medical costs of managing Type 2 Diabetes Mellitus in Malaysia?

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ABSTRACT

Introduction: An economic analysis was performed to estimate the annual cost of diabetes mellitus to Malaysia.

Methods: We combined published data and clinical pathways to estimate cost of follow-up and complications, then calculated the overall national cost. Costs consisted of diabetes follow-up and complications costs.

Results: Patient follow-up was estimated at RM459 per year. Complications cost were RM42,362 per patient per year for nephropathy, RM4,817 for myocardial infarction, RM5,345 for stroke, RM3,880 for heart failure, RM5,519 for foot amputation, RM479 for retinopathy and RM4,812 for cataract extraction.

Conclusion: Overall, we estimated the total cost of diabetes as RM2.04 billion per year for year 2011 (both public and private sector). Of this, RM1.40 billion per year was incurred by the government. Despite some limitations, we believe our study provides insight to the actual cost of diabetes to the country. The high cost to the nation highlights the importance of primary and secondary prevention.

KEY WORDS:

Cost; diabetes; diabetic complication; expenditure; Malaysia

INTRODUCTION

Diabetes Mellitus affects more than 382 million people globally and Type 2 Diabetes Mellitus (T2DM) is a leading cause of morbidity and mortality.^{1,2} Like many countries in Asia, economic development in Malaysia has also fuelled an increase in non-communicable diseases (NCD), such as T2DM, which are related to lifestyle and diet.³ It has been estimated that in 2015, there were over 3.5 million adults in Malaysia with diabetes.⁴ According to the National Health and Morbidity Surveys, the prevalence of diabetes has been increasing from 11.6% in 2006 to 15.2% in 2011, and further to 17.5% in 2015.^{4,5} Meanwhile, based on the International Diabetes Federation Diabetes Atlas 2015, Malaysia has the highest prevalence of T2DM at 16.6% in the Western-Pacific region excluding the Pacific Island countries.¹ This was higher than neighbouring countries such as Singapore (12.8%), Indonesia (6.2%), Philippines (6.1%) and Thailand (8.0%).¹

T2DM leads to several types of complications. One of the most common complication is diabetic nephropathy resulting in diabetic kidney disease and kidney failure. In Malaysia, there were 6,222 new cases of diabetes patients requiring dialysis in 2013.⁶ Over the last 15 years, the dialysis treatment rate has increased more than 8-fold in both public and private healthcare facilities.^{7,8} There are also other complications of diabetes such as ischemic heart disease, stroke, retinopathy, foot ulcers and peripheral vascular disease (PVD) which can result in amputation. The UK Prospective Diabetes Study (UKPDS) has reported that in the long-term, up to 15.4 per 1,000 T2DM patients with HbA_{1c} ≥10% would experience a myocardial infarction (MI), 6.0 per 1,000 patients would experience a stroke and 4.7 per 1,000 patients would have an amputation as a result of PVD.⁹

The impact of diabetes on society is substantial. Even without considering the costs of productivity losses and the loss of patients' quality of life, the economic cost to the healthcare system alone is large.¹⁰ Although Malaysia has a parallel public and private system, the majority of treatment for chronic diseases is provided by the public healthcare system which is heavily subsidised by the government. In 2011, the budget allocation to the Ministry of Health (MOH) was RM15.22 billion, equivalent to 7.1% of the entire government budget in the same year.^{11,12} It is important to understand how much of this budgetary resource would be needed to address and manage T2DM and its complications. In addition, Malaysia has begun to use pharmacoeconomic evidence, such as cost-effectiveness analysis, in its regulatory assessments of new drugs.¹³ Hence, the need to have knowledge about the costs of managing diseases has become even more pressing.

There are several studies that have estimated the cost of specific aspects of diabetes treatment in Malaysia. A study by Sharifa Ezat et al., reported on inpatient costs for diabetes in MOH facilities.¹⁴ Diabetes-related admissions into hospitals with specialists and hospitals without specialists were found to cost RM1,951.00 and RM 1,974.44, respectively. Another study conducted by Rohana et al., found that the annual costs of outpatient care in clinics with family medicine specialists (FMS) was RM1,127.91 and RM802.15 at clinics without FMS.¹⁵ Ibrahim et al., reported that inpatient care costs for T2DM admissions in a tertiary hospital was RM2,161. The review also reported that the cost of diabetic

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foot treatment in orthopaedic wards in the same hospital was RM12,934.61.¹⁶ Another study by Goldhaber-Fiebert et al., conducted in multiple Asian countries, including Malaysia, explored the cost of inpatient T2DM treatment and found that the cost ranged from RM1,788 to RM11,396 which were the costs for retinopathy and cerebrovascular disease respectively.¹⁷

The only study to have attempted to estimate the overall cost of diabetes treatment to the Malaysian healthcare system was a multi-country study by Zhang et al., which estimated the cost of diabetes care in 193 countries.¹⁰ Relying on evidence from a not-for-profit US healthcare payer that healthcare expenditure of diabetics were double those of non-diabetics, the study estimated that Malaysia as a nation spent more than USD600 million on treatment of diabetes mellitus (DM) in 2010, equivalent to 16% of total health spending.

While this is a helpful guide to the cost of diabetes in Malaysia, we felt that evidence from local studies might provide a more accurate reflection of actual cost in the local setting than the estimation methodology employed in Zhang et al. And to the best of our knowledge, at the time of study, there were no estimates of the national cost of diabetes from local data. Hence, the objective of this study was to estimate the national cost of managing diabetes and its complications in one year. Secondly, we also intended to estimate the cost incurred by the government of Malaysia.

MATERIALS AND METHODS

This economic costing analysis was performed from a healthcare payer perspective. The study involved a three part exercise. Firstly, we estimated the cost of managing T2DM itself and its individual complications. Costing of several clinical pathways had been conducted as part of an earlier unpublished study which was registered in the National Medical Research Register (NMRR-09-143-3645). The complications considered in the study were MI, stroke, PVD requiring amputation, heart failure (HF), microvascular disease (kidney failure and retinopathy) and cataract extraction.⁹ Next, we obtained the best estimates of disease burden in Malaysia, both for diabetes itself as well as that of its complications. Finally, we calculated the annual cost of T2DM and its complications by taking into account both cost and disease burden using the formula shown in Figure 1.

Estimation of costs

A literature review was performed to assess cost information that has been published related to diabetes in Malaysia. The findings are described in Table I. To ascertain the cost of T2DM management and its related complications, we included the basic cost of diabetes treatment and management, as well as the major long-term complications i.e., MI, stroke, PVD requiring amputation, HF, kidney failure, retinopathy and cataract.⁹ The year of analysis was 2011 based on the latest available data at the time of the study. For two of the complications, kidney failure and cataract surgery, we used costs that had already been published.^{18,19} The costs were inflated to reflect the year of analysis.²⁰ The cost of pre-dialysis treatment and renal transplantation was not included in the study. For other complications, we used costs

calculated in the earlier study which utilised a pathway costing method. These included the cost of MI, stroke, retinopathy, cataract and amputation. Finally, the pathway costing had also been performed for outpatient diabetes care which included cost of clinic visits to the doctor, diabetes educator, investigations and medications. Data sources used are provided in Table II.

Estimation of disease burden

We estimated the size of the DM population using data from the National Health and Morbidity Survey (NHMS) 2011, which was the most up-to-date data available at the time of the study.⁵ The survey results reported a total DM prevalence of almost 2.6 million or 15.2% of the adult population aged 18 years and above. This included both diagnosed and undiagnosed individuals living with diabetes. Among the 1.2 million individuals living with diabetes, from published data, it was assumed that 80.6% received outpatient follow-up at MOH clinics, while 72.2% were admitted to government facilities.⁵

The number of DM-related complications that occur each year was determined by the size of the population at risk multiplied by the probability of complication. This was assumed to comprise of 2.6 million patients (diagnosed and undiagnosed).⁵ Due to the lack of local data on the probability of complications each year, we applied the incidence rate of complications from UKPDS 35 for all complications with the exception of nephropathy.⁹ The incidence of nephropathy was based on Malaysian dialysis statistics which is routinely captured as End Stage Renal Disease due to diabetes by the National Renal Registry.⁶ Only incident dialysis cases attributed to a DM cause were counted towards the cost of DM. The sources of data used to estimate disease burden are listed in Table II.

Analysis

In order to estimate the total cost of diabetes nationally, we applied the estimated unit costs of diabetes and its complications to the number of diabetes patients nationwide. The number of incident complications (MI, stroke, heart failure, amputation, retinopathy, and cataract) were estimated using probabilities derived from the UKPDS. For nephropathy, we used available published data and included the costs of incident dialysis cases attributable to DM as well as for diabetes patients currently in dialysis. Since dialysis is life-long, nephropathy was the only complication assumed to include the costs of existing as well as new patients each year. The cost to the government was estimated based the proportion of patients receiving government funded dialysis. A list of disease burden and cost assumptions is provided in Table III.

Finally, sensitivity analysis was performed to establish a range of highest and lowest likely cost of diabetes using unit costs of treatment from published literature. Data used in the sensitivity analyses are described in Table IV.

The calculations were performed in Microsoft Excel. The reference year was fixed at 2011 as this was the most recent nationally representative survey data available. The USD to RM exchange rate on 30 December 2011 was USD1=RM3.177.²¹

Table I: Published costs of treatment for T2DM in Malaysia from past studies

Condition and Setting	Cost per patient in study year (RM)	Cost per patient, adjusted to 2011 (RM)	Unit	Source
T2DM outpatient care				
MOH health clinics (with FMS)	1,128	1,281	per year	Rohana et al., 2007 ¹⁵
MOH health clinics (without FMS)	802	911	per year	Rohana et al., 2007 ¹⁵
MOH hospital with specialist	773	909	per year	Sharifa Ezat et al., 2009 ¹⁴
MOH hospital without specialist	761	896	per year	Sharifa Ezat et al., 2009 ¹⁴
MOH health clinic	386	454	per year	Sharifa Ezat et al., 2009 ¹⁴
Cardiovascular disease				
Myocardial infarction, tertiary teaching hospital	2,235	2,487	per admission	Goldhaber-Fiebert et al., 2010 ¹⁷
Non-fatal coronary event, public hospitals	3,915-6,976	4,133-7,365	per admission	Clarke et al., 2010 ²²
Fatal coronary event, public hospitals	479-854	506-902	per admission	Clarke et al., 2010 ²²
Cerebrovascular disease				
Tertiary teaching hospital	11,396	12,685	per admission	Goldhaber-Fiebert et al., 2010 ¹⁷
Non-fatal cerebrovascular event, public hospitals	4,495-8,010	4,746-8,457	per admission	Clarke et al., 2010 ²²
Fatal cerebrovascular event, public hospitals	2,511-4,474	2,651-4,723	per admission	Clarke et al., 2010 ²²
Heart failure (HF)				
Non-fatal HF, public hospitals	4,630-8,251	4,888-8,711	per admission	Clarke et al., 2010 ²²
Fatal HF, public hospitals	654-1,166	690-1,231	per admission	Clarke et al., 2010 ²²
Peripheral vascular disease (PVD)				
Tertiary teaching hospital	4,246	4,726	per admission	Goldhaber-Fiebert et al., 2010 ¹⁷
Non-fatal PVD, public hospitals	943-1,680	996-1,774	per admission	Clarke et al., 2010 ²²
Fatal PVD, public hospitals	6,120-10,906	6,461-11,514	per admission	Clarke et al., 2010 ²²
Diabetic foot amputation, tertiary teaching hospital	12,935	14,937	per admission	Ibrahim et al., 2010 ¹⁶
Microvascular disease				
Retinopathy, tertiary teaching hospital	1,788	1,990	per admission	Goldhaber-Fiebert et al., 2010 ¹⁷
Cataract surgery, MOH hospitals	3,750	4,812	treatment	Loo et al., 2004 ¹⁹
Dialysis, MOH centres	33,481	42,362	per year	Hooi et al., 2005 ¹⁸

Abbreviation: FMS – family medicine specialist; MOH - Ministry of Health

Table II: Data sources

Data	Sources
Epidemiological data	
DM-related complications risk	UKPDS 35 ⁹
Adult population in 2011	NHMS 2011 ⁵
Prevalence of known and unknown diabetes	NHMS 2011 ⁵
Treatment provider sector	NHMS 2011 ⁵
Dialysis incidence and prevalence	Malaysian National Renal Registry ⁶
Dialysis funding	Malaysian National Renal Registry ⁶
Primary cause of renal disease	Malaysian National Renal Registry ⁶
Resource use quantities	
Drugs	MOH, clinical experts
Investigations	Clinical expert opinion
Procedures	Clinical expert opinion
Consultations	Clinical expert opinion
Hospitalisations	Clinical expert opinion
Unit costs	
Drugs	MOH, MIMS 127th Ed, 2011 ²⁶
Investigations	MOH, MMA Schedule of fees, 4th Ed, 2002 ²⁷
Procedures	MOH, MMA Schedule of fees, 4th Ed, 2002 ²⁷
Consultations	MOH, MMA Schedule of fees, 4th Ed, 2002 ²⁷
Hospitalisation	MOH, clinical experts

Abbreviations: MMA - Malaysian Medical Association; MOH - Ministry of Health; NHMS - National Health and Morbidity survey; UKPDS - UK Prospective Diabetes Study

Note: Malaysian data sources used which were the NHMS 2011⁵, National Renal Registry⁶ and the MMA Schedule of fees²⁷ are available publically in aggregated form as published in annual reports. Opinions of clinical experts were collected as part of this study.

Table III: List of assumptions

Assumption	Description	Source
A. Epidemiological assumptions		
Population at risk of complications	15.2% of adult Malaysians have diagnosed or undiagnosed diabetes (2.6 million people), and are at risk of complications.	NHMS 2011 ⁵
Diabetes patients on current follow up	7.2% of adult Malaysians are diagnosed with diabetes (1.2 million people).	NHMS 2011 ⁵
Risk of nephropathy complications	Nephropathy complications include incident and prevalent cases in one year	NRR 2013 ⁶
Risk of other complications - MI - Stroke - HF - Amputation - Retinopathy - Cataract	- Includes incident complications only - Only one event is assumed to occur in one year - The proportions (p) of patients experiencing the event are based on the UK population risk factors	UKPDS 35 ⁹
B. General cost assumptions		
Private sector unit costs	Private sector costs were equal to public sector costs.	Assumption
Hospitalization by sector	Hospitalization in the public sector is assumed to be in any government hospital.	NHMS 2011 ⁵
Cost of diabetes outpatient care	Outpatient care costs are incurred by all patients with diagnosed diabetes (1.2 mil people).	NHMS 2011 ⁵
Cost of nephropathy complications	- Annual cost of nephropathy per patient is assumed to be equal to the cost of dialysis in MOH centres. - Excludes the cost of pre-dialysis treatment and renal transplants. - Cost includes government-sponsored dialysis patients in non-government centres	Hooi et al., 2005 ¹⁸ Assumption NRR 2013 ⁶
Cost of complications for: - MI - Stroke - HF - Amputation - Retinopathy - Cataract	- This is assumed to be incurred by a proportion of the diagnosed and undiagnosed diabetics (2.6 mil people) - Cost is calculated for the proportions of patients experiencing the event in one year.	NHMS 2011 ²⁸ UKPDS 35 ⁹
C. Cost to government assumptions		
Costs to the government	Includes costs incurred at or by any government facility	Assumption
Location of service received (applicable to MOH cost calculation)	- 80.6% of T2DM outpatient care was provided at MOH care centres, comprising 56% at MOH clinics and 24.6% in hospitals - 72.2% of patients with complications are treated in MOH hospital (for MI, stroke, HF, amputation, retinopathy, cataract) - For nephropathy, 59% of dialysis patients are government funded.	NHMS 2011 ⁵

Table IV: Sensitivity analysis unit cost inputs (RM)

Condition	Base case input cost (a)	Low sensitivity input cost (b)	High sensitivity input cost (c)	Sources
T2DM outpatient care	459	454	1,281	(a) Present study; (b) Sharifa Ezat et al., 2009 ¹⁴ ; (c) Rohana et al., 2007 ¹⁵
Myocardial infarction	4,817	506	7,365	(a) Present study, (b), (c) Clarke et al., 2010 ²²
Stroke	5,345	2,651	12,685	(a) Present study; (b) Clarke et al., 2010 ²² ; (c) Goldhaber-Fiebert et al., 2010 ¹⁷ ;
PVD requiring amputation	5,519	996	14,397	(a) Present study; (b) Clarke et al., 2010 ²² ; (c) Ibrahim et al., 2010 ¹⁶
Retinopathy	479	479	1,990	(a), (b) Present study, (c) Goldhaber-Fiebert et al., 2010 ¹⁷
Nephropathy	42,362	42,362	42,362	(a), (b), (c) Hooi, et al., 2005 ¹⁸
Cataract	4,812	4,812	4,812	(a), (b), (c) Loo et al., 2004 ¹⁹
Heart Failure	3,880	690	8,711	(a), (b), (c) Clarke et al., 2010 ²²

Table V: Estimated unit costs of diabetes management and treatment of complications

Condition	Costs in 2011 (RM)
<u>Outpatient diabetes care (per patient per year)</u>	
Clinic visits	215
Investigations	78
Medication	166
Total	459
<u>Myocardial infarction (per patient per episode)</u>	
Hospitalisation and medication	3,023
Investigations and procedures	1,648
Outpatient medication	146
Total	4,817
<u>Stroke (per patient per episode)</u>	
Hospitalisation and medication	2,589
Investigations and procedures	1,283
Physical therapy	1,427
Outpatient medication	46
Total	5,345
<u>Retinopathy (per patient per episode)</u>	
Outpatient visits	131
Investigations and procedures	347
Total	479
<u>Foot amputation (per patient per episode)</u>	
Hospitalisation and medication	3,016
Investigations and procedures	2,503
Total	5,519

Note: Values may not add up due to rounding differences

Table VI: Total cost of diabetes management per year

Condition	Base case estimate RM (million)	Low estimate RM (million)	High estimate RM (million)	Cost to Government RM (million)
T2DM outpatient care	554.7	548.6	1,547.4	451.1
Myocardial infarction	307.4	32.3	470.0	222.0
Stroke	92.7	46.0	220.1	67.0
PVD requiring amputation	41.7	7.5	108.9	30.1
Retinopathy	16.9	17.0	70.5	12.2
Nephropathy	918.0	717.2	948.6	543.8
Cataract	65.4	65.4	65.4	47.2
Heart Failure	40.2	7.2	90.3	29.0
Total cost	2,037.1	1,441.1	3,521.0	1,402.5

$$\sum cD = nD^{op} \cdot cD^{op} + nD^k(\rho M \cdot cM + \rho S \cdot cS + \rho H \cdot cH + \rho A \cdot cA + \rho R \cdot cR + \rho E \cdot cE) + nK^l \cdot cK^l - nK^p \cdot cK^p$$

Fig. 1: Note: *cD*=cost of T2DM, *n*=number of patients, *c*=cost, *D^{op}*=outpatients receiving T2DM care, *D^k*=Known and unknown T2DM patients, *p*=probability of the complication occurring in one year, *M*=myocardial infarction, *S*=stroke, *H*=heart failure, *A*=amputation, *R*=retinopathy, *E*=cataract, *K^l*=new nephropathy patients requiring dialysis annually, *K^p*=existing nephropathy patients requiring dialysis annually.

RESULTS

As shown in Table V, we estimated that the annual cost of diabetes follow-up management was RM459 per patient per year. The estimated cost per patient per episode of complication was RM4,817 for MI, RM5,345 for stroke, and

RM479 for retinopathy and RM5,519 for amputation as seen in Table V. The cost of dialysis and cataract surgery was based on two published studies but inflated to the analysis year 2011.^{18,19} Hence, the cost of cataract surgery was estimated at RM4,812 per patient per treatment, based on the cost of conventional extracapsular cataract surgery (ECCE) and phacoemulsification (Table I).¹⁹ The annual cost of dialysis was estimated to be RM42,362 per patient per year, after adjusting from current RM to constant 2011 RM. This included the cost of treatment for haemodialysis (HD) and continuous ambulatory peritoneal dialysis (CAPD) patients.¹⁸

The total annual cost of diabetes and its complications to the nation was estimated to be RM2.04 billion in the base case (Table VI). In the scenario sensitivity analysis, using the lowest possible estimates, the total cost of diabetes was RM1.44 billion whereas using the highest possible estimates, the costs could be as high as RM3.52 billion. The cost incurred by the government corresponding to the base case analysis was estimated at RM1.40 billion.

DISCUSSION

Our estimate of the cost of diabetes to the nation indicates that the annual cost of diabetes and its complications is high at approximately RM2.04 billion, of which RM1.40 billion is incurred by the government. Nearly 70% of the cost is borne by the government since a greater proportion of patients would seek care at MOH facilities for chronic and catastrophic illness. In 2011, this amount of RM1.40 billion corresponded to 9.21% of the entire MOH budget.^{11,12,20} This annual burden, estimated as RM2.04 billion in the base case, could be as high as RM3.52 billion; or as low as RM1.44 billion as indicated by our sensitivity analyses.

An interesting point to note is that our results are similar in magnitude to the findings by Zhang et al., in their study estimating the cost of diabetes for 193 countries. Zhang estimated that Malaysia's expenditure on diabetes in 2010 was USD600.4 million to 1.0 billion in 2010, equivalent to RM1.85 to 3.1 billion based on an exchange rate in 2010 (USD1=RM3.083 on 30 December 2010).^{10,21} It appears that Zhang's estimates for the year 2010 are similar to our base case (RM2.0 billion) and high estimates (RM3.5 billion) for the year 2011. Zhang's estimate was based on a ratio of spending on treatment of diabetes as being between double and triple the expenditure for non-diabetics. Thus, in Malaysia expenditure on diabetes treatment could well be between two or three times the expenditure on non-diabetes treatment. Overall, our findings give an indication that the cost of diabetes to the nation is significant. Furthermore, our results serve as a reminder that a large proportion of the cost of treating T2DM is borne by the government, estimated at RM1.4 billion.

We are inclined to believe that our estimates are conservative. As mentioned above, we calculated the cost burden to the nation using unit costs incurred by the MOH which is widely accepted as being much less than the cost in private. Data from NHMS 2011 indicate that while the majority of DM patients sought care in government health facilities, many also utilise private centres where the costs incurred would be higher.⁵ Furthermore, we only included the ongoing management cost of dialysis for patients with nephropathy. Whereas, the same ongoing additional costs could be applied for patients with other complications who would also require follow-up specific to that complication, especially MI, stroke, heart failure and amputation. If the unit cost from private sector and the cost of all complications follow-up were to be included, then the total costs would likely be closer to the high end estimate. We noted that the unit costs of items included in our analysis seemed to be low. For instance, the estimated cost for non-fatal coronary event was RM4,817 per event in our base case analysis. However, the cost would be higher if the patient received an expensive procedure such as percutaneous coronary angioplasty. We attempted to address this by using a higher value in the sensitivity analysis. It is conceivable that the cost of any complications managed in the private setting could be even higher than the high-end cost estimates we have used (RM7,365).

There are other limitations to our study mainly related to the lack of data. Firstly, there are no readily available databases that can be used to directly ascertain costs in Malaysia and therefore no definitive way of corroborating our findings. In

developed countries, there are administrative databases that can be used to obtain cost data. Since these are not available, we relied on clinical pathways and estimation by clinical experts and published fee schedules. Secondly, we used the UKPDS risk rates to derive the number of incident cases that would have a new complication at any given year. Unfortunately, incidence rates of diabetes-related complications in Malaysia are still lacking. Thirdly, for ongoing treatment, we only included the costs of ongoing dialysis since they are published and likely to be the most impactful. The costs of follow-up for other complications have not been published thus far. Finally, our study did not estimate the unit cost of HF because there has been no local study that directly estimated HF cost. Therefore, we had utilised the cost of HF estimated from a multi-country study published by Clarke et al.²² Despite the limitations which we recognise, to our best knowledge, no recent more up-to-date cost studies on these treatments are available in Malaysia. Our study was conducted to ascertain only the contribution of direct medical costs of diabetes and its complications on the total economic burden of diabetes on Malaysian society. Costs such as loss of productivity (both the patient's and carer's) and cost of disability support should be included in future studies to take into account the societal perspective. If these were included, then the burden of diabetes would be much higher.

The results of our study provide further evidence on the need to strengthen various preventive measures, both primary and secondary, and an improvement in the quality of care. Measures that target the primary prevention of diabetes, ranging from lifestyle and dietary modifications should be made a priority. Secondary prevention once diabetes is diagnosed is also crucial since complications are the major driver of costs. Similar to studies from the US and Europe, we also found that the cost of outpatient follow up is much less than the costs of treating any of the complications.²³ Improving quality of care at the primary care level would require reengineering of the health system to enable better outcomes in diabetes which is a chronic disease. This should be done in line with the Chronic Care Model (CCM).²⁴ Both the Innovative Care for Chronic Conditions (ICCC) Framework and CCM provide specific strategies for creating innovations in the care of chronic conditions.²⁴ Compelling evidence on successful implementation and quality outcomes of innovative programmes in low, middle and high-income countries are available from around the world. The Global Action Plan for the Prevention and Control of NCDs 2013-2020 provides an overall framework for country's response to the NCD epidemic, and Malaysia has its own National Strategic Plan for NCDs.^{25,3} It is hoped that our findings may be helpful to set the stage for policy-making as well as assist in the implementation of any future plans.

In 2012, Malaysia launched its own Pharmacoeconomic Guidelines which demonstrated the country's commitment to selecting the best value-for-money investments in health that would provide benefits to patients in the long-term.¹³ Future studies on the cost-effectiveness of programmes as well as treatment strategies would be needed to better understand what strategies would maximize outcomes for patients while minimizing costs. In order to enable future cost-effectiveness studies to be performed, knowledge of the cost of the disease per se has to be available and we hope that our results

provide further insights into the cost of diabetes at the national level.

CONCLUSION

We performed an economic analysis to estimate the annual cost of diabetes and its complications to the country. We relied primarily on local published costs and cost estimates based on clinical pathway costing. The base case estimate of RM2.04 billion per year is significant and is likely to be conservative. The results should give pause to consider the need for more effective disease prevention, early detection of diabetes and quality care to reduce the risk of diabetes-related complications. We hope that these study findings will help to support advocacy and decision-making on NCD and T2DM related policies. Finally, we hope the results of this study will form the basis of future research to further understand the costs of T2DM in Malaysia and other developing countries.

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CONFLICT OF INTERESTS

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