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Forecasting the cost of diabetes: A systematic review

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ABSTRACT

Background: Diabetes poses a significant global health risk and is a leading cause of death and reduced life expectancy. Objective: A systematic review was conducted to collect studies predicting the economic burden of diabetes, offering insights for policymakers and stakeholders. Methods: A preferred reporting item for systematic reviews and meta-analyses (PRISMA)-guided systematic review identified relevant studies through a literature search in databases like Embase, PubMed, and Cochrane. Study quality was assessed using the Cost of Illness (COI) checklist. All costs were converted to 2024 US dollars after analyzing study characteristics and findings. Results: There were 16 of 1,667 studies from the three databases satisfied the selection and exclusion criteria. Studies were conducted in several nations across Asia, Europe, North America and globally with all studies were modeled using a descriptive cross-sectional design. Studies have projected the cost of diabetes over a period of 1–40 years. Incidence-based and prevalence-based methods were used in these studies. In previous studies, costs ranged from US$0.19 billion to US$3.1 trillion (USD 2024), depending on the region and forecast year. Incidence-based studies estimated total costs at US$15.88 billion. When combining both approaches, the cost range was found to be between US$0.007 billion and US$248.98 billion. Conclusion: Diabetes is forecast to create a huge economic burden on national health systems, society, and the economy. A concerted effort is required to prepare for such changes. To gain a more holistic understanding of the future costs of diabetes, it is vital to expand the research in developing countries.

Keywords: *forecast, cost, diabetes, systematic review*

1. INTRODUCTION

Diabetes mellitus (DM) is a metabolic syndrome with many microvascular complications (e.g., neuropathy, retinopathy, and nephropathy) and macrovascular complications (e.g., coronary heart, cerebrovascular, and peripheral vascular diseases). It is a major global health threat and a leading cause of mortality and reduced life expectancy. In 2017, the International Diabetes Federation (IDF) estimated that 451 million people (aged 18–99 years) worldwide had diabetes and predicted that by 2045, that number would increase to 693 million [1]. An estimated 4.2 million deaths among people aged 20–79 years are attributable to diabetes. Diabetes is estimated to contribute to 11.3% of deaths globally [2]. Diabetes and its complications have a significant financial impact on patients and their families, healthcare systems, and national economies. The global cost of diabetes in 2015 was US$1.31 trillion of the global gross domestic product [3]. In 2019, IDF expected the global direct health spending on diabetes to reach US$760 billion [4]. With rising healthcare costs and limited resources, it is necessary to understand the status and future impacts of DM on the economy. Many studies have predicted the cost of diabetes treatment to forecast its economic consequences to help countries, international health organizations, and local public health agencies plan actions suitable to reduce the burden of diabetes and its complications. Therefore, a systematic review was conducted to synthesize studies that predict and

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provide an overview of the costs of diabetes and inform experts who make policies.

2. METHODS

Research objects: Studies that forecast the cost of diabetes treatment.

Research question

Table 1 shows the research question derived using the PICOS model.

Table 1. PICOS

P (Population)	Diabetic patients
I (Intervention)	Not applicable
C (Comparators)	Not applicable
O (Outcome)	Future cost of diabetes (direct cost, indirect cost), the rising and falling trends of costs
S (Study)	Cost forecasting study

Methods: A systematic review was performed according to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines using the following steps: identification, selection, quality evaluation, data extraction, and synthesis. Two independent researchers conducted all steps of the review process. Disagreements were resolved through discussions between the two researchers and a third member to determine the problem and appropriate solutions.

Identification

E-library data sources, including Pubmed, Embase, and Cochrane, were searched to identify all eligible studies to 24/06/2023. The main keywords for the search were "prediction," "forecast," "projection," "cost," "economic burden," "diabetes," and the operators "and" and "or".

+Pubmed: ((prediction[Title/Abstract]) OR (forecast[Title/Abstract]) OR (projection[Title/Abstract])) AND ((cost*[Title]) OR ('economic burden'[Title])) AND (diabetes[Title/Abstract])

+Cochrane: (#1 or #2 or #3) and (#4 or #5) and #6 with #1: (prediction):ti,ab; #2: (forecast):ti,ab; #3: (projection):ti,ab; #4: (cost*):ti; #5: (economic burden):ti; #6: (diabetes):ti,ab

+Embase: "('prediction':ab,ti OR 'forecast':ab,ti OR 'projection':ab,ti) AND ('cost*':ti OR 'economic burden':ti) AND 'diabetes':ab,ti"

Selection

Relevant studies were considered using the selection and exclusion criteria shown in Table 2.

Table 2. Selection criteria and exclusion criteria

Selection criteria	Exclusion criteria
- Analytical and predictive study - Study of diabetic patients - Result: Future cost of diabetes (direct cost, indirect cost), the rising and falling trends of costs - Study is written in English or Vietnamese	- Unavailable full text - Systematic review - Letter to editorial board, case report, commentary, clinical trial

Extract, synthesize, and present data

Data were extracted, including study characteristics (author name, country, publication year, and perspective), study method (model, forecasting period, discount rate, and type of research cost), study design, and study results (cost and sensitivity analysis). The results were converted to one currency, US$, at the 2024 exchange rate based on the consumer price index (CPI) and the Purchasing Power Parity (PPP), using the tools provided by the CCEMG - EPPI-Centre Cost Converter [5].

Evaluation of research quality

As there was no checklist to evaluate the quality of economic studies on cost forecasting, this study was evaluated using a version of the guide for critical evaluation of COI studies developed by Schnitzler et al. for the express purpose of evaluating and assessing the quality of COI studies [6]. Based on the checklist, the studies were assessed according to 17 items. For each content, the study was scored as follows: 0 = not mentioned; 1 = fully mentioned; and 0.5 = mentioned but incomplete or did not meet the checklist content. Studies with scores of > 12 were included in the analysis.

3. RESULTS

3.1. Identification and selection

Using the database and search commands, we obtained 1,667 results: 436 from PubMed, 482 from Cochrane, and 749 from Embase. After we screened them and removed duplicate studies, 1,201 remained. Given our selection criteria, there were 102 satisfactory studies after we excluded

1,099 studies. There were 34 studies extracted in full-text and 18 studies excluded because of others langugae (6 articles) or not mention cost (12 articles). The remaining nine studies were selected for synthesis, analysis, and evaluation. Figure 1 presents an overall flowchart of the analysis.

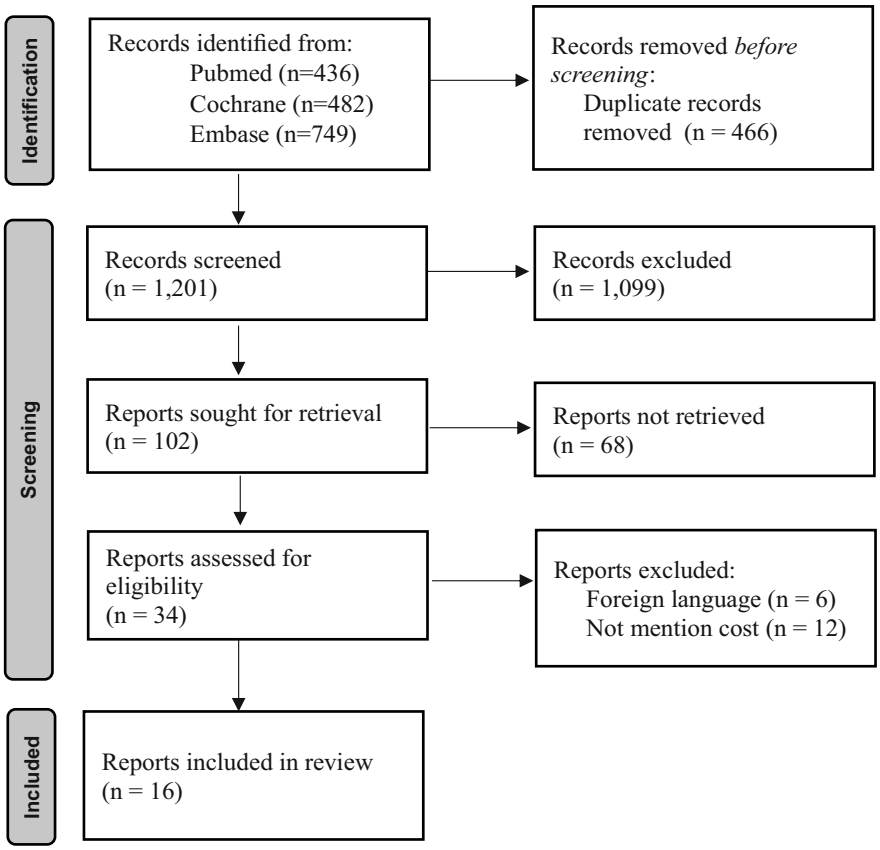

Figure 1. PRISMA flowchart

3.2. Evaluation of research quality

The details of the criteria are presented in Table 2. A summary of the results is presented in Table 3**.** As shown in Table 3, the studies' scores ranged from a low of 12 for Rhys et al. [4] to a high of 13.5 for Hahl et al. [7] and Png et al. [13].

Table 3. The results of the quality assessment of the studies according to the COI checklist

	Study characteristics	Methodology and cost analysis	Results and reporting	Total
Total	**3.0**	**9.0**	**5.0**	**17.0**
Hahl et al. [7]	3.0	9.0	4.5	16.5
Ohinmaa et al. [8]	3.0	8.0	4.0	15.0
Huang ES et al. [9]	3.0	8.7	4.0	15.7
Waldeyer et al. [10]	3.0	8.0	4.0	15.0
Flessa et al. [11]	3.0	8.0	4.5	15.5
Javanbakht et al. [12]	3.0	7.0	4.0	14.0
Png et al. [13]	3.0	7.7	4.0	14.7
Lauffenburger et al. [14]	2.0	7.0	3.0	12.0
Abu-Rmeileh et al. [13]	1.5	7.0	4.0	12.5
Bilandzic et al. [15]	1.5	7.0	4.0	12.5
Bommer et al. [16]	3.0	7.7	4.0	14.7
Panton et al. [17]	3.0	9.0	4.5	16.5
Khanala et al. [18]	3.0	8.0	4.0	15.0
Rhys Williams a et al. [4]	3.0	8.7	4.0	15.7
Di Zhu et al. [19]	3.0	8.0	4.0	15.0
Liu J et al. [20]	3.0	8.0	4.5	15.5

3.3. Characteristics of the studies

Table 4 summarizes the characteristics of the 16 studies.

The research found that the studies were performed in many different countries in Asia (Singapore, Iran, Nepal, and the West Bank in Israel's State of Palestine, China, Cambodia), Europe (Germany, Finland), and North America (Canada and the United States), with were published between 1998 and 2023, as shown in Table 4. In addition, Bommer et al. (2018) and Rhys et al. (2020) forecasted the full global costs of diabetes. These studies combined modeling with descriptive cross-sectional, such as the Markov, DEMOS, simple demographic transition, and OPT IMPACT Diabetes Forecast models. Three of the 16 studies were based on a societal perspective, three on the healthcare system perspective, one on both perspectives; one on provider perspective; the remaining studies did not have a specific perspective. Direct costs were assessed in most studies, and indirect costs were also evaluated in six studies. The majority of studies did not incorporate discounting; however, Abu-Rmeileh et al. [13] applied a discount rate of 3%, 5% and 7%, while Flessa et al. and Hahl J et al. used a discount rate of 5%. To check for plurality, sensitivity analysis was performed using multiple methods.haracteristics of the 16 studies.

Table 4. Characteristics of the studies

Authors	Year	Country	Study design	Model	Perspective	Cost	Discount	Sensitivity analysis
Waldeyer et al. [10]	2013	Germany	Modeling combined with descriptive cross-sectional analysis	Markov	Society	Direct cost	NA	Yes
Ohinmaa et al. [8]	2004	Canada	Modeling combined with descriptive cross-sectional analysis	NA	NA	Direct cost	NA	NA
Png et al. [13]	2016	Singapore	Modeling combined with descriptive cross-sectional analysis	DEMOS	Society	Direct cost, indirect cost	NA	Yes
Panton et al. [17]	2018	America	Modeling combined with descriptive cross-sectional analysis	Simple demographic transition model	NA	Direct cost, indirect cost	NA	NA
Khanala et al. [18]	2019	Nepal	Modeling combined with descriptive cross-sectional	NA	NA	Direct cost	NA	Yes
Javanbakht et al. [12]	2015	Iran	Modeling combined with descriptive cross-sectional analysis	Markov	NA	Direct cost, indirect cost	NA	Yes
Bommer et al. [16]	2018	Global	Modeling combined with descriptive cross-sectional analysis	NA	Society	Direct cost, indirect cost	NA	Yes
Bilandzic et al. [15]	2017	Canada	Modeling combined with descriptive cross-sectional analysis	NA	Health care system	Direct cost	NA	Yes
Abu Rmeile et al. [13]	2017	West Bank	Modeling combined with descriptive cross-sectional analysis	OPT IMPACT Diabetes forecast model	Society and health care system	Direct cost	3%, 5% and 7%	Yes
Flessa et al. [11]	2014	Cambodia	Modeling combined with descriptive cross-sectional analysis	Markov	Health care system	Direct cost	5%	Yes

Authors	Year	Country	Study design	Model	Perspective	Cost	Discount	Sensitivity analysis
Lauffen-burger JC et al. [14]	2017	America	Modeling combined with descriptive cross-sectional analysis	Group-based trajectory models	NA	Direct cost	NA	Yes
Rhys Williams a et al. [4]	2020	Global	Modeling combined with descriptive cross-sectional analysis	NA	NA	Direct cost	NA	No
Di Zhu et al. [19]	2020	China	Modeling combined with descriptive cross-sectional analysis	Autoregressive integrated moving Average (ARIMA) model	NA	Direct and indirect cost	NA	No
Liu J et al. [20]	2023	China	Modeling descriptive cross-sectional analysis	Bayesian model	NA	Direct and indirect costs	NA	No
Hahl J et al. [7]	1998	Finland	Modeling combined with descriptive cross-sectional analysis	Deterministic	Provider	Direct cost	5%	Yes
Huang ES et al. [9]	2009	America	Modeling descriptive cross-sectional analysis	Markov	Health care system	Direct cost	NA	Yes

NA: not answer

3.4. The result of the study

Table 5 presents the conversion of these results into US$ in 2024, based on the CCEMG - EPPI-Centre Cost Converter [5]. As shown in Table 5, one study investigated diabetes patients with type 1, five studies investigated patients with type 2 diabetes, five studies investigated patients with type 1 and type 2 diabetes, and four studies investigated all types of diabetes. Abu-Rmeileh et al. [13] focused on diabetes type 2 and its complications. Most studies were prevalence-based, with the exception of Bilandzic et al. [15], which adopted an incidence-based method and two studies that assessed using both approaches. These studies projected the cost of diabetes over a period of 1–40 years. Png et al. [8] conducted a projection encompassing the longest forecast period of 40 years, spanning from 2010 to 2050, and estimated that the costs in Singapore would reach US$1.87 billion by 2050 (US$2.94 billion when adjusted for 2024). Khanala et al. [18] predicted the cost of diabetes treatment to be US$ 0.24 billion (US$ 0.29 billion in 2024) by 2044. Two studies forecasted costs for 2040: Waldeyer et al. [10] who predicted costs in Germany in 2040 would reach €21.1 billion (US$ 36.51 billion in 2024), and Panton et al. –[17] predicted the costs in 2040 for three North American cities—Houston, Mexico City, and Vancouver—would be US$11.5 billion ($14.06 billion in 2024), US$2.81 billion (US$3.44 billion in 2024), and US$2.59 billion (US$3.17 billion in 2024), respectively. Five studies forecasted costs for 2030: (1) Bommer et al. [16] forecasted global costs would be US$2,500 billion (US$3,060 billion in 2024); based on past trends and US$2,100 billion (US$2,810 billion in 2024) using target scenarios; (2) Rhys Williams et al. [4] also forecasted global costs would be $825 billion (2024 US$ 978.03 billion) by 2030. Furthermore, this study extended its forecasts to 2045, estimating costs to reach $845 billion, or $1,001.74 billion when adjusted for 2024. (3) Javanbakht et al. [12] predicted the total cost of diabetes treatment in Iran would be US$9.0 billion (US$11.60 billion in 2024); and (4) Abu-Rmeileh et al. [13] forecasted costs in the West Bank at US$0.32 billion (US$ 0.38 billion in 2024) for diabetes without complication and 0.57 billion (US$ 0.67 billion in 2024) for diabetes complications in absence of intervention, assuming a discount rate of 3%. Abu-Rmeileh et al. [13] also forecasted costs in 2030 if having action, at US$0.30 billion (US$0.35 billion in 2024) for without complications and 0.35 billion (US$0.41 billion in 2024) for within complications. (5) The study by Liu J et al. [20] conducted in China

estimated that total costs of diabetes in adults would be $460.4 billion (2024 US$ 470.83 billion) in 2030. Two studies forecasted costs in Canada: Bilandzic et al. [15] forecasted US$15.36 billion (US$ 15.88 billion in 2024) by 2021/2022, and Ohinmaa et al. [8] forecasted Can$8.14 billion (US$10.66 billion in 2024) in 2016. The study by Hahl J et al. [7] evaluated type 1 diabetes patients with a 10-year recorded spending period and estimated the total costs of diabetes in adults to reach $171 billion (equivalent to $248.98 billion in 2024) by 2007.

Table 5. The results of the studies

Authors	Population	Approach	Forecasting period	Start year	Cost at starting year	Period	End year	Cost at ending year
Waldeyer et al. [10]	Diabetes Type 2	Prevalence	2010-2040	2010	€11.8 billion (2024 US$20.42 billion)	30	2040	€21.1 billion (US$36.51 billion)
Ohinmaa et al. [8]	Diabetes Type 1 & 2	Prevalence	2000-2016	2000	Can$4.66 billion (US$6.10 billion)	16	2016	Can$8.14 billion (US$10.66 billion)
Png et al. [13]	Diabetes Type 2	Prevalence	2010-2050	2010	- The estimated total economic cost is US$ 0.790 billion (US$1.24 billion) in 2010 - The total economic cost per patient in this population is therefore estimated to be US$5,646 (US$8,884.33) in 2010.	40	2050	-The estimated total economic cost is projected to increase to US$1.87 billion (US$2.94 billion). -The total economic cost per patient in this population is therefore estimated to be US$7,791 (US$ 12,259.62)
Panton et al. [17]	Diabetes Type 1 & 2	Prevalence	2015-2040	2015	Houston: US$6.61 billion ($8.08 billion) Mexico City: US$1.75 billion (US$2.14 billion) Vancouver: US$1.22 billion (US$1.49 billion)	35	2040	Houston: US$11.5 billion ($14.06 billion) Mexico City: US$2.81 billion (US$3.44 billion) Vancouver: US$2.59 billion (US$3.17 billion)
Khanala et al. [18]	Diabetes Type 2	Prevalence	2013-2033	2013	US$0.079 billion (US$0.095 billion)	20	2033	US$0.16 billion (US$0.19 billion)
			2013-2043			30	2044	US$0.24 billion (US$0.29 billion)
Javanbakht et al. [12]	Diabetes Type 1 & 2	Prevalence	2009-2030	2009	Direct costs: US$1.71 billion (US$2.20 billion) Indirect costs: US$1.93 billion (US$2.49 billion) Total costs: US$ 3.64 billion (US$4.69 billion)	21	2030	Direct costs: US$ 4.2 billion (US$ 5.41 billion) Indirect costs: US$ 4.8 billion (US$ 6.18 billion) Total costs: US$ 9.0 billion (US$ 11.60 billion)
Bommer et al. [16]	All diabetes types	Prevalence	2015 – 2030	2015	US$ 1,300 billion (US$ 1,590 billion)	15	2030	The absolute global economic burden was US$2,500 billion (US$ 3,060 billion)

Authors	Population	Approach	Forecasting period	Start year	Cost at starting year	Period	End year	Cost at ending year
Bommer et al. [16]	All diabetes types	Prevalence	2015 – 2030	2015	US$ 1,300 billion (US$ 1,590 billion)	15	2030	when prevalence and mortality increased in line with previous trends, and US$2,100 billion (US$ 2,810 billion) when prevalence and mortality achieved global targets
Bilandzic et al. [15]	Diabetes types 1 & 2	Incidence	2011/ 2012- 2021/ 2022	2012		10	2022	Total costs were 7.55 billion CAD (US$7.81 billion) for females and 7.81 billion CAD (US$8.08 billion) for males (15.36 billion CAD total - US$ 15.88 billion)
Abu-Rmeileh et al. [13]	Diabetes type 2, it's complications	Prevalence	2012-2030	2012	If no national intervention was taken by the governorate, the cost is expected to increase to 0.22 billion (2023 US$ 0.26 billion) in 2015, 0.26 billion (2023 US 0.31 billion) in 2020 and 0.32 billion (2023 US$ 0.38 billion) in 2030 with 3% discounting rate assumption. If obesity prevalence level off by the year 2017, the estimated direct cost of diabetes would be 0.26 billion (2023 US$ 0.31 billion) in 2020, and 0.30 billion (2023 US$ 0.35 billion) in 2030.	18	2030	The estimated direct cost of diabetes complications is 0.35 billion in 2012 (2023 US$ 0.41 billion), 0.47 billion in 2020 (2023 US$ 0.55 billion) and 0.57 billion in 2030 (2023 US$ 0.67 billion) if no intervention takes place. If the prevalence of obesity stopped increases (if action is taken) in 2017, the estimated direct cost for diabetes and its complication almost drop by half.
Flessa et al. [11]	Diabetes type 2	Prevalence, incidence	2008 – 2028	2008	The diagnosed T2DM patients would incur costs of some 0.002 billion US$ (US$ 0.003 billion) to cover all of diabetes treatment	20	2028	This amount will have grown to some 0.004 billion US$ (US$ 0.005 billion). If all patients (incl. non-diagnosed) had to be paid-for the respective figure would be 0.006 billion (US$ 0.007 billion) and 0.011 billion US$ (US$ 0.014 billion).

Authors	Population	Approach	Forecasting period	Start year	Cost at starting year	Period	End year	Cost at ending year
Lauffenburger JC et al. [14]	Diabetes type 2	Prevalence	2012 – 2013	2012		1	2013	Minimal user (14.9%): these patients consistently incur the lowest monthly costs, staying below $400 ($500.76) throughout the 24 months. Low-cost (25.2%): this group has stable monthly costs around $600–$700 ($751.13 – 876.32). Moderate-cost (28.4%): with monthly costs increasing from around $700 ($876.32) at the beginning to about $800 ($1,001.51) by the end of the 24 months. High-cost (25.3%): these patients consistently spend more, with costs fluctuating between $1,400 and $1,800 per month ($1,752.65 and $2,253.40 per month) throughout the period. Rising-cost (6.6%): this group shows a sharp increase in costs, starting from around $600 ($751.13) and rising steeply to nearly $1,800 ($2,253.40), peaking around months 16-18 before stabilizing.

Authors	Population	Approach	Forecasting period	Start year	Cost at starting year	Period	End year	Cost at ending year
Rhys Williams a et al. [4]	Diabetes types 1 & 2	Prevalence	2019 – 2030	2019	$760 billion (2024 US$ 900.97 billion)	11	2030	$825 billion (2024 US$ 978.03 billion)
			2019 – 2045			26	2045	$845 billion (2024 US$ 1,001.74 billion)
Di Zhu et al. [19]	All diabetes types	Prevalence	2019 – 2025	2019	- Direct economic burden were $115.15 billion (2024 US$136.51 billion) - Indirect economic burden were $41.15 billion (2024 US$ 48.78 billion). - Total economic burden were $156.30 billion (2024 US$ 185,30 billion)	6	2025	- Direct economic burden were $125.25 billion (2024 US$ 148.49 billion). - Indirect economic burden were $44.72 billion (2024 US$ 53.01 billion). - Total economic burden were $169.97 billion (2024 US$ 201.50 billion).

Authors	Population	Approach	Forecasting period	Start year	Cost at starting year	Period	End year	Cost at ending year
Liu J et al. [20]	All diabetes types	Prevalence	2020 – 2030	2020	-DC: $190.2 billion (2024 US$ 194.51 billion) - IC: 60.0 billion (2024 US$ 61.36 billion) -TC: $250.2 billion (2024 US$ 255.87 billion)	10	2030	-DC: $337.8 billion (2024 US$ 345.45) - IC: $122.6 billion (2024 US$ 125.38 billion) -TC:$460.4 billion (2024 US$ 470.83 billion) in 2030
Hahl J et al. [7]	Diabetes type 1	Prevalence	1997-2007	1997		10	2007	The 10-year direct costs per child are US$ 217 (2024 US$ 1,979.97) if the genetically targeted approach is used and U$ 619 (2024 US$ 5,647.93) if the pure immunological strategy is chosen.
Huang ES et al. [9]	All diabetes types	Prevalence, incidence	2009-2034	2009	For the Medicare-eligible population: $0.008 billion (2024 US$ 0.011 billion) Spending: $45 billion (2024 US$ 65.52 billion)	25	2034	For the Medicare-eligible population: 0.015 billion (2024 US$ 0.021 billion) Spending: $171 billion (2024 US$ 248.98 billion)

4. DISCUSSION

Based on the selection and exclusion criteria, this systematic review of the cost of diabetes found 16 studies that met the eligibility criteria for analysis. The studies' research-quality scores ranged from 12 to 16.5. Most studies lost points for the following: lack of discounting; description of characteristics of the population, setting, and location; or nondisclosure of funding sources. The studies were carried out in multiple countries, primarily in developed countries. It is necessary to strengthen the research in developing countries to gain a more multidimensional view of the future costs of diabetes. The studies used modeling combined with descriptive cross-sections, and most were from either the societal or healthcare system perspectives. Most studies focused on direct cost analysis, although a few studies investigated indirect costs. Waldeyer et al. [10] and Abu-Rmeileh et al. [21] assessed irrational costs from a social perspective but only assessed direct costs. Javanbakht et al. [12] discovered that indirect costs were higher than direct costs, and that failing to account for indirect costs could result in serious flaws in the estimated costs of diabetes treatment assessment. Most of the studies used forecast periods of more than 10 years; the longest was 40 years. Most studies used a prevalence-based approach that showed costs ranging from US$0.19 billion to $3,060 billion, depending on the region and forecast year. The exception was Bilandzic et al. [15], who used an incidence-based approach and projected the cost of diabetes as CAN$ 15.36 billion (US$ 15.88 billion in 2024) for 2022.

Five studies forecasted the cost of diabetes by 2030 with Bommer et al. [16] and Rhys Williams et al. [4] forecasted costs worldwide. Thus, their cost predictions were broader and larger than the other two studies: $2,100 billion (US$2,810 billion in 2024) with all diabetes types and $825 billion (2024 US$

978.03 billion) with type 1 and type 2 diabetes. The costs predicted by Javanbakht et al. [12] and Abu-Rmeileh et al. [21] were US$9.0 billion (US$ 11.6 billion in 2024) and US$0.57 billion (US$ 0.67 billion in 2023), respectively. Those numbers were significantly different because Javanbakht et al. [12] studied patients with type 1 and type 2 diabetes and assessed direct and indirect costs, while Abu-Rmeileh et al. [21] studied only patients with type 2 diabetes and its complications and only assessed direct costs. Waldeyer [10] and Panton –[17] forecasted the cost of diabetes up to 2040 as €21.1 billion (US$ 36.51 billion in 2024) and US$16.9 billion (US$20.67 billion in 2024), respectively. Panton –[17] evaluated type 1 and type 2 diabetes but investigated only three cities in North America. Thus, the study population was smaller than in Waldeyer's study [10], as reflected in the lower diabetes costs. The projected cost of diabetes in Germany (US$36.51 billion in 2024) in 2040 was 12 times higher than the cost in Singapore (US$ 2.94 billion in 2024) in 2050 [8, 10]. This is consistent with the two countries' populations; Germany's population is 14 times larger than Singapore's [22]. In addition, differences in the countries' economic conditions and each study's assumptions of interventions, health services costs, and drug prices also affected the disparities. Despite these nine studies' differences, our analyses indicated that diabetes would likely pose a significant burden on national health systems, societies, and economies in the future. Accordingly, appropriate measures are required to prevent diabetes and reduce the economic burden.

This study is the most recent systematic review of diabetes costs using systematic search and the recommended review methodology. To avoid study selection bias, two independent reviewers conducted a dual search following the comprehensive inclusion and exclusion criteria. This systematic review provided an overview of diabetes cost projections by synthesizing and analyzing studies that predicted diabetes costs from diverse perspectives. This study provides useful information for decision-makers and planners to help formulate appropriate and timely policies to prevent diabetes and reduce the economic burden of diabetes.

However, the study had some language limitations because it only considered full-text studies in English. Furthermore, the data source was limited to three commonly used electronic data sources, so it did not screen all the relevant studies. No studies were excluded during the study screening process because of language restrictions; therefore, language restrictions did not significantly affect this systematic review. The decision not to exclude research based on specific quality criteria (e.g., study design, cost technique, sample size, or reporting standards) could have led to the inclusion of lower-quality studies with less accurate estimates and jeopardized cross-national comparability. Our primary goal was to achieve a comprehensive global assessment of the literature on the projected costs of diabetes. For reasons often beyond the researchers' control, the included studies might have been of low quality and would have been eliminated if we had used stricter quality parameters.

Forecasting diabetes costs in Vietnam requires addressing the evolving landscape of diabetes management, including the impact of newer interventions aimed at reducing the economic burden associated with treatment and complications. The prevalence of diabetes continues to rise, leading to significant healthcare expenses, including medication, hospitalization, and managing complications such as neuropathy, nephropathy, and cardiovascular issues. Over the years, the costs associated with diabetes care have increased, driven by factors such as an aging population and urbanization. However, the introduction of newer interventions, including advanced medications, technology-based monitoring systems, and lifestyle-focused prevention programs, offers the potential to mitigate these rising costs. These innovations can improve glycemic control, reduce hospital admissions, and minimize long-term complications, leading to potential cost savings.

5. CONCLUSIONS

This review provides an updated and considerably expanded picture of the literature on the future global economic impact of diabetes, offering valuable insights to experts who formulate policies. Diabetes is expected to become an increasingly significant burden on national health systems, the society, and the economy. A concerted effort is required to prepare for such changes. To gain a more holistic understanding of the future costs of diabetes, it is vital to expand the research in developing countries.

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Dự báo chi phí đái tháo đường: Nghiên cứu tổng quan hệ thống

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TÓM TẮT

Bối cảnh: Đái tháo đường là một vấn đề sức khỏe toàn cầu lớn và là nguyên nhân hàng đầu của tử vong và giảm tuổi thọ. Mục tiêu: Nghiên cứu thực hiện tổng quan hệ thống để thu thập các nghiên cứu dự đoán gánh nặng kinh tế của đái tháo đường, cung cấp thông tin hữu ích cho các nhà hoạch định chính sách và các bên liên quan. Phương pháp: Tổng quan hệ thống thực hiện theo hướng dẫn của "Báo cáo ưa thích cho các tổng quan hệ thống và các phân tích gộp" (PRISMA) để xác định các từ khóa, cụm từ và tiêu chí lựa chọn phù hợp thông qua việc tìm kiếm tài liệu từ các cơ sở dữ liệu như Embase, PubMed và Cochrane. Bảng kiểm chi phí bệnh tật (COI) đã được sử dụng để đánh giá chất lượng nghiên cứu. Các chi phí đã được chuyển đổi sang tỷ giá USD năm 2024 sau khi phân tích dữ liệu về các đặc điểm và kết quả nghiên cứu. Kết quả: Trong số 1,667 nghiên cứu từ ba cơ sở dữ liệu, có 16 nghiên cứu đáp ứng được tiêu chí chọn lọc và loại trừ. Các nghiên cứu được thực hiện ở các quốc gia trên toàn châu Á, châu Âu, Bắc Mỹ và toàn cầu, với tất cả các nghiên cứu đều được mô hình hóa bằng thiết kế mô tả cắt ngang. Các nghiên cứu dự đoán chi phí của bệnh đái tháo đường trong khoảng từ 1 đến 40 năm bằng phương pháp dựa trên tỷ lệ hiện mắc và tỷ lệ mới mắc. Dựa trên phương pháp tiếp cận hiện mắc, chi phí dao động từ 0.19 tỷ USD đến 3.1 triệu tỷ USD (USD 2024), tùy thuộc vào khu vực và năm dự đoán. Các nghiên cứu dựa trên tỷ lệ mới mắc ước tính tổng chi phí có giá trị 15.88 tỷ USD. Khi kết hợp cả hai phương pháp, khoảng chi phí được tìm thấy dao động từ 7.16 triệu USD đến 248.98 tỷ USD. Kết luận: Đái tháo đường được dự đoán sẽ tạo ra gánh nặng kinh tế to lớn lên hệ thống y tế quốc gia, xã hội và nền kinh tế. Do đó, cần có sự phối hợp giữa các bên để phòng ngừa cho các biến chứng có thể xảy ra. Để có được sự hiểu biết toàn diện hơn về các chi phí trong tương lai của bệnh đái tháo đường, việc mở rộng nghiên cứu tại các quốc gia đang phát triển là rất quan trọng.

Từ khóa: *dự báo, chi phí, đái tháo thường, tổng quan hệ thống*

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