QUALITY INDICATORS FOR DIABETES MELLITUS: A RAPID EVIDENCE SYNTHESIS

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Abstract

Diabetes is a serious public health problem in Malaysia with the prevalence of type 2 diabetes at 18.3% among adults above the age of 18, affecting 3.9 million individuals as reported by NHMS (2019). Monitoring of diabetes necessitates a set of quality measures comparable with other countries; thus, identifying meaningful indicators is pivotal. This rapid review aimed to identify the quality of care indicators for adults with type 2 diabetes across the continuum of care. A comprehensive MEDLINE search was conducted using PubMed for relevant studies. This search was supplemented by an examination of relevant government and international organisation websites. Records were included if the paper had quality indicators, complete with its numerator and denominator. Non-English articles were excluded. Records were screened and data were extracted into a pre-determined data extraction form. We found 130 records using various search techniques. A total of 27 records were eligible to be included for analysis. The collected indicators were then classified using Donabedian's structure-process-outcome framework, and assigned to six diabetes care categories. The final list of diabetes quality indicators included 65 indicators, with 69% of them being process indicators, 29% outcome indicators and only 2% structure indicators. Two diabetes care categories with the highest number of indicators were risk factors for diabetes complication (n = 14, 22%) and diabetes education (n = 12, 18%). This review aided the establishment of an inventory of international diabetes quality indicators, complete with numerators and denominators, focusing on different aspects of diabetes monitoring across quality domains and levels of health care. This may facilitate our relevant stakeholders in indicator selections, adoption and adaptation in the local context.

Keywords: Diabetes Mellitus, Quality Indicators, Rapid Review

Introduction

Currently, diabetes mellitus (DM) is one of the most significant burdens on public health globally. It is a chronic condition that necessitates extensive medical care as well as several risk-reduction techniques, including glycaemic management. In 2021, over 537 million adults (aged 20-79 years) had diabetes, consuming 10% of global health expenditure; and 79% of people with diabetes lived in low- and middle-income countries (1). In Malaysia, the prevalence of diabetes among Malaysian adults was 18.3% in 2019, higher in women, and peaked in the age group of 65-69 years (43.4%) (2). The prevalence is expected to reach 31.3% for adults aged 18 years by 2025 (3).

Efficient diabetes management is an essential component to prevent or delay the complications and comorbidities of diabetes mellitus. According to Asif (4), diabetes-specific complications can be reduced as a result of good diabetes management. The focus on this management is increasing due to a dedication to integrate care across all stages of care, as well as a growing interest in evidence-based medicine and results. In the process of managing a diabetic patient, a number of factors work together, including patient education, physician adherence to practise recommendations, appropriate consultation, medicine supply, and ancillary services. However, the quality of existing initiatives and the extent to which healthcare personnel adhere to existing standards are unknown.

The Institute of Medicine defines quality in healthcare as having six domains: effectiveness, safety, patient-centeredness, equity, efficiency and timeliness (5). The majority of diabetes quality assessments cite metrics only within the 'effectiveness' domain, such as achieving

glycaemic control and screening for complications (6). Quality indicators for diabetes care are important to monitor the performance and improve healthcare delivery.

Evaluation and monitoring quality of care has become crucial for health care systems worldwide to enhance the responsibility of health care providers, to increase resource allocation efficiency, to minimise medical errors and to improve health outcomes. It can be achieved by using quality indicators, which are based on standards of care and the best available evidence. Health care quality indicators are important tools that can lead efforts to improve patient care.

Quality indicators for diabetes have been developed and published by several organisations in different countries, many of which focus on diabetes care and diabetes prevention (7, 8). However, there is a lack of evidence which looks into quality measurement on DM which incorporates all domains of quality across stages of care (keep healthy, cure when possible, chronic disease and disability, and end-of-life care) (9) including those developed with patient involvement. This rapid review aimed to identify quality indicators used to measure diabetes mellitus among adults over 18 years at all stages of care. This review also used to create internationally comparable diabetes quality indicator inventory to inform respective stakeholders on the potential indicators to be considered in monitoring DM.

Materials and Methods

A rapid review methodology was selected for this evidence synthesis due to the advantages of a systematic approach to review evidence. This review was chosen because of the prioritisation with stakeholders and requirement of information within a short timeframe. A systematic framework to conduct a rapid review has been provided by the Malaysian Alliance for Embedding Rapid Reviews in Health System Decision Making (MAera) (10).

Identifying the research question

To meet the objective of the study, we developed the following research question: 'What are the indicators that can be used to measure diabetes mellitus for all stages of care?'

Identifying relevant studies

A comprehensive search technique using multiple sources was used. Our definition of an indicator explicitly mentioned numerator and denominator.

Data sources

First, we used the PCC (Population, Concept, Context) model (Table 1) to conduct a systematic MEDLINE literature search via PubMed (11).

Table 1: Inclusion and exclusion criteria for identifying diabetes mellitus quality indicator

Population	Concept	Context
Diabetes mellitus type-2	Article that included quality indicators. Explain the numerator and denominator	All stages of care (keep healthy, cure when possible, chronic disease & disability and end-of-life care)
Exclusion criteria: diabetes in pregnancy and diabetes mellitus type-1	No exclusion	No exclusion

Since the indicators of diabetes mellitus with complete formulas were not widely reported in scientific publications, we enriched the systematic approach by performing supplemental grey literature search through targeted website searches.

We checked the websites of international organisations (International Diabetes Federation (IDF), World Health Organization (WHO), and Organisation for Economic Cooperation and Development (OECD)) to include the established surveillance indicators. We searched official Ministry of Health and clinical guideline database websites of the 36 OECD member countries.

Keywords and search strategies for internet and electronic database search Medline (via PubMed)

Specific research questions by articles on diabetes mellitus health indicators orientated on PCC framework, with combinations and truncated variations of the following search terms, were used for database search: Diabetes mellitus, non-insulin dependent diabetes, type 2 diabetes, quality indicator, quality measure, performance measure, performance indicator and all stages of care. Relevant wildcards were used to account for singular and plural forms of each search terms. Variations in spelling were additionally used in varying combinations to broaden the search. The final search strategy is as listed (Table S1, Supplementary Data).

Websites

To enhance the sensitivity of the search strategy, a grey literature search plan was formulated, integrating search strategies in targeted website searches. The process consisted of two steps: first, a Google search was performed to find the organisations and websites that published materials in the desired subject area. Second, the homepages of each of the relevant websites were

'hand-searched' for potentially relevant papers (such as internet pages, reports). Each website was searched using keyword combinations in the database or search bar. Websites without a database or search bar were manually searched (12).

The first step identified relevant international organisations and websites such as the IDF, WHO and OECD. The websites or homepages of these organisations were navigated and explored using the search strategy 'diabetes mellitus indicator'. We additionally searched the Ministry of Health websites of OECD member countries with the search strategy 'diabetes mellitus indicator' and explored the clinical guideline databases from the OECD member countries using the search strategy 'diabetes'. In this step, fifty websites were identified (Table S2, Supplementary Data).

Inclusion criteria

Studies were included if the quality indicators for diabetes mellitus have completed the formula with numerator and denominator. All study designs were considered.

Exclusion criteria

Studies were rejected if they were posters, abstracts, commentaries, or literature reviews. We also excluded records that were not available in English.

Study selection

The title and source of papers identified and considered relevant were entered into an Excel sheet. These papers were screened for duplicates and were excluded using Excel's remove duplicate function. An initial pilot test of 10 papers was conducted to ensure clarity and consistency in the application of the inclusion and exclusion criteria during the title and abstract screening. Eligible articles were identified and analysed in two parts. Firstly, the results of the database search were reviewed by the title and abstract for potential inclusion, using the above-mentioned definitions and criteria. For the second part, the full-text articles for the remaining records which had passed the level 1 screening were retrieved and independently reviewed to satisfy the complete formula with numerator and denominator, and the data were extracted using a standardised data extraction form (Microsoft Excel 2010). Disagreements were discussed between two reviewers, and a third reviewer was consulted if disagreements could not be resolved.

Assessment of methodological quality

Eligible studies from the PubMed database were critically appraised by two independent reviewers for methodological quality using the Joanna Briggs Institute (JBI) critical appraisal checklist (Table S3, Supplementary Data) (13). The cross-sectional research included eight questions with expected responses (Yes, No, Unclear, or Not relevant). We gave 1 point for yes responses and 0 points for no, unclear, and not applicable replies. According to the overall marks per study, we classified studies as having a low, moderate, or high risk of bias. Any disagreements between the reviewers were resolved through consensus or with a third reviewer. On the other hand, quality assessment for grey literature was not done as we assumed that the data from the authorities was deemed reliable (14).

Data extraction

The following parameters were extracted from the papers that were included: i) study characteristics (e.g., year of publication, country of study), ii) List of indicators used and their characteristics (indicator name, definition of indicator, numerator, denominator, standard, quality domain, inclusion and exclusion criteria, data collection method, challenges during data collection and lesson learnt).

Results

The literature search yielded a total of 130 records (Figure 1). We excluded 56 records because they did not have diabetes mellitus indicators and were non-English, leaving us with 74 potential records. Out of the 74 records, 47 were excluded because there were no calculation or formula. We were left with a total of 27 records that met the inclusion criteria. Of these included records, we initially found 190 indicators. After similar and duplicative indicators were combined, 65 unique indicators of diabetes mellitus remained which consisted of structure, process and outcome indicators (Table 2).

The indicators were then grouped into different categories using four disease specific categories from European Union Diabetes Indicators Project (EUDIP) (15): 1) Risk factors for diabetes mellitus, 2) Epidemiology of diabetes mellitus, 3) Risk factors for diabetes complications, and 4) Epidemiology of diabetes complications; and another two categories from research group consensus: 5) Diabetes education, and 6) Health system. Then, these indicators were categorised by type of measure, quality domain, and stages of care (Table 3).

Structure indicators

Only one indicator was identified on assessing the structure necessary to provide high quality diabetes mellitus care (Table 2). This indicator measures the ability for people to access services that are culturally suitable (Table 3).

Process indicators

Most of the indicators (n = 45, 69%) focused on evaluating the processes that must be in place to provide high-quality diabetes mellitus care. Thirty-nine percent of the overall indicators focused on risk factors for type 2 diabetes and diabetes complications (in people with diabetes), which were commonly defined as a possible prevention of diabetes and its complications. Diabetes education represented 18% of overall indicators. These indicators measure diabetes education, intensive lifestyle change, and a structured education programme (Table 3). Lastly,

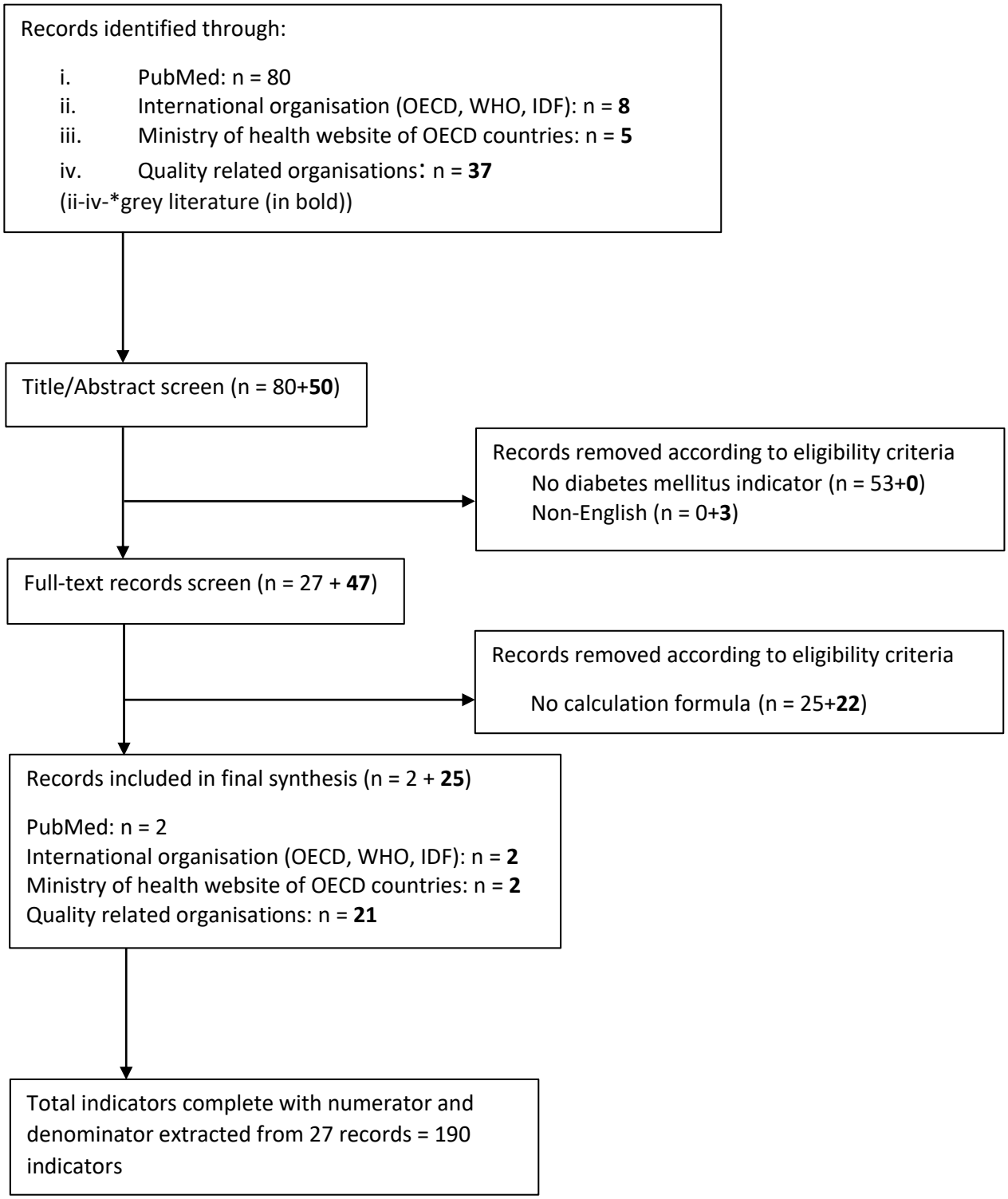

Figure 1: Flow chart rapid review

*First number marks the results found in the PubMed database and second number (in bold) indicates the additional records found in the grey literature

Table 2: Categories of 65 quality indicator for diabetes mellitus identified

Indicator category	n (%)
Structure indicators (n = 1)	
i. Health system	1 (2)
Process indicators (n = 45)	
i. Risk factors for type 2 diabetes	11 (17)
iii. Risk factors for diabetes complication (in people with diabetes)	14 (22)
iii. Epidemiology of complications	8 (12)
iv. Diabetes education	12 (18)
Outcome indicators (n = 19)	
i. Risk factors for diabetes complication (in people with diabetes)	4 (6)
ii. Epidemiology of diabetes	4 (6)
iii. Epidemiology of complications	11 (17)

Table 3: Quality indicators of diabetes mellitus according to European Union Diabetes Indicators Project (i – iv) and additional (v – vi) categories

No.	Indicator	Structure-process-outcome Category	Quality domain	Stages of care	Source of Reference (Appendix)
i. Risk factors for Type 2 Diabetes (n = 11)					
1.	**Prevalence of overweight and obesity over time**	Process	Patient centredness	Keep healthy	21
2.	**Proportion of people not following dietary recommendations**	Process	Adherence	Cure when possible	22
3.	**Proportion of people not following guidelines for physical activity**	Process	Adherence	Cure when possible	22
4.	**Proportion of persons at high risk for diabetes with prediabetes who report increasing their levels of physical activity**	Process	Patient centredness	Cure when possible	22
5.	**Proportion of persons at high risk for diabetes with prediabetes who report trying to lose weight**	Process	Patient centredness	Cure when possible	22
6.	**Proportion of persons at high risk for diabetes with prediabetes who report reducing the amount of fat or calories in their diet**	Process	Patient centredness	Cure when possible	22
7.	**Percentage of people with type 2 diabetes who smoke**	Process	Patient centredness	Cure when possible	5
8.	**Proportion of people who meet guideline targets for weight/body mass index**	Process	Patient centredness	Cure when possible	22
9.	**Percentage of patients with diabetes with measured weight/ BMI within specified timeframe**	Process	Patient centredness	Cure when possible	22
10.	**Proportion of people at risk of Type 2 diabetes who are being opportunistically screened**	Process	Patient centredness	Cure when possible	22
11.	**Proportion of people at risk of Type 2 diabetes who correctly identify that they are at risk and who are taking steps to reduce their risk**	Process	Patient centredness	Cure when possible	22

Table 3: Quality indicators of diabetes mellitus according to European Union Diabetes Indicators Project (i – iv) and additional (v – vi) categories (continued)

No.	Indicator	Structure-process-outcome Category	Quality domain	Stages of care	Source of Reference (Appendix)
ii. Epidemiology of diabetes (n = 4)					
12.	**Prevalence of cardiovascular disease among people with diabetes over time**	Outcome	Health status	Any stage	22
13.	**Prevalence of diagnosed diabetes**	Outcome	Health status	NA	8
14.	**Percentage of people with newly diagnosed type 2 diabetes in one year**	Outcome	Health status	NA	7
15.	**Incidence of diagnosed DM**	Outcome	Health status	NA	24
iii. Risk factors for complications (in people with diabetes) (n = 18)					
16.	**% of type 2 diabetes patient who achieved targeted BP level**	Process	Effectiveness	Chronic disease & disability	24
17.	**% of type 2 diabetes patient with poor BP control**	Process	Effectiveness	Chronic disease & disability	8
18.	**Influenza vaccination among non-institutionalised adults with diagnosed diabetes**	Process	Utilisation	Chronic disease & disability	23
19.	**Pneumococcal vaccination among non-institutionalised adults with diagnosed diabetes**	Process	Utilisation	Chronic disease & disability	23
20.	**Uptake of the Practice Incentives Program (PIP) diabetes incentive**	Process	Utilisation	Chronic disease & disability	23
21.	**% of people with type 2 diabetes formally assessed for well-being in one year**	Process	Utilisation	Chronic disease & disability	23
22.	**% of patients with diabetes with measured BP within specified timeframe**	Process	Timeliness	Chronic disease & disability	22
23.	**% of patients with diabetes who achieved targeted cholesterol level**	Outcome	Effectiveness	Chronic disease & disability	5
24.	**% of patients with diabetes with uncontrolled cholesterol level**	Outcome	Effectiveness	Chronic disease & disability	24
25.	**% of patients with diabetes with measured cholesterol level within specified timeframe**	Process	Timeliness	Chronic disease & disability	22
26.	**% of patients with diabetes who visit dentist within specified timeframe**	Process	Timeliness	Chronic disease & disability	9
27.	**% of patients with diabetes with measured HbA1C within specified timeframe**	Process	Timeliness	Chronic disease & disability	1
28.	**% of type 2 diabetes patient who achieved targeted HbA1c level**	Outcome	Effectiveness	Chronic disease & disability	2
29.	**% of type 2 diabetes patient with poor glycemic control**	Outcome	Effectiveness	Chronic disease & disability	21
30.	**% of type 2 diabetes patient on diet alone with uncontrolled diabetes**	Process	Effectiveness	Chronic disease & disability	22
31.	**Adequate use of cholesterol lowering treatment in people with diabetes**	Process	Utilisation	Chronic disease & disability	25
32.	**First choice antihypertensives for people with diabetes**	Process	Utilisation	Chronic disease & disability	25

Table 3: Quality indicators of diabetes mellitus according to European Union Diabetes Indicators Project (i – iv) and additional (v – vi) categories (continued)

No.	Indicator	Structure-process-outcome Category	Quality domain	Stages of care	Source of Reference (Appendix)
33.	**Proportion of adults with type 2 diabetes who are started on dual therapy when their HbA1c level is 58 mmol/mol**	Process	Utilisation	Chronic disease & disability	12
iv. Epidemiology of complications (n = 19)					
34.	**Prevalence of end-stage kidney disease among people with diabetes over time**	Outcome	Health status	NA	22
35.	**Incidence of end-stage kidney disease among people with diabetes over time**	Outcome	Health status	NA	22
36.	**% of patients with diabetes nephropathy screening within specified timeframe**	Process	Timeliness	Chronic disease & disability	8
37.	**Prevalence of non-traumatic amputation among people with diabetes over time**	Outcome	Health status	NA	7
38.	**Incidence of non-traumatic amputation among people with diabetes over time**	Outcome	Health status	NA	7
39.	**Prevalence of visual loss among people with diabetes over time**	Outcome	Health status	NA	7
40.	**Hospitalisation for ophthalmic conditions with type 2 diabetes as a principal diagnosis**	Outcome	Health status	NA	24
41.	**% of patients with diabetes neuropathy screening within specified timeframe**	Process	Timeliness	Chronic disease & disability	23
42.	**Death rate due to diabetes**	Outcome	Health status	NA	7
43.	**% of patients with diabetes undergone eye assessment within specified timeframe**	Process	Timeliness	Chronic disease & disability	7
44.	**% of patients with diabetes undergone foot assessment within specified timeframe**	Process	Timeliness	Chronic disease & disability	7
45.	**Proportion of presentations of limb-threatening or life-threatening diabetic foot problems in which the multidisciplinary foot care service is informed**	Process	Utilisation	Chronic disease & disability	8
46.	**% of patients aged 18 years and older with a diagnosis of diabetes mellitus who had a neurological examination of their lower extremities within 12 months**	Process	Timeliness	Chronic disease & disability	9
47.	**% of patients aged 18 years and older with a diagnosis of diabetes mellitus who were evaluated for proper footwear and sizing**	Process	Patient centredness	Chronic disease & disability	7
48.	**% of patients with diabetes with measured microalbuminuria within specified timeframe**	Process	Timeliness	Chronic disease & disability	22
49.	**Diabetes hospital admission**	Outcome	Health status	NA	19

Table 3: Quality indicators of diabetes mellitus according to European Union Diabetes Indicators Project (i – iv) and additional (v – vi) categories (continued)

No.	Indicator	Structure-process-outcome Category	Quality domain	Stages of care	Source of Reference (Appendix)
50.	**Incidence of cardiovascular disease among people with diabetes over time**	Outcome	Health status	NA	22
51.	**Prevalence of depressive disorders among adults aged ≥ 18 years with diagnosed diabetes**	Outcome	Health status	Any stage	9
52.	**Quality of life of people with diabetes**	Outcome	Effectiveness	Chronic disease & disability	9
v. Diabetes education (n = 12)					
53.	**% of diagnosed diabetes patient who have taken diabetes education program**	Process	Patient centredness	Chronic disease & disability	3
54.	**% of people with type 2 diabetes receiving nutrition personalised counselling in one year**	Process	Patient centredness	Chronic disease & disability	3
55.	**The proportion of people with diabetes who have received a review of treatment to minimise hypoglycaemia in the previous 12 months**	Process	Patient centredness	Chronic disease & disability	23
56.	**% of people with diabetes routinely performing SMBG**	Process	Patient centredness	Chronic disease & disability	24
57.	**The proportion of people with diabetes who are offered annual care planning**	Process	Patient centredness	Chronic disease & disability	9
58.	**Proportion of adults with type 2 diabetes who are referred for a structured education programme at diagnosis**	Process	Patient centredness	Chronic disease & disability	8
59.	**Proportion of adults with type 2 diabetes who attend a structured education programme after a referral**	Process	Patient centredness	Chronic disease & disability	22
60.	**Proportion of adults with type 2 diabetes who complete a structured education programme**	Process	Patient centredness	Chronic disease & disability	22
61.	**Proportion of adults at high risk of type 2 diabetes who attend an intensive lifestyle change programme after a referral**	Process	Patient centredness	Chronic disease & disability	22
62	**Proportion of adults at high risk of type 2 diabetes who are referred to an intensive lifestyle change programme**	Process	Patient centredness	Chronic disease & disability	22
63	**The proportion of people with diabetes who receiving personalised advice on physical activity**	Process	Patient centredness	Chronic disease & disability	22
64.	**The proportion of people with diabetes who participate in annual care planning**	Process	Patient centredness	Chronic disease & disability	21
vi. Health system (n = 1)					
65	**Ability for people to access services that are culturally suitable**	Structure	Utilisation	Chronic disease & disability	22

12% of overall indicators focused on the epidemiology of complications which included potential processes, such as eye or foot assessment in identifying diabetic neuropathy.

Outcome indicators

Twenty-nine percent of overall indicators focused on the outcomes that occurred when quality diabetes mellitus care was provided. One category among the outcome indicators was focused on the epidemiology of complications, such as nephropathy, amputation, and mortality, which made up 17% of the overall indicators (Table 2). Marking up 6% of overall indicators were the indicator categories of epidemiology of diabetes (focusing on the prevalence and incidence of diagnosed diabetes with other comorbidities), and risk factors for diabetes complications (Table 3).

Discussion

The recent Malaysian National Health and Morbidity Survey conducted in 2019 revealed an increasing health burden from non-communicable diseases, with diabetes mellitus showing an increasing trend (2). The indicators for diabetic mellitus are measurable aspects that provide a quantitative basis for clinicians, organisations, and policymakers, aiming to improve the diabetic care, surveillance activities and their outcomes. This rapid review marks Malaysia's first step to establish a comprehensive database of diabetes mellitus indicators across the different stages of disease, drawing insights from other countries to enable learning through comparison. The results of the rapid review have revealed significant heterogeneity in the categories of quality indicators of diabetes mellitus. Upon further categorisation of the extracted indicators, an uneven distribution became apparent, with the majority focusing on the process of care.

Structure indicators in healthcare refer to the assessment of the infrastructure, resources and organisational characteristics that contribute to the delivery of healthcare services (16). While structure indicators are an essential component of a comprehensive quality assessment, they may appear less prominent because their direct relationship with improving patient outcomes might be less clear compared to process and outcome indicators. Another potential justification for the lack of structural diabetes quality indicators could be their perceived limited actionability, as addressing structural issues often demands more time, resources, system-related changes and substantial investments which might be less feasible. Therefore, the selection of diabetes quality indicators related to structure should be approached cautiously, considering the local context and its constraints.

The primary objective in developing or selecting diabetes quality indicators is to enhance patient outcomes and experiences. As such, greater emphasis is placed on measurable and tangible aspects, such as adherence to the established diabetes best practices (process) and the health status of diabetes patients (outcome). This is evident by the findings of the current study. Process indicators focus on the steps involved in healthcare delivery, evaluating whether protocols and guidelines are being followed (16). Process indicators are more commonly employed as processes are often more easily modifiable than outcomes. The predominant preference for process indicators is typically justified by their numerous advantages over outcome indicators in terms of measurement. For instance, necessary data are often readily available in medical records, and sophisticated case-mix and large sample sizes are generally not required (17). Measurement and improvement initiatives addressing process of care issues are relatively easier to implement. Moreover, establishing a robust process of care for diabetes mellitus will indirectly lead to better long-term outcomes.

Outcome indicators assess the impact of healthcare on patients (16). While process indicators focus on the steps taken, outcome indicators offer a holistic view of the overall diabetes care effectiveness. Often patient-centred, these indicators reflect the ultimate goal of healthcare: improving diabetes care. Outcome data are most useful for tracking diabetic care given by high-volume providers over extended periods, and for detecting issues in the implementation of diabetic care processes (16). While diabetic outcome quality indicators are valuable, a potential weakness is their tedious and expensive measurement due to the unavailability of readily accessible data. Consequently, many health systems have relied on proxy indicators, such as process indicators. Outcome indicators are deemed most crucial for diabetic patients as they ultimately seek healthcare to improve their diabetic care, and they are less concerned with the structures and processes used to deliver it (18). Structure and process indicators, on the other hand, are typically regarded as highly informative for hospital management and internal quality improvement (17).

Among the six diabetes care categories, the highest number of indicators was found in four categories: risk factors for diabetes complications, diabetes education, risk factors for diabetes mellitus and epidemiology of complications. This highlights an increased emphasis on prevention measures and patient empowerment. Given the rising trend of diabetes mellitus among the Malaysian population, these indicators are significant. A pivotal part of diabetes care is undertaken by the patient; hence, patient empowerment is crucial to improve the effectiveness of diabetes self-care management (19, 20). Emphasising preventive measures may contribute to better diabetes control and the prevention of complications, subsequently reducing hospital admission rates, and the financial burden associated with diabetes.

After obtaining a pool of recommended indicators for diabetes mellitus, the selection of indicators for implementation is a challenging yet critical step to avoid generating additional data collection tasks. Ideally, these indicators serve as pointers for the actions needed to enhance surveillance and care for the diabetic population. Developing these indicators can be resource-intensive.

Therefore, it is advised to be selective and to opt for fewer but robust indicators, combined with other quality improvement measures to meaningfully enhance the quality of diabetic care (21-23). Given the potential strain on resources and healthcare staff to report data for newly developed indicators, future research should prioritise revising and adapting existing indicators where possible (24).

As a way forward, the indicators collated from this rapid review can be deliberated by experts from relevant stakeholders to ensure robustness. The input from these experienced individuals, well-versed with the current state of diabetes in Malaysia, is expected to result in the selection of indicators that are meaningful, comparable, feasible, and reproducible in the Malaysian context. Existing quality indicators for diabetes mellitus that are being monitored in Malaysia can also be mapped against this inventory as an input to the relevance of continued monitoring of these indicators. With a myriad of indicators available, it is crucial to consider the type of data painstakingly collected at the ground-level and the measurement requirements. Redundant data collection could overburden healthcare staff at the ground-level, emphasising the importance of thoughtful selection. Future research should focus on refining the existing indicators to guide the assessment of diabetes mellitus care quality, identify unmet needs, inform policy decisions, and improve service provision.

Strengths and limitations

This review is subject to limitations similar to any other review. The search may not have been exhaustive due to language restrictions. Another potential limitation of this study was that we used a rapid review approach, which was less rigorous than a systematic review. Hence, there was a possibility of overlooking grey areas containing relevant indicators as the area explored was focused on diabetes mellitus. Nevertheless, rapid reviews are useful for synthesizing information in a timelier manner.

Ideally, indicators developed are clinical based. However, due to the scientific evidence in healthcare being limited or likely not methodologically rigorous, the indicators are often constructed using consensus methods combined with available published evidence or literature reviews (25). This rapid review was an efficient approach to promptly aid the process of developing indicators to measure diabetes mellitus among adults over 18 years across all stages of care using literature reviews, after which these shortlisted indicators will undergo a series of expert reviews.

Conclusion

As healthcare priorities evolve over time, indicators should undergo periodic revision to reflect the dynamic nature of healthcare. Despite the growing emphasis on non-communicable diseases, developing and evaluating measurable indicators for diabetes mellitus relevant to the Malaysian context pose a challenge due to country-specific restrictions. Leveraging indicators on diabetes mellitus across all stages of care from established surveillance systems in other countries, as identified in our rapid review provides a practical evidence-based database for selecting comparable indicators suited for routine measurement in Malaysia. As highlighted in our results, process and outcome indicators offer a more comprehensive reflection of diabetic care effectiveness. In resource-constrained countries like Malaysia, prioritising these indicators is crucial, given their immediate and direct impact on diabetes patient care. Regardless of the chosen indicator category, feasibility of measurement is a key consideration.

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Competing interests

The authors declare that they have no competing interests.

Ethical Clearance

The study was registered in the National Medical Research Register of Malaysia (NMRR ID: NMRR-20-639-54393) and approved by the Medical Research and Ethics Committee, Ministry of Health Malaysia. No consent to participate was needed as no human subjects were recruited.

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Supplementary Data

Table S1: Search strategy

	Key words	Results
Problem	((("diabetes mellitus") OR "type 2 diabetes") OR "type 2 diabetes mellitus") OR "non-insulin dependent diabetes"	449158
Concept	(("performance measure*") OR "performance indicator*") OR "quality indicator*"	4429
Context	1. (((prevention) OR "preventive care") OR promotion) OR "primary prevention" 2. ((((cure) OR "acute cure") OR "hospital care") OR diabetes care) OR curative 3. (("chronic care") OR "living with illness") OR complication 4. ((("end of life care") OR rehabilitation) OR domiciliary) OR "palliative care"	1840070 263071 305185 685555
	(((((((prevention) OR "preventive care") OR promotion) OR "primary prevention")) OR (((((cure) OR "acute cure") OR "hospital care") OR diabetes care) OR curative)) OR (((("chronic care") OR "living with illness") OR complication)) OR ((((("end of life care") OR rehabilitation) OR domiciliary) OR "palliative care")	2920014
P&C&C	((((((("diabetes mellitus") OR "type 2 diabetes") OR "type 2 diabetes mellitus") OR "non-insulin dependent diabetes")) AND ((("performance measure*") OR "performance indicator*") OR "quality indicator*")) AND (((((((prevention) OR "preventive care") OR promotion) OR "primary prevention")) OR (((((cure) OR "acute cure") OR "hospital care") OR diabetes care) OR curative)) OR ((("chronic care") OR "living with illness") OR complication)) OR ((((("end of life care") OR rehabilitation) OR domiciliary) OR "palliative care"))	80

Table S2: Websites identified through targeted web searches

#	Website name/organization	Link
1	Australian Institute of Health and Welfare	https://www.aihw.gov.au/
2	Australian Government Department of Health and Aged Care	https://www.health.gov.au/
3	Federal Ministry for Social Affairs, Health, Care and Consumer Protection of Austria	https://www.sozialministerium.at/en.html
4	FPS Public Health - Belgium.be	https://www.health.belgium.be/en
5	Canadian Institute for Health Information	https://www.cihi.ca/en
6	Health Canada	https://www.canada.ca/en/health-canada.html
7	Ministry of Health of Chile	https://www.minsal.cl/
8	Ministry of Health of the Czech Republic	https://www.mzcr.cz/en/the-ministry-of-health/
9	Ministry of the Interior and Health of Denmark	https://sum.dk/english
10	Republic of Estonia Health Board	https://www.terviseamet.ee/en
11	Finland Ministry of Social Affairs and Health	https://stm.fi/en/ministry
12	Ministry of Health and Prevention (France)	https://sante.gouv.fr/
13	Robert Koch Institute	https://www.rki.de/EN/Home/homepage_node.html
14	Federal Ministry of Health (Germany)	https://www.bundesgesundheitsministerium.de/en/
15	Ministry of Health (Greece)	https://www.gov.gr/en/upourgeia/upourgeio-ugeias/ugeias
16	Ministry of State for Health (Hungary)	https://www.nnk.gov.hu/
17	Ministry of Health (Iceland)	https://www.government.is/ministries/ministry-of-health/
18	Department of Health (Ireland)	https://www.gov.ie/en/organisation/department-of-health/
19	Ministry of Health of Israel	https://www.gov.il/en/departments/ministry_of_health/govil-landing-page
20	Ministry of Health of Italy	https://www.salute.gov.it/portale/p5_11.jsp
21	Ministry of Health, Labour and Welfare of Japan	https://www.mhlw.go.jp/english/
22	Ministry of Health and Welfare of South Korea	https://www.mohw.go.kr/eng/
23	Ministry of Health of the Republic of Latvia Health Inspectorate	https://www.vi.gov.lv/en/departments
24	Ministry of Health of The Republic of Lithuania	https://sam.lrv.lt/en/
25	Ministry of Health The Luxembourg Government	https://msss.gouvernement.lu/en.html

Table S2: Websites identified through targeted web searches (continued)

#	Website name/organization	Link
26	The Secretariat of Health (Mexico)	https://www.gob.mx/salud/en
27	Ministry of Health, Welfare and Sport (Netherlands)	https://www.government.nl/ministries/ministry-of-health-welfare-and-sport
28	Ministry of Health New Zealand	https://www.health.govt.nz/
29	Ministry of Health and Care Services (Norway)	https://www.regjeringen.no/en/dep/hod/id421/
30	Ministry of Health Republic of Poland	http://www.mz.gov.pl/
31	Ministry of Health Portugal	http://www.min-saude.pt/
32	Ministry of Health of the Slovak Republic	https://www.health.gov.sk/Titulka
33	Ministry of Health Republic of Slovenia	https://www.gov.si/en/state-authorities/ministries/ministry-of-health/
34	Ministry of Health Spain	https://www.sanidad.gob.es/en/home.htm
35	Ministry of Health and Social Affairs (Sweden)	https://www.government.se/government-of-sweden/ministry-of-health-and-social-affairs/
36	Federal Office of Public Health Switzerland	https://www.bag.admin.ch/bag/en/home.html
37	Republic of Türkiye Ministry of Health	https://www.saglik.gov.tr/?_Dil=2
38	The United States Department of Health and Human Services (HHS)	https://www.hhs.gov/
39	Agency for Healthcare Quality (AHRQ)	https://www.ahrq.gov/
40	National Quality Forum	https://www.qualityforum.org/Home.aspx
41	Institute for Healthcare Improvement	https://www.qualityforum.org/Home.aspx
42	Office of Disease Prevention and Health Promotion (ODPHP)	https://health.gov/about-odphp
43	National Committee for Quality Assurance	https://www.ncqa.org/
44	America Diabetes Association	https://diabetes.org/
45	Department of Health and Social Care (United Kingdom)	https://www.gov.uk/government/organisations/department-of-health-and-social-care
46	NHS Digital	https://digital.nhs.uk/
47	The National Institute for Health and Care Excellence	https://www.nice.org.uk/
48	International Diabetes Federation	https://idf.org/
49	Organisation for Economic Co-operation and Development	https://www.oecd.org/
50	World Health Organization (WHO)	https://www.who.int/

Table S3: Risk of bias assessment

Author, Year	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Risk of bias
Klemenc-Ketiš Z, 2017 (Appendix, 1)	Yes	Yes	NA	Yes	NA	NA	Yes	Yes	Moderate risk of bias
Gauthier L, 2014 (Appendix, 1)	Yes	Yes	Yes	Yes	NA	NA	Yes	Yes	Moderate risk of bias

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Appendix 1

Total lists of records included for indicator extraction

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