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Diabetes Screening Interventions in Low- and Middle- Income Countries: A Systematic Review

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Systematic Review

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Abstract

Background

The rising prevalence of type 2 diabetes (T2DM) in low- and middle-income countries (LMICs) places significant strain on already fragile health systems, particularly given that diagnosis is frequently delayed until after serious complications have arisen. Screening interventions can ensure early detection of undiagnosed diabetes hence improve treatment outcomes. Evidence on how successful screening interventions could be designed, implemented, and linked to ongoing care in these resource-limited settings remains fragmented. There is also limited evidence that systematically describes and characterises screening interventions. This study aims to identify and categorise screening interventions for type 2 diabetes (T2DM) in LMICs and to describe their characteristics, implementation outcomes, and contextual factors.

Method

We conducted a systematic review of studies evaluating T2DM screening interventions in adult populations (≥ 18 years) within LMICs. We searched CINAHL, Embase, MEDLINE, PsycInfo, PubMed, and Scopus in March 2026. Two reviewers independently screened studies on Rayyan, extracted data and performed a narrative synthesis. The screening interventions were classified into various key components covering target population, screening test, screening intensity, screening technology/tool, diagnostic criteria, delivery agent/personnel, training component, screening location, geographical and health system setting, program integration and care cascade progression.

Results

From an initial 13,396 identified records, 19 included studies were conducted across 12 countries, with the majority from India (n = 9). Most of the reported screening interventions targeted the general population and were conducted mostly in urban areas (n = 8), within the community, by community health workers. Detection rates were higher for targeted screening approaches. Only three studies reported completion of the care cascade beyond screening. The use of existing health systems, task shifting to community health workers, and adoption of technology were cited as the main facilitators of successful implementation. Limited resources were reported as the main constraint in most studies.

Conclusion

T2DM screening interventions in LMICs are heterogeneous in design and setting. Integration into existing infrastructure, targeting at-risk groups, and task shifting as key facilitators of diabetes screening in LMICs. However, the care cascade revealed major gaps due poor linkage, loss to follow-up, and "screening only" designs, alongside scarce economic evidence. Future programmes should embed linkage-to-care, economic evaluation, and sustainability planning from the outset, prioritizing at-risk populations at the primary healthcare level.

Introduction

Diabetes mellitus is a chronic disease marked by increased blood glucose levels caused by either insufficient insulin production by the pancreas or inefficient insulin utilization by the body[1]. The condition has grown into a major global public health concern due to its rising prevalence, morbidity, and mortality[2]. The burden is driven by socio-economic, demographic, environmental, and genetic factors[3, 4]. About 80% of adults living with diabetes live in low- and middle-income countries[5], where prevalence of diabetes is increasing rapidly as a result of demographic changes, urbanisation, changes in nutritional behaviours and reduced physical activity and increasing obesity[6]. A defining aspect of the burden is the proportion of undiagnosed diabetes. The prolonged asymptomatic phase of the disease keeps it undetected before the symptoms appear[7, 8], [9]. Undiagnosed and therefore unmanaged diabetes increases the risk of complications[10, 11], consequently increasing mortality[12, 13] and further imposes economic burden on individuals, households and health systems[14–16]. Globally, 42.8% of people with diabetes were undiagnosed in 2024, with low- and middle-income countries (LMICs) accounting for a larger proportion of undiagnosed diabetes[17].

Screening through blood sugar tests and risk assessment is essential for early detection of undiagnosed diabetes to prevent morbidity and complications[1, 18]. Through screening, individuals at high risk of developing diabetes, those with hyperglycaemia and prediabetes can be identified for timely lifestyle modification interventions and initiation into treatment at early stages[19][20, 21]. Early interventions have been shown to reduce mortality among prediabetes patients[19]. Furthermore, risk factor screening, educational activities promote adoption of healthier lifestyles hence reducing diabetes morbidity[20, 21]. Screening for diabetes and prediabetes combined with preventative management has been shown to be cost saving from a health system perspective in a high-income setting[22] and low-income settings[23, 24].

International guidelines and recommendations on diabetes screening are inconsistent on who to test, when to begin and how frequently to screen. Based on the International Diabetes Federation 2025 Global Clinical Practice Recommendations for Managing Type 2 Diabetes, diabetes screening should target individuals with risk factors such as excessive weight, family history, or prior gestational diabetes[25, 26]. The American Diabetes Association recommends beginning screening, or at an earlier age for at-risk individuals with repeat screening every three years if normal and annually if prediabetes is diagnosed[27]. World Health Organization Global Diabetes Compact(GDC) that outlines targets for diagnosis and diabetes care for the global diabetes population by 2030[28] The GDC recommends integrating diabetes prevention and management into primary health care as a core component, with a focus on improving access to diagnostics and essential health products[29].

In the absence of consensus, LMICs have adopted diverse approaches to diabetes screening resulting in substantial heterogeneity in screening interventions. In LMICs, screening interventions are implemented at the community or facility level[30]. The implementation outcomes and effectiveness of screening interventions in LMICs are context specific[31] and are influenced by health system challenges including low healthcare capacity and inadequate infrastructure[32], poor referral and follow-up protocols[33], socio-cultural barriers[34], economic constraints in accessing care[35], and persistent health inequalities in underserved populations[36–38]. Screening interventions have been adapted to account for the constraints through task-shifting to community health workers[39, 40], use of non-invasive[41] or risk-score-based screening tools[42], or integration of diabetes screening onto existing healthcare services[43–45]. Despite the adaptations, the reach of preventative interventions including blood glucose screening remains low in LMICs[30].

Most studies in LMICs have reviewed individual aspects of screening like diagnostic accuracy of test methods[46, 47], screening tools[48, 49], cost-effectiveness of screening interventions[31] rather than screening as a complete health system intervention. Existing reviews have been limited to community-based screening interventions[50] and priority population screening[51], leaving a gap in understanding it as a complex health system intervention and how the intervention components influence implementation outcomes across different settings. The shift towards scale-up NCD prevention initiatives in LMICs through universal health coverage(UHC) and donor funded programmes[52–56], necessitate evidence on effective type 2 Diabetes mellitus(T2DM) screening strategies. This systematic review intends to identify, describe, and characterise T2DM screening interventions implemented in LMICs and provide evidence on what strategies work, for whom and under what conditions. The findings will support policymakers and implementers in designing feasible screening interventions that reach the target population, detect cases successfully,and ensure linkage to continuous care.

Methods

Protocol registration and reporting

This systematic review was registered on PROSPERO (CRD420251155518) and has been reported as per the Preferred Reporting for systematic reviews (PRISMA) 2020 guidelines[57].

Study eligibility criteria

Studies were considered eligible for inclusion in the review if they were conducted in LMICs, evaluated diabetes screening interventions, focused on adult populations, published in English language and in peer reviewed journals. Studies were excluded if they focused exclusively on type 1 diabetes, gestational diabetes, or diabetes complications. Studies that focused on measuring prevalence without describing or evaluating an intervention were also excluded. Additionally, reviews, editorials, conference abstracts and grey literature were considered ineligible.

Search strategy and Data sources

The search strategy was developed by combining terms related to "type 2 diabetes mellitus", "screening", and "low- and middle-income countries". The complete search strategy was adapted to the different databases and is presented in Supplementary file 1. We systematically searched CINAHL, Embase (via Ovid), MEDLINE, PsycINFO, PubMed, and Scopus from database inception to March 2026. Other studies were identified using backward citation searching.

Study selection and data extraction

All the records retrieved from the search process were imported in Endnote for deduplication before uploading to Rayyan[58] for further automatic deduplication and screening. Screening was done against the eligibility criteria by two independent reviewers (CA and JOO), with a third reviewer (either CVT or PJD) resolving any resulting selection conflicts. The first stage of screening involved titles and abstracts, followed by full-text review of potentially eligible articles, resulting in the final included studies for extraction. Data were extracted from the studies using an Excel tool that was piloted against three included studies and revised to ensure it captured all the information. Extracted information included study characteristics, population characteristics, screening strategy and implementation, intervention outcomes.

Framework for characterising diabetes screening interventions

Drawing from Dobrow et al.'s consolidated principles for screening as a starting point, we developed a structured framework for characterising diabetes screening interventions. The framework is specific to diabetes screening intervention components and provides a structured approach for extracting, comparing and reporting the characteristics of the screening interventions. The framework consists of core screening components which define what the intervention involves and implementation components which describe the delivery of the intervention. Together, these components cover the *"Who"*, *"What"*, *"Where"*, *"How"* and *"By Whom"* of the screening interventions. The extracted information was examined and grouped into the framework components. The core components include target population, screening method/test, screening intensity, technology/tool, and diagnostic criteria and delivery agent. Implementation components include geographical setting, screening location, health system level, program integration, screening frequency/interval, linkage to care, training. The components might include multiple categories within the same intervention and are not mutually exclusive. The definitions of the framework components and their categories have been presented in **Table 1.**

[TABLE 1]

Risk of bias assessment

Since the review included studies with varying research designs, the Joanna Briggs Institute (JBI) critical appraisal checklists were applied to assess the quality of each study according to its specific design[59]. Specifically, different JBI checklists tailored to study types such as randomized controlled trials, cohort studies, quasi-experimental and cross-sectional studies were used[60].

Data synthesis and analysis

We conducted a narrative synthesis of the extracted information whereby studies were broadly grouped by their characteristics, screening strategy components, screening implementations outcomes. We generated summaries for each group and presented them in tables and graphs. All analyses were conducted using STATA version 19[61].

Results

Out of 13,397 search results retrieved from databases, 19 studies were included in the final review [62–80]. The individual studies have been summarised in **Table 2**.

[TABLE 2]

The selection process and exclusion of studies at each stage have been outlined in the PRISMA flow diagram in **Fig. 1**.

Study characteristics

Out of the included studies, a majority(8) of the studies were published between 2021 and 2024 and were conducted in Asia(9) followed by African regions(6). Most of the included studies were conducted in India(7) and cross-sectional study design was the most common approach(10). **(Fig. 2)**

Screening Intervention Characteristics

The screening interventions were broadly classified according to their target populations into universal screening (11 studies), and targeted screening focusing on at-risk populations (8 studies). In terms of geographical setting, the interventions were implemented in urban areas (8 studies), rural areas (4 studies), and in both rural and urban areas (1 study). Screening interventions were predominantly conducted within the primary healthcare system (16 studies), mainly in locations in the community(10 studies). **(Fig. 2)**

Core Screening Intervention Components

The screening components in each study have been summarized in (**Table 3**).

[TABLE 3]

Target Population

Universal screening of general populations were reported in 11 studies[64, 66, 67, 69, 71–73, 76–79]. Targeted screening was reported in seven studies[62, 65, 68, 70, 74, 75, 80].Targeted screening mainly focused on at-risk populations[75, 80], TB patients[74], family members of known people with diabetes[70]. In one study, both at-risk and general populations were screened each intervention arm/scenario[63].

Screening Method/Test

A wide range of screening tests were used with random blood glucose(RBG/RBS) being the most common initial test(8 studies)[62, 66, 69, 71, 73, 74, 78, 79]. However, some studies noted limitations using this diagnostic modality, especially in variation in timing of last meals[73, 79]. Fasting blood glucose(FBG/FPG/FCPG) was used as a more standardized test in six studies[62, 64, 67, 68, 70, 76]. Risk scores like FINDRISC, Indian Diabetes Risk Score and Thai Diabetes Risk Score were used in four studies[72, 75, 77, 80]. HbA1c[65] and OGTT[63] were used in one study each.

Screening intensity

Most of the studies used a two-step approach to screening (11), with an initial screening or risk assessment followed by a confirmatory test. One step approach involving a single test was used in eight studies. One step screening was mainly used in resource limited settings. For instance, Nuci et al., screened 22.1 million individuals using a single capillary glucose test during a nationwide campaign[76]. Two-step screening typically involves an initial non-invasive or point of care test. For instance, Manios et al. (2020) used FINDRISC in schools, followed by FPG measurement in community clinics[80]. Sathish et al. (2019) used the Indian Diabetes Risk Score (IDRS) as the initial screen, followed by OGTT for those with IDRS ≥ 60[75]. Ekeke et al. (2017) used RBG as the initial screen, with FBG for those with RBG ≥ 110 mg/dL[74].

Screening technology/tool

A variety of screening tools and technologies were used in the 19 studies. For blood glucose measurement, glucometers were widely used in 12 studies[62, 66–71, 73, 74, 76, 78, 79]. The specific devices mentioned included OneTouch Select[66, 67], Abbott Optimum Xceed[79], Accu-Chek Active[62, 74], and FreeStyle Optium[64, 70]. These devices were valued for their portability, low cost, and ease of use by community health workers and non-medical personnel.

Laboratory methods were applied by Adam et al. (2004) used enzymatic methods with a photometer for OGTT[63], while Manios et al. (2020) used accredited laboratories for fasting plasma glucose analysis[80].

Digital platforms, including mobile apps and technologies were used in five studies. Bassi et al. (2023) used the SMARThealth CDSS on Android tablets, which provided automated referrals, electronic health records via OpenMRS, and clinical decision support for ASHAs and PHC physicians[64]. Nong et al. (2024) used the DHIS2 tracker app on tablets, which facilitated data storage, reporting, automatic BMI calculation, and offline data capture with synchronization when the internet was available[77]. Manios et al. (2020) used a combination of digital and paper-based FINDRISC questionnaires[80]. Sathish et al. (2019) used a mixed approach with paper-based IDRS and digital data capture[75]. Kubiak et al. (2021) used a point-of-care HbA1c device (A1cNow®+)[65].

Diagnostic criteria

WHO criteria diagnosis criteria were used in five studies[62, 63, 66, 74, 76] especially in earlier ones. ADA diagnostic criteria were used in five studies[65, 68, 73, 75, 80] mainly recent studies. National guidelines were used in seven studies[64, 67, 69–71, 78] to align with local health systems. For instance, Bassi et al used Indian Research Society for study of diabetes in India (RSSDI) guidelines[64], while Nonterah et al 2024 used Ghana's national guidelines[67].

Implementation components

Delivery Agent

Different cadre groups conducted the screening activities, including medical staff in nine studies[62, 63, 67, 68, 72–74, 76, 78] research staff in four studies[65, 69, 70, 80] Community health workers conducted screening in four studies[64, 71, 75, 77] while multidisciplinary teams with both medical and non-medical staff screened in two studies[66, 79] Medical staff typically comprised of nurses, physicians, pharmacists, laboratory technologists. Community health workers like Accredited Social Health Activists (ASHAs) in India[64] Integrated self-help club(ISHC) volunteers in Vietnam[77] and other trained non-medical workers[75] were effectively used for task-shifting in the screening interventions. Research staff were also trained to perform the screening activities.

Training Provided

Thirteen studies reported providing training to screening personnel while six studies[63, 65, 66, 69, 70, 72] did not report training as part of the screening intervention. Training content varied but typically covered use of equipment, screening protocols and referral procedures. Nucci et al., provided nationwide training to personnel prior to the screening campaign[76]. Bassi et al., conducted initial training followed field practice and another by booster training[64]. Sathish et al… provided initial training and followed by four refresher sessions[75].

Screening Location

Screening was conducted in different settings including the community (10 studies), facility-based settings(7 studies), and both settings(2). The most common community-based setting was homes/households where screening as conducted through included door to door visits[70, 71, 75, 79]. Community centres like schools served as entry points in European countries[80], faith-based centres were used in Ghana[67] and workplace/office in Indonesia[63]. Health camps and community outreaches were used in rural India[73] and Nigeria [62]respectively. A mobile van was also used at the community level to reach underprivileged populations in Delhi[78]. Most studies reporting facility-based screening used primary healthcare centres[64, 66, 68, 76], HIV clinics[65], covid vaccination sites[69] and TB treatment centres[74], providing opportunities for integrated screening for diabetes in some of the studies. Community pharmacies hosted diabetes risk assessment in Thailand[72].

Geographical setting

Eight studies were conducted exclusively in urban settings. The urban settings included Makassar Municipality, Indonesia[63], resource-constrained communities (slums) in Lagos, Nigeria[62], COVID-19 vaccination sites in Johannesburg, South Africa[69], underprivileged urban colonies in Delhi, India[78], HIV testing clinic in Umlazi township, Durban, South Africa[65], Primary Health Centre in Puducherry, India[66], Villianur, Puducherry, India[70] and Hunter region of New South Wales, Australia (urban/suburban), and Central Thailand[72]. Four studies were conducted exclusively in rural settings which included Faith-Based Centres in the Kasena-Nankana Districts of Northern Ghana[67], Webuye town, western Kenya[79], a rural health block in northern India (Punjab/Haryana region)[71] and five districts of Uttar Pradesh, India (Lalitpur, Maharajganj, Sitapur, Shajahanpur, Varanasi)[73]. Seven studies were conducted in both urban and rural settings[64, 68, 74–77, 80].

Health system level

For the majority of the studies(16), screening was conducted at the primary level both at the community and health facilities. For two of the studies, screening was conducted at the secondary level which included family polyclinics in Uzbekistan[68] and hospitals/TB centres in Nigeria[74]. Screening was conducted at both Primary and secondary levels in one study[69].

Program integration

Screening was delivered as a standalone activity in most studies(10 studies). Screening was conducted as an integrated service in three studies[65, 69, 74]. In integrated models, diabetes screening was embedded in existing healthcare services like HIV care, TB services and COVID-19 vaccination. Screening was also offered as part of the NCD package in five studies[64, 71, 77, 78, 80], where screening was jointly done for diabetes and other non-communicable diseases like hypertension.

Screening frequency/interval

Most studies conducted a single round of screening but Gopalan et al conducted periodic screening over a period of three years using a mobile van that visited multiple times to allow for repeat screening[78].

Screening Intervention Outcomes

The screening intervention outcomes were grouped screening performance outcomes, cascade outcomes and economic outcomes and implementation outcomes.

[TABLE 4]

Screening performance outcomes

Screening uptake was reported in nine out of the 19 studies and was notably highest for targeted screening approaches. Ekeke et al reported 100% uptake among newly diagnosed TB patients[74], Ramaswamy et al achieved 99% uptake among family members of people with known diabetes[70]. Sathish et al reported 96% uptake for the initial risk-based screening and 79.1% for OGTT confirmatory test[75]. Population-based mass screening campaigns recorded lower uptake. For instance, Thomas et al reported that only 5.8% of people reached by information, education and communication(IEC) materials attended screening camps[73]. **(Table 4)**

Diabetes detection rates varied across the screening models used. However, most of the studies that reported higher detection rate were those that targeted high risk populations. Adam et al reported a 17.08% detection rate for the office-based arm targeting high risk individuals[63]. Gopalan et al targeted underserved populations and reported a detection rate of 18.7%[78]. Sathish et al. (2019) reported a 16.7% diabetes detection rate among high-risk individuals who underwent OGTT[75]. Other studies also reported a high detection rate for diabetes[64, 66, 76, 79]. Lower detection rates(0.9% – 2.9%) were recorded for studies that targeted the general population like Thomas et al that screened at community camps in India[73], Nonterah et al that screened at faith based centres[67] and Brennan et al, that screened at COVID-19 vaccination sites[69]. Detection rates for prediabetes were reported in five studies[65, 70, 73, 75, 80].

The number needed to screen(NNS), which represents the number of individuals who must be screened to identify one diabetes case, was reported in four studies with studies targeting high risk individuals recording lowest NNS. Sathish et al reported the highest yield with only six individuals needing to be screened to identify one diabetes case[75]. In Nigeria, Ekeke et al reported an NNS of 18 among newly diagnosed TB patients[74]. Higher NNS values corresponding to lower yield were reported for studies that targeted lower risk groups[65, 70]. **(Table 4).**

Economic outcomes

Economic outcomes were reported in only a minority of studies with most of the studies describing only resource inputs required for screening without detailing their costs. The commonly described resource input described in the studies. Included personnel, equipment, training, logistics like transport and mobilization and infrastructure.

Two studies reported cost per case detected for diabetes screening. Sathish et al found that cost per prediabetes case was USD 33.8 and the cost per diabetes case was USD 116.5 using a two-stage screening approach[75]. They also reported that personnel costs constituted nearly two-thirds (63.5%) of total screening costs, but the authors noted that the costs would be lower in real world practice as community health workers would deliver screening as part of routine health services[75]. Alieva et al compared four screening scenarios in Uzbekistan reported that glucose-based screening was 21500 Som per case while HbA1c based screening was 83000 Som per case[68]. The authors concluded that screening for incidental glycemia in patients with at least one risk factor, followed by fasting glucose testing for those with incidental glycemia ≥ 7.8 mmol/L, was the most cost-effective strategy in their setting[68].

Willingness to pay for diabetes screening services was reported in one study that compared WTP for diabetes risk assessment at community pharmacies in Australia and Thailand[72]. The WTP value was higher in Australia (USD 4.2) than Thailand (USD 1.5). A higher proportion of Thai participants (72.4%) were willing to pay for the service compared to Australian participants(18.9%). **(Table 4).**

Reporting of cascade outcomes

Initial diabetes screening was conducted in all the 19 studies as the primary intervention. Linkage to care was done in 14 studies which explicitly reported referring individuals who screened positive to healthcare facilities for confirmatory testing and further management. Confirmatory testing was done in 11 studies[64, 66–68, 70, 71, 74, 75, 77–79] following the initial screening. Six studies[64, 67, 70, 71, 78, 79] reported initiation of treatment among individuals diagnosed with diabetes, which typically involved lifestyle counselling, oral glycaemic agents or insulin where appropriate. Glycaemic monitoring following treatment initiation was done in three studies. Figure 5 shows the clear pattern of attrition of services across the care cascade stages as reported in the studies. **(Fig. 4)**

Only three studies[64, 67, 78] completed the full cascade steps, comprehensively following up participants from initial screening to glycaemic monitoring. Gopalan et al conducted periodic screening and follow-up over three years that allowed glycaemic monitoring over time[78]. Nonterah et al assessed glycaemic control during follow-up at health facilities[67] while Bassi et al measured HbA1C at follow-up as part of their NCD package[64]. Four studies [63, 72, 73, 80] showed significant gaps as they only completed the screening step and did not report further services in the cascade. Nong et al., reported screening and confirmatory diagnosis without information on referral for further care or management[77]. Other studies[62, 65, 69, 76] reported linkage to care but did not conduct confirmatory diagnosis, suggesting that patients were referred for further care based on the initial screening test alone. **(Fig. 5)**

Implementation outcomes

The main implementation outcomes of the screening interventions extracted from the studies included their feasibility, sustainability and the barriers and facilitators to their successful implementation as reported in each study.**(Table 5)**

[TABLE 5]

Feasibility

All the 19 studies reported on the feasibility of the respective screening interventions across the different settings. Bassi et al reported feasibility of task shifting to community health workers. Nucci et al. (2004) successfully implemented a nationwide screening campaign across 5,301 municipalities in Brazil, screening 22.1 million individuals, corresponding to 73% of the target population[76]. Gopalan et al. (2019) demonstrated feasibility of mobile van-based screening across 10 underprivileged areas over three years, conducting over 312,000 visits[78]. Ramaswamy et al. (2019) achieved 99% coverage of eligible family members through home-based screening, leveraging existing health system contact[70]. While Nong et al found that the digital screening app was feasible, its use was hindered by limited digital literacy among older volunteers[77]. **(Table 5)**

Sustainability

Sustainability of the interventions were discussed in all the 19 studies; six implemented concrete plans for sustainability during the study period while 13 provided recommendations for sustainability.

The studies that reported explicit plans through actions to ensure sustainability beyond the study included Nonterah et al. (2024) that aligned their intervention with Ghana Health Service's Network of Practice (NoP) policy, ensuring integration into existing primary care systems, and engaged faith leaders to support long-term adherence[67]. Gopalan et al. trained 292 frontline workers and 256 medical and paramedical staff, established community ambassadors to ensure sustainability post-project[78]. Nucci et al. embedded their nationwide campaign within the broader Plan for Reorganization of Care for Arterial Hypertension and Diabetes Mellitus[76]. Bassi et al. (2023) embedded the intervention within the existing public healthcare system using routine workforce (ASHAs and PHC physicians)[64]. Pastakia et al. (2013) leveraged a partnership with the Kenyan Ministry of Health for wide-scale implementation and integrated screening with existing community health workers and HIV infrastructure[79].

Studies that did not implement concrete plans only provided recommendations for sustainability which included: strengthening referral and linkage systems[71, 74], integrating into existing health systems[69, 71, 80], establishing national steering committees or policies[62, 68], scaling up through community health worker training[66, 70, 73], and adapting strategies to local context[72]. Adam et al. (2004) recommended targeted over population-based screening as more sustainable[63]. **(Table 5)**

Facilitators

All the 19 studies reported facilitating factors for the intervention implementation. The most cited facilitators were existing health system infrastructure, task sharing and task shifting with existing health workers, point of care testing, community engagement.

Existing health system infrastructure was leveraged in eight studies that used COVID-19 vaccination sites[69], HIV testing clinics[65], TB clinics[74], community pharmacies and others that also used primary care facilities[76]. Task-sharing was demonstrated as a facilitator in five studies including Alieva et al., 2022 that reported that used general practitioners who achieved similar outputs as endocrinologists[68]. In other settings, ASHAs[64], non-medical staff[75], multipurpose workers[71] were empowered to conduct screening.

Community engagement was highlighted as an important factor in five studies. Adepoju et al. (2022) conducted advocacy visits to traditional rulers[62]; Gopalan et al. established community ambassadors[78]; Nonterah et al. (2024) leveraged faith leaders[67]; Nong et al. (2024) engaged local leaders[77]; and Ramaswamy et al. used community health workers to build trust[70]. Point of care testing was reported in four studies[65, 69, 74, 79] as a strength in enabling immediate results. **(Table 5)**

Barriers

Low follow-up or loss to follow-up was the most commonly cited barrier to the implementation of screening interventions. Alieva et al. (2022) reported that 68.8% of patients with intermediate glucose levels did not return for repeat testing[68]. Pastakia et al. (2013) found that only 22–31% of screen-positive individuals returned for confirmatory testing[79]. Brennan et al. (2023) reported that approximately 50% of screen-positives did not link to care within four weeks[69]. Low awareness and risk perception was also a major barrier. Kubiak et al. (2021) noted that only 0.5% of participants had prior awareness of their diabetes diagnosis[65]. Soundappan et al. (2024) reported that 65% of individuals with elevated blood pressure and 78.9% with elevated glucose cited "no symptoms" as the reason for not seeking care[71]. Nonterah et al. (2024) identified low baseline awareness as a challenge[67].

Resource constraints were also highlighted as a major barrier. Alieva et al. (2022) cited limited resources and computer skills in remote regions[68]; Gopalan et al. (2019) noted that HbA1c testing was not done due to cost[78]; and Nucci et al. (2004) reported variable participation rates across regions due to resource disparities[76] and Thooputra cited staff shortages as a barrier[72]. Additional barriers included community rumours and mistrust[62, 70] digital literacy limitations[77] sample transport challenges[70]. **(Table 5)**

Risk of Bias

Of the 19 included studies, two were rated Good (low risk of bias), 13 Fair (moderate risk), and four Poor (high risk). The main methodological limitations across studies were inadequate control for confounding (especially in cross-sectional studies) and incomplete follow-up without appropriate handling (in cohort studies and RCTs). Blinding was rarely achieved in RCTs. (**Table 6**)

[TABLE 6]

Discussion

This review identified and synthesized evidence on diabetes screening interventions in LMICs from 19 studies. Screening interventions were categorized into respective components based on target population, screening intensity, screening interval, delivery approach, testing tools and delivery agents. While screening interventions in most studies targeted general populations, those targeting high-risk individuals yielded higher detection rates. Most of the studies were conducted in both rural and urban geographical settings and most screening interventions were conducted at the community level. Only three studies reported screening and completion of the care cascade. Economic outcomes were reported in two of the studies.

Screening location was identified as a major factor facilitating screening reach and uptake. Community settings such as households, faith-based centres, and health camps are spaces that people frequent, trust and are familiar with. Screening at the community provides access and successful reach for vulnerable populations that would otherwise not be able to navigate formal health facilities due to cost, distance and other factors. Facility-based screening was particularly beneficial when integrated into existing health services which leveraged the existing health infrastructure and patient contact. Healthcare interactions like Covid-19 vaccination, TB services and HIV testing proved to be useful opportunities for diabetes screening. Additionally, screening in most studies was offered as an integrated package for NCDs which meant that in one contact, an individual got screened for other NCDs apart from diabetes. Diabetes and hypertension share risk factors and are also risk factors for other NCDs and are better addressed in a single visit or instance. Integration of diabetes screening with other services has the potential to improve coverage and save costs and time associated with multiple visits to health facilities.

Task-shifting to community health workers emerged as a strong facilitator for effective diabetes screening. Studies that used non-medical workers like ASHAs in India[64], HIV counsellors in Kenya[79], ISHC volunteers in Vietnam[77] to conduct screening demonstrated that with proper training, community health workers could effectively conduct screening and referral. Most LMICs are moving towards Universal health coverage (UHC)[81, 82] and are adopting community-based interventions[83, 84] as well as care integration at the primary healthcare level to ensure healthcare is accessible to all people[85–87]. The use of community health workers to offer selected health services including screening has been lauded as a strength in low resource settings[88–90]. Therefore, screening interventions delivered as integrated health packages at the PHC level are likely to be scalable and sustainable in LMICs.

With limitation of resources reported in most studies, target interventions high risk groups have the potential for cost-efficiency. Our study found that compared to general population screening, interventions that targeted high risk individuals yielded higher detection rates. These findings are consistent with other findings that have also demonstrated that risk assessment before screening improves yield [91–93]. The American Diabetes Association[27] and World Health Organization[1] both recommend targeted screening of high-risk populations rather than universal screening. Screening interventions in LMICs should prioritize high risk groups to maximize yield and optimize the limited health resources. However, we also found very limited reporting of cost and resource data that would help inform intervention budgeting and prioritization based on cost-effectiveness. Future studies should provide detailed reports of economic outcomes and incorporate economic evaluation as an integral component of screening program implementation.

There were observed gaps in implementation of the diabetes care cascade stages with most interventions not offering care continuity beyond screening. For that reported care beyond screening, loss to follow-up was the most reported barrier, implying gaps in linkage. Some of the reported reasons for loss to follow-up were mainly low risk perception (no symptoms) and perception of non-importance of further testing(not necessary).The pattern of attrition reflects the cascade of care phenomenon that has been shown by diabetes studies[94–97], whereby notable proportions of individuals are lost at each step of the care continuum. For studies that completed the care cascade beyond screening, achieved successful linkage through short intervals between screening and confirmatory testing, active follow-up through phone reminders and home visits[67, 70, 75]. Also, some of the studies were designed for screening only without follow-up or active linkage to care. These findings highlight a major gap in the design of screening interventions. Screening programs can only be effective if identified at-risk individuals subsequently access confirmatory diagnosis, receive treatment and further glycaemic monitoring. Diabetes screening programs should therefore be designed with the view of the entire cascade from the onset, considering factors that would facilitate linkage and retention in care.

The findings of this study suggest that diabetes screening can be successfully implemented across diverse settings in resource constrained contexts, except for gaps in scalability and sustainability[32]. The concern is not whether screening can be done in LMICs, but how it can be done more efficiently and how to ensure screen-positives receive care beyond screening. All the studies discussed sustainability recommendations with only four studies implementing sustainability plans as part of the intervention. Sustainability planning is important for scale-up and translation of screening programs to routine practice for continued benefit[32]. Therefore, sustainability plans should be embedded in the design of screening interventions by incorporating capacity building, stakeholder engagement and integration into existing healthcare systems.

Conclusion

This review categorized diabetes screening interventions into key design components to inform future programme development and evaluation. Screening has been successfully implemented across many LMICs, with integration into existing healthcare infrastructure, targeting of at-risk groups, and task shifting to community health workers frequently identified as facilitators. However, the care cascade revealed substantial gaps driven by poor linkage, loss to follow-up, and "screening only" designs, while economic evidence remained scarce. Future programmes should therefore embed linkage-to-care strategies, economic evaluation, and sustainability planning from the outset, with more complete reporting of cascade linkage and costing data to enable better

evaluation and planning. As the diabetes burden rises in LMICs, priority should be given to screening interventions that target at-risk populations and are delivered at the primary healthcare level.

Abbreviations

ADA
American Diabetes Association
ASHAs
Accredited Social Health Activists (India's community health workers)
BMI
Body Mass Index
CDSS
Clinical Decision Support System
DHIS / DHIS2
District Health Information System (version 2)
FBG
Fasting Blood Glucose
FCPG
Fasting Capillary Plasma Glucose
FINDRISC
Finnish Diabetes Risk Score
FPG
Fasting Plasma Glucose
GP
General Practitioner
HbA1c
Glycated Hemoglobin / Hemoglobin A1c
HIV
Human Immunodeficiency Virus
IDRS
Indian Diabetes Risk Score
ISHC
Intergenerational Self-Help Club
LMICs
Low- and Middle-Income Countries
NCD
Non-Communicable Disease
NNS
Number Needed to Screen
NoP
Network of Practice (Ghana Health Service)
OGTT
Oral Glucose Tolerance Test
PHC
Primary Health Centre
RBG
Random Blood Glucose
RBS
Random Blood Sugar (same as RBG)
RSSDI
Research Society for the Study of Diabetes in India
SMARThealth
Systematic Medical Appraisal, Referral and Treatment
T2DM
Type 2 Diabetes Mellitus
TB
Tuberculosis
UHC
Universal Health Coverage
WHO

World Health Organization

Declarations

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Competing interests

Authors have no competing interests

Author Contribution

CA Conceptualised the study and drafted the protocol. CA conducted the literature search with input from CVT, PJD and JOO. JOO and CA conducted screening for titles and abstracts and full texts, while CVT and PJD resolved conflicts. CA and JOO extracted data. CA analysed the data with input from CVT and PJD. CA Drafted the initial manuscript that was then reviewed and revised by CA, JOO, PJ and CVT before submission for publication.

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Tables

Table 1

Screening interventions classification framework

Core screening components	Component	Definition	Examples / Categories
	1. Target population	**The population for whom the screening intervention is intended.**	**Universal – Systematic screening of a general population or community** **Targeted – Screening of a specific high-risk group (e.g., based on age, family history, or other risk factors).** **Hybrid – A combination of approaches.**
	2. Screening method/test	The test or method used to identify individuals with possible diabetes or elevated blood glucose.	CBG – Capillary Blood Glucose FPG – Fasting Plasma Glucose RBG – Random Blood Glucose PPBG – Postprandial Blood Sugar OGTT – Oral Glucose Tolerance Test HbA1C – Glycated Haemoglobin Risk score – A questionnaire-based risk assessment tool. Urinalysis
	3. Screening intensity	The number of screening steps used to identify individuals requiring further diagnostic assessment.	One-step – A single test is used for screening Two-step/Multi-step – An initial screening test (e.g., risk score, capillary blood glucose) is used to identify individuals who then undergo a confirmatory diagnostic test.
	4. Technology/tool	The equipment, technology, instrument, or decision-support tool used to conduct or support screening.	Glucose meter; point-of-care HbA1c analyser; laboratory analyser; mobile application; electronic risk assessment tool; paper-based risk score.
	5. Diagnostic criteria	The thresholds, criteria, or guidelines used to classify individuals as having diabetes following screening or confirmatory testing.	ADA – American Diabetes Association criteria. WHO – World Health Organization criteria. National guidelines– Country-specific national guidelines.
	6. Delivery agent	The individual, professional cadre, or workforce responsible for conducting or supporting the screening intervention.	Medical staff – Doctors, nurses, or other licensed healthcare professionals.. Research staff – Personnel specifically employed for the research study. Community – Community health workers and other trained non-medical cadres
Implementation components	7. Geographical setting	The broader geographical environment in which the screening intervention is implemented.	Urban Rural Both.
	8. Screening location	The physical, social, or service setting in which screening is conducted.	Community -based- Screening conducted in settings where people live, work, worship, or gather (household; workplace; school; faith-based setting; market/public space; mobile/outreach setting) Facility-based- Screening conducted within formal healthcare institutions Both- Screening conducted at both community and facility
	9. Health-system level	The level of the health system at which screening is delivered or coordinated.	Primary healthcare Secondary healthcare; Tertiary healthcare; multiple/mixed levels.
	10. Programme integration	The extent to which screening operates independently or is incorporated into an existing health service or programme.	Standalone – Screening was the primary intervention. Integrated – Screening was integrated into existing healthcare services or programs. NCD package – Screening was part of a broader non-communicable disease (NCD) package of care.
	11. Screening frequency/interval	How often screening is offered and, where applicable, the interval between screening rounds or opportunities.	One-off (single event) Periodic/repeated (annual, biennial)
	12. Linkage to care	The process through which individuals identified through screening are connected to diagnostic confirmation, treatment, follow-up, or continuing diabetes care.	No linkage reported referral for diagnosis/ treatment/active follow-up
	13. Training	The preparation provided to personnel to enable them to deliver the screening intervention according to the intervention protocol.	No specific training reported Training provided

Table 2

Summary of the included studies.

Study ID	Year of publication	Country	Title	Study design	Objective (as stated in study)	Primary Outcome(s) Evaluated	Findings summary	Policy linkage
Adam et al., 2004	2004	Indonesia	Asymptomatic Diabetes: The Difference Between Population-based and Office-based Screening	Cross-sectional	"To compare the results between population-based and office-based diabetes screening."	Comparison of diabetes prevalence between population-based and office-based screening strategies.	Office-based screening detected more asymptomatic diabetes cases. For early detection, clinical screening targeting high-risk individuals is recommended as it is more practical and yields higher detection rates.	Aligned with A recommendat (2002) for screening hig risk groups in clinical settin
Adepoju et al., 2022	2022	Nigeria	Bidirectional Screening for Tuberculosis, Diabetes Mellitus and other Comorbid Conditions in a Resource Constrained Setting: A Pilot Study in Lagos, Nigeria	Quasi-experimental	"To determine the outcomes of bidirectional screening for TB and diabetes (DM) in resource constrained communities, Lagos, Nigeria."	Yield of bidirectional screening: proportion of TB patients with DM, DM patients with TB, HIV, and HBV detection rates.	Approximately one in twenty newly diagnosed TB patients had DM as a comorbid condition. Strengthening bidirectional screening for TB-DM is needed to achieve additional gains in TB case findings.	Aligned with V recommendat for collaborat TB-DM care. Highlights absence of national bidirectional screening pol in Nigeria des high burden o both diseases
Alieva et al., 2022	2022	Uzbekistan	Assessing the Effectiveness of Type 2 Diabetes Mellitus Screening in the Republic of Uzbekistan	RCT	"To offer the most effective, simple, and economical option required for the actual implementation of regular T2DM screening in the country's primary care."	Proportion of T2DM diagnoses confirmed by endocrinologist; cost per case detected.	Screening for incidental glycemia in patients with at least one risk factor, followed by fasting glycemia for those with incidental glycemia ≥ 7.8 mmol/L, is the recommended cost-effective strategy for Uzbekistan.	Results are intended to gu national polic
Bassi et al., 2023	2023	India	Innovative mobile-health led participatory approach to comprehensive screening and treatment of diabetes (IMPACT diabetes): rationale, design, and baseline characteristics	RCT	"To develop and evaluate a bespoke diabetes management program that empowers ASHA and PHC doctors through a mobile platform-based CDSS embedded in the public healthcare system."	Difference in HbA1c between baseline and end-line (9 months) between intervention and control arms (study ongoing).	Technology-enabled transfer of clinical procedures from physicians to non-physician health workers can support healthcare in underserved communities. ASHAs can successfully screen and refer patients with diabetes to primary care.	Aligned with National Heal Policy's Healt and Wellness Centres (HwC initiative and shifting to AS for NCDs.
Brennan et al., 2023	2023	South Africa	Integration of point-of-care screening for type 2 diabetes mellitus and hypertension into the COVID-19 vaccine	Cohort	"To assess the feasibility, effectiveness, and linkage-to-care of implementing a rapid screening program for diabetes,	Proportion with elevated blood glucose/BP; proportion linked to care within 4 weeks; predictors of outcomes.	Integrating NCD screenings into routine healthcare visits holds promise in resource-	Aligned with South African National Department o Health guideli integrated int government COVID-19

Study ID	Year of publication	Country	Title	Study design	Objective (as stated in study)	Primary Outcome(s) Evaluated	Findings summary	Policy linkage
			programme in Johannesburg, South Africa		hypertension, and COVID-19 in conjunction with an ongoing government COVID-19 vaccination program."		constrained settings. However, concerted efforts to strengthen care linkage are crucial for holistic NCD management.	vaccination programme
Ekeke et al., 2017	2017	Nigeria	Screening for diabetes mellitus among tuberculosis patients in Southern Nigeria: a multi-centre implementation study under programme settings	Cross-sectional	"To determine screening efficacy, prevalence of DM and determinants of DM among TB patients."	Proportion of TB patients with DM; additional yield; NNS; determinants of DM.	The burden of DM among TB patients is high. Screening can detect more than half of undiagnosed DM cases. Prioritizing screening for TB patients aged > 40 years may yield the greatest benefits.	Aligned with WHO/The Uni Collaborative Framework fo TB-DM. Provi evidence to inform Nigeri National TB Control Programme (I policy
Gopalan et al., 2019	2019	India	"Diabetes care at doorsteps": A customised mobile van for the prevention, screening, detection and management of diabetes in the urban underprivileged populations of Delhi	Cross-sectional	"To evaluate if this is possible through awareness and education of diabetes and obesity by the trained technicians, nutritionists, and physicians provided at the doorstep of this population."	Feasibility of mobile van for diabetes awareness, screening, detection, and management; number screened; proportion with hyperglycaemia; weight reduction.	The mobile van project successfully educated, screened, and managed diabetes in urban underprivileged populations. This model could be extended to other cities, rural areas, and other developing countries.	Aligned with National Heal Mission guidelines for mobile medic units for underprivilege populations. Supports Indi NCD preventi and control g
Kubiak et al., 2021	2021	South Africa	Clinic-based diabetes screening at the time of HIV testing and associations with poor clinical outcomes in South Africa: a cohort study	Cohort	"To examine the burden of diabetes, pre-diabetes, and associated risk factors among adults testing positive for HIV in South Africa and to assess relationships between diabetes and key clinical outcomes."	Prevalence of diabetes/pre-diabetes among PLHIV; NNS; association with HIV outcomes (viral suppression, retention, hospitalization, TB, death).	Diabetes and pre-diabetes were common among adults testing positive for HIV and associated with death. Clinic-based screening targeted to higher-risk groups (BMI ≥ 25 kg/m²) may improve HIV treatment outcomes.	Aligned with South African and NCD guidelines; authors recommend inclusion of diabetes screening in national HIV guidelines to improve uptal
Kumar et al., 2015	2015	India	Effect of mobile reminders on screening yield during opportunistic screening for type 2 diabetes mellitus in a primary health care setting: A randomized trial	RCT	"To study whether mobile reminders increased follow-up for definitive tests resulting in higher screening yield during opportunistic screening for diabetes."	Effect of mobile reminders on follow-up rates and screening yield.	Mobile reminders during opportunistic screening in primary care improve screening yield for diabetes. The intervention is effective and feasible for replication in resource-limited settings where mobile phones are widely used.	Aligned with India's Nation Programme f Prevention an Control of Diabetes, Cardiovascul diseases and Stroke (NPCD which recommends opportunistic screening of persons abov years.

Study ID	Year of publication	Country	Title	Study design	Objective (as stated in study)	Primary Outcome(s) Evaluated	Findings summary	Policy linkage
Manios et al., 2020	2020	Bulgaria, Hungary, Belgium, Finland, Greece, Spain	Two-stage, school and community-based population screening successfully identifies individuals and families at high-risk for type 2 diabetes: the Feel4Diabetes-study	RCT	"To describe the screening procedure applied in the Feel4Diabetes-study and examine its effectiveness in identifying individuals and families at high risk, primarily for T2D and secondarily for hypertension."	Effectiveness of two-stage screening in identifying high-risk individuals and families; prevalence of prediabetes, diabetes, hypertension.	The two-stage school and community-based screening procedure effectively identified high-risk individuals and families in vulnerable populations across Europe. This approach could be scalable and sustainable.	Aligned with European pub health prioriti for T2D prevention; co be integrated national scho and healthcar systems
Nong et al., 2024	2024	Vietnam	Challenges and Opportunities in Digital Screening for Hypertension and Diabetes Among Community Groups of Older Adults in Vietnam: Mixed Methods Study	Mixed-methods	"To investigate the role of faith-based screening for T2DM and hypertension and the linkage of cases to the healthcare system and examine the care cascade."	Feasibility of faith-based screening; linkage to care; care cascade outcomes (awareness, treatment, control).	Faith-Based Centres have the potential to expand screening, linkage, and management of hypertension and diabetes. This approach may result in improved early diagnosis, reduced complications, and reduced premature mortality.	Aligned with Vietnam's national digita transformatio strategy in healthcare an the national strategy for N prevention.
Nonterah et al., 2024	2024	Ghana	Hypertension and diabetes control: faith-based centres offer a promise for expanding screening services and linkage to care in Ghana	Cross-sectional	"To assess the strengths, barriers, and limitations of the NCD screening app used by the ISHC health volunteers on tablets and to provide recommendations for further scaling up."	Strengths, barriers, limitations of NCD screening app; data completeness; data quality.	Implementation of the NCD screening app by ISHC volunteers can be effective for community-led NCD screening. However, barriers (non-age-friendly app, limited digital literacy) need to be addressed to maximize efficient use.	Aligned with Ghana Health Service's Netv of Practice (N policy and WH PEN Plus initiative.
Nucci et al., 2004	2004	Brazil	A nationwide population screening program for diabetes in Brazil	Cross-sectional	"To describe the overall participation rate and positivity rate of the screening campaign, as well as factors associated with the level of participation among the municipalities in Brazil."	Participation rate; positivity rate; factors associated with high participation at municipal level.	The massive response to the campaign (73% participation, 22.1 million tested) attests to the potential of such programs to raise diabetes awareness and set the stage for capacity-building at the primary care level.	Part of Brazili Ministry of Health's Plan the Reorganizatio Care for Arter Hypertension Diabetes Mell
Pastakia et al., 2013	2013	Kenya	Screening for diabetes and hypertension in a rural low income setting in western Kenya utilizing home-based and community-based strategies	Cross-sectional	"To compare a community-based versus home-based screening strategy for hypertension and diabetes."	Comparison of home-based vs community-based screening strategies; follow-up rates.	Both screening strategies are feasible. However, to increase long-term health benefits, an integrated approach linking screening, care, and follow-up	

Study ID	Year of publication	Country	Title	Study design	Objective (as stated in study)	Primary Outcome(s) Evaluated	Findings summary	Policy linkage
							regardless of service delivery point needs to be implemented.	
Ramaswamy et al., 2019	2019	India	High prevalence of prediabetes among the family members of individuals with diabetes. Findings from targeted screening program from South India.	Cross-sectional	"To screen for prediabetes, diabetes and other cardiovascular risk factors among family members of people with diabetes registered for care."	Number and proportion screened; newly diagnosed DM and prediabetes; factors associated with prediabetes; NNS.	One in eight family members had diabetes. Though DM yield was modest (3%), screening coverage was high (99%). The strategy was beneficial in detecting large numbers of prediabetes and hypertensives.	Aligned with India's Nation Programme f Prevention an Control of Ca Diabetes, Cardiovascula Diseases and Stroke (NPCD Supports its g of early diagn and treatmen
Sathish et al., 2019	2019	India	Targeted screening for prediabetes and undiagnosed diabetes in a community setting in India	Cross-sectional	"To examine the screening program in terms of its uptake, yield, and costs."	Uptake of each screening step; yield (NNS); average cost per case detected.	Targeted screening using a simple diabetes risk score had high uptake and high yield for prediabetes and undiagnosed diabetes. The screening costs reported could be used for designing community-based screening programs.	Aligned with National Programme f Prevention an Control of Diabetes, Cardiovascula Diseases and Stroke in India supports use IDRS for targe screening.
Soundappan et al., 2024	2024	India	Expanded and intensified population-based screening and diagnosis of hypertension and diabetes mellitus among rural adults in Northern India: An implementation research in routine programmatic setting	Cohort	"To assess an expanded PBS (including people 18–29 years) and intensified (home-based) diagnosis confirmation strategy for hypertension and diabetes mellitus in a routine programmatic setting."	Feasibility of expanded screening and intensified home-based diagnosis; turnout rates; additional yield.	Expanding PBS to include all adults ≥ 18 years is feasible. Intensified home-based confirmation can be done among screen-positives, a missed opportunity yet in the program. Cost-effectiveness studies are needed.	Aligned with India's Nation Program for Prevention an Control of NC (NP-NCD). Th study tests ar expansion of existing policy (including 18- year-olds and home-based confirmation)
Thomas et al., 2015	2015	India	Diabetes screening and the distribution of blood glucose levels in rural areas of North India	Cross-sectional	"To screen individuals for diabetes and to obtain the trends of distribution of blood glucose by age and gender."	Trends in blood glucose distribution; prevalence of prediabetes and diabetes; prediabetes: diabetes ratio.	Mass screening helps estimate prevalence and hidden burden. Selective screening of people aged > 40 years can have higher yield. Screening programs can strengthen healthcare system initiatives.	Project suppo by World Diab Foundation; aimed to strengthen healthcare system initiat for diabetes control in Indi

Study ID	Year of publication	Country	Title	Study design	Objective (as stated in study)	Primary Outcome(s) Evaluated	Findings summary	Policy linkage
Thooputra., 2016	2016	Australia and Thailand	Opportunistic Risk Screening for Type 2 Diabetes: Exploring of Application of Diabetes Risk Assessment Tool in Community Pharmacy in Australia and Thailand	Cross-sectional	"To evaluate the feasibility of providing diabetes risk assessment at community pharmacy level in Australia and Thailand from organizational aspects."	Feasibility, facilitators, barriers; willingness-to-pay (WTP) for risk assessment service.	Providing opportunistic diabetes risk assessment at community pharmacies is feasible in both countries. Strategies to encourage pharmacists differ between developed and developing countries based on local healthcare environment and culture.	Aligned with national diabe prevention strategies in b countries.

Table 3
Screening intervention components

Study ID	Core Screening Components					Screening Implementation components			
	Target Population	Test(s)	Intensity	Technology Used	Diagnostic Criteria	Location	Geographical setting	Health System level	
Adam et al., 2017	Population arm: General Population; Office based arm: At-risk	OGTT	Two-step	Lab method	WHO	Population arm:Community; Office based arm: Facility(hospital or doctor's private practice)	Urban	Primary	
Adepoju et al., 2022	At-risk	FBS or RBS	One-step	Mixed(Digital and Glucometer)	WHO	Community(Community based medical outreaches)	Urban	Primary	
Alieva et al., 2022	At-riSk	FPG	Two-step	Glucometer	ADA	Facility(Family Polyclinics)	Both	Secondary	
Bassi et al., 2023	General Population	FCPG	Two-step	Digital	National	Facility(Primary Healthcare facilities)	Both	Primary	
Brennan et al., 2023	General Population	RBG	One-step	Glucometer	National	Facility(Primary healthcare centres and hospital)	Urban	Primary and Secondary	
Ekeke et al., 2017	At risk	RBG	Two-step	Glucometer	WHO	Facility((hospitals and TB treatment centers))	Both	Secondary	
Gopalan et al., 2019	General Population	RBG	Two-step	Glucometer	National	Community(Mobile van)	Urban	Primary	
Kubiak et al., 2021	At risk	HbA1C	One-step	Digital	ADA	Facility(Public Outpatient HIV Clinic)	Urban	Secondary	
Kumar et al., 2015	General Population	RBG	Two-step	Glucometer	WHO	Facility(Primary health centre)	Urban	Primary	
Manios et al., 2020	At-risk	Risk score(FINDRISC)	Two-step		ADA	Community(Schools and community centres)	Both	Primary	
Nong et al., 2024	General Population	Risk score(FINDRISC)	One-step	Digital	Not reported	Community	Both	Primary	
Nonterah etal.,, 2024	General Population	FPG	One-step	Glucometer	National	Community(Faith based centres, churches and mosques)	Rural	Primary	
Nucci et al., 2004	General Population	FCBG	One-step	Glucometer	WHO	Facility(Primary healthcare centres)	Both	Primary	
Pastakia et al., 2013	General Population	RBS	Two-step	Glucometer	National	Community(Home-based arm: Households (door-to-door). Community-based arm: Health fair booth in town center)	Rural	Primary	
Ramaswamy et al., 2019	At-risk	FCBG	Two-step	Glucometer	National	Community(Homes)	Urban	Primary	
Sathish et al., 2019	At-risk	Risk score (Indian diabetes Risk Score)	Two-step	Mixed(Digital and Paper questionnaire)	ADA	Community(Homes and community centres)	Both	Primary	

Study ID	Core Screening Components					Screening Implementation components			
	Target Population	Test(s)	Intensity	Technology Used	Diagnostic Criteria	Location	Geographical setting	Health System level	
Sondappan et al., 2024	General Population	RBG	Two-step	Glucometer	National	Community(Households)	Rural	Primary	
Thomas et al., 2015	General Population	RBG	One-step	Glucometer	ADA	Community(Health camps)	Rural	Primary	
Thooputra., 2016	General Population	Risk score (Thai diabetes Risk Score)	One-step	Questionnaire	Not reported	Facility(Community pharmacies)	Urban	Primary	

Table 4
Screening Outcomes and Economic Outcomes

Study	Screening Outcomes		Economic Outcomes
	Uptake / Participation	Yield (Detection rate(%), NNS)	
Adam et al., 2004	Not reported*	Population: (DM:5.42%) Office: (DM:17.08%)	Not reported
Adepoju et al., 2022	Not reported*	DM:5.0%	Resource inputs only
Alieva et al., 2022	Not reported*	DM:9.3% to 15.9%	Cost per case detected: Glucose: 21,500 som; HbA1c: 83,000 som
Bassi et al., 2023	Not reported*	DM:21.3%	Resource inputs only
Brennan et al., 2023	Not reported*	DM:0.9%	Resource inputs only
Ekeke et al., 2017	100%	DM:5.5%, NNS = 18	Resource inputs only
Gopalan et al., 2019	10.40%	DM:18.7%	Resource inputs only
Kubiak et al., 2021	38.90%	DM:3.5%, Pre-DM: 20.6%, NNS = 46.5	Resource inputs only
Kumar et al., 2015	58.50%	Intervention arm: (DM:18.6%) Control arm: (DM:10.2%)	Resource inputs only
Manios et al., 2020	Stage 1: 40.6%; Stage 2: 70.3%	DM:3.0%, PreDM: 23.2%	Resource inputs only
Nonterah et al., 2024	Not reported*	DM:2.5%	Resource inputs only
Nong et al., 2024	Not reported	Not reported	Resource inputs only
Nucci et al., 2004	73.00%	DM:15.7%	Resource inputs only
Pastakia et al., 2013	Not reported*	Home-based: 23% Community-based: 8%	Resource inputs only
Ramaswamy et al., 2019	99%	DM:2.2%, Pre-DM: 32.1%, NNS = 46	Resource inputs only
Sathish et al., 2019	IDRS: 96.3%; OGTT: 79.1%	DM:16.7%, Pre-DM: 57.5%, NNS = 6	Cost per case detected: Pre-DM: $33.8; DM: $116.5
Soundappan et al., 2024	Not reported	DM:7.3%	Resource inputs only
Thomas et al., 2015	5.80%	DM:2.9%, Pre-DM: 10.6%.	Resource inputs only
Thoopputra et al., 2016	Not reported*	34% high-risk (Thailand). No blood glucose testing.	Willingness to pay:(Thailand: 72.4% ($1.5))

* Denominator (eligible population) not reported; DM: Diabetes : Pre-DM: Prediabetes

Table 5

Implementation outcomes

Study ID	Screening Feasibility	Screening Sustainability	Key Facilitators	Key Barriers
Adam et al., 2004	Population screening requires large funds and is technically difficult in Indonesia, while clinical screening is more practical	Recommends screening at the clinic for sustainability	Clinical setting allows for standard OGTT; patients are more cooperative; immediate follow-up therapy possible.	Population screening technically difficult and costly; single 2-hour test may miss cases; different diagnostic criteria between strategies.
Adepoju et al., 2022	Bidirectional TB-DM screening feasible with appropriate staffing	Recommends joint TB-DM steering committee for planning policy implementation to sustain bidirectional screening	Collaboration with TB Control Programme; use of GeneXpert infrastructure; community engagement (advocacy to traditional rulers); escorted referral system.	Reliance on cough symptom for TB screening may miss asymptomatic TB in DM patients; no chest X-ray; small number of TB cases.
Alieva et al., 2022	Feasible only in limited conditions; incidental glycemia screening recommended	Recommends national screening system with funding and staff training	Simple risk factors (age, BP, BMI/WC) easy to assess; task-sharing with GPs (diagnosis rates similar to endocrinologists); lower cost of glucose-based screening.	High loss to follow-up (68.8% did not return for repeat testing); low health literacy; limited resources and computer skills in remote regions.
Bassi et al., 2023	ASHAs achieved 100% completeness of data for anthropometric, BP, and blood glucose measures, demonstrating feasibility of task-shifting	* Embedded in existing PHC system; uses routine workforce(ASHAs, PHC physicians)	Task-shifting to ASHAs (existing trusted workforce); technology-enabled CDSS with automated referrals; integration into routine health promotion work (no additional visits).	Limited sample size may underpower true effect detection; non-random participant selection limits prevalence estimation.
Brennan et al., 2023	Feasible at COVID-19 vaccination sites using existing infrastructure	Recommends integration into existing and future health initiatives	Leveraging existing healthcare infrastructure and patient traffic; brief healthcare interactions utilized as screening opportunities; individuals already seeking health measures.	Ensuring swift transition to suitable healthcare services remains a challenge; approximately 50% of screen-positives did not link to care within 4 weeks; single measurement insufficient for diagnosis.
Ekeke et al., 2017	Feasible in routine programmatic settings with minimal training	Recommends prioritizing older TB patients (≥ 40) for cost-effective screening, establishing functional referral systems to ensure quality DM services	Integration into existing TB services; use of simple and available technology (glucometer); minimal additional training required; strong collaboration with private and public facilities.	Exclusion of PHC settings; lack of anthropometric measurements; FBG has low sensitivity; HbA1c expensive and cumbersome.
Gopalan et al., 2019	Mobile van feasible across 10 underprivileged areas over 3 + years	* Trained frontline workers (292) and medical/paramedical staff (256; community ambassadors ensure sustainability *	Doorstep service eliminates travel costs and lost wages; comprehensive approach (awareness, screening, management, training, telemedicine); strong community engagement.	Resource constraints (not all patients screened for all complications); HbA1c not done due to cost; more women participants (men unavailable due to work).
Kubiak et al., 2021	Screening at HIV testing feasible; BMI targeting improves efficiency	Recommends integration into routine HIV care using existing infrastructure	Existing HIV clinic infrastructure and regular visits; point-of-care testing allows immediate results; high pre-diabetes prevalence (20.6%) justifies screening.	Loss to follow-up (51% reached at 12 months); low awareness (only 0.5% had prior diagnosis); single HbA1c not diagnostic per guidelines; anaemia may affect HbA1c accuracy.
Kumar et al., 2015	Mobile reminders are feasible without disrupting OPD, demonstrating feasibility for replication in resource-poor settings.	Recommends task transfer of mobile reminders to lab technician or automated calls	Wide mobile phone penetration; simple intervention; integration into existing OPD; blinding at outcome assessment.	Short follow-up period (3 days); use of capillary blood glucose (epidemiological not clinical diagnosis); PHC lacked facility for plasma glucose testing.
Manios et al., 2020	Two-stage school and community-based screening procedure was feasible across six countries	Recommends embedding school-based entry point into local/national school and health systems	School-based entry point reached vulnerable populations effectively; two-stage approach kept costs low; high response for Stage 2 (70.3%).	40.6% response rate for Stage 1; need to avoid stigmatization of high-risk families; variations in FINDRISC performance across regions.
Nonterah et al., 2024	Faith-based screening feasible; achieved high 97.6% linkage, 94.9% retention	* Aligned with Ghana's NoP policy; faith leaders support adherence *	Strong community engagement through faith leaders; high religious affiliation (98.9%); social groupings within FBCs for support; free screening.	Low baseline awareness, treatment, and control levels; majority of referred patients seen by lower-cadre staff (not doctors); shortage of critical health staff.

*Study reported actual plans for sustainability

Study ID	Screening Feasibility	Screening Sustainability	Key Facilitators	Key Barriers
Nong et al., 2024	App feasible but affected by digital literacy and app issues	* Capacity building and involving younger members implemented; integrating the app into the existing health information system for long-term sustainability.	Advanced app functions (easy data storage/reporting, timesaving); capacity building for volunteers (improved tech skills); strengthened stakeholder relationships.	Non-age-friendly app design (small font, English text, complex steps); limited digital literacy of older volunteers; irregular technical support (due to COVID-19); poor internet connectivity.
Nucci et al., 2004	Nationwide campaign feasible; 73% coverage, 22.1 million tested	* Part of broader Plan to build primary care capacity and Reorganization of Care for Arterial Hypertension and Diabetes Mellitus.	Massive media campaign (television, radio, billboards); prior nationwide training of 13,029 health professionals; existing UHS infrastructure; high political commitment.	260 municipalities excluded (5%); some repeats and previously diagnosed included indirect assessment of diagnostic impact; variable participation rates across regions (65.4% in Southeast vs 92.7% in North).
Pastakia et al., 2013	Both home and community-based strategies feasible	* Partnership with Ministry of Health and integration with community health workers for wide-scale implementation	Existing HIV screening infrastructure (HBCT program); trained HIV counsellors available; point-of-care devices; integration with HIV services improved HIV testing acceptance.	Low follow-up rates (22–31%) regardless of strategy; single screening measurement not diagnostic; timing of screening affected RBS results (post-meal).
Ramaswamy et al., 2019	Home-based screening feasible; 99% coverage	Recommends training community health workers for feasibility under programmatic settings	Leveraging existing contact with health system (index patient already registered for care); home-based approach minimized travel burden; high coverage (99%).	Community rumours (HIV/AIDS misinformation) initially caused fear; required official credentials; sample transport challenges (glycemia drops rapidly; needed dedicated staff and timely transport); 21.2% of index patients' houses could not be traced.
Sathish et al., 2019	Two-stage screening feasible; 96.3% IDRS, 79.1% OGTT uptake	Recommends community health workers for routine service delivery	High uptake both steps; short interval between steps (median 3 days); assertive tracking (phone reminders, follow-up clinics); OGTT gold standard; external quality control (ICC 0.964–0.990).	Lower OGTT uptake among males (due to early work schedules); lower IDRS uptake among younger adults (30–40 years); follow-up clinics had lower uptake (50%) than initial clinics (78.2%).
Soundappan et al., 2024	Expanded and intensified screening feasible in a routine programmatic setting using existing health workers	Recommends replication pending cost-effectiveness studies	Use of existing health workers (MPHW); linkage to existing NCD clinics; home-based confirmation strategy for non-responders; high treatment initiation rates.	Low risk perception ("no symptoms"); reliance on private sector for diagnosis (65% with out-of-pocket costs); initial low uptake for DM confirmation (69.5%).
Thomas et al., 2015	Large scale camp-based screening feasible; 45,318 screened over 2 years	Recommends screening programs to strengthen health system initiatives	Camp-based approach reached rural populations; large-scale IEC activities raised awareness (reached ~ 900,000 people); standardized training and equipment across 8 centres.	Low uptake (5.8% of those reached attended camps); convenience sampling; single RBS measurement; linkage to care not tracked.
Thoopputra et al., 2016	Pharmacy-based opportunistic risk assessment feasible in both countries	Recommends government support tailored to local context	Positive pharmacist attitudes; perceived health benefits; government support and collaboration (Thailand); remuneration/incentives (Australia); increased customer loyalty (Thailand).	Time and staff shortage (both countries); lack of economic incentives (Australia); lack of knowledge and client interest (Thailand); selection bias (those who felt at risk more likely to participate).

*Study reported actual plans for sustainability

Table 6 is available in the Supplementary Files section.

Figures

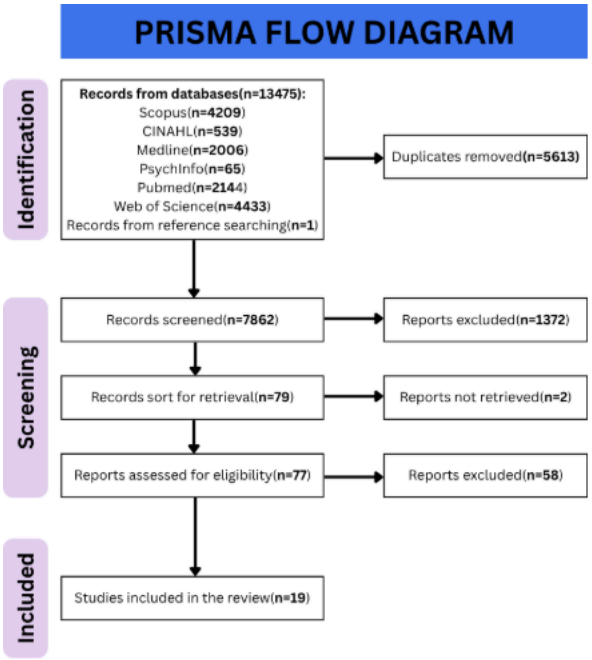


Figure 1

PRISMA Flow diagram

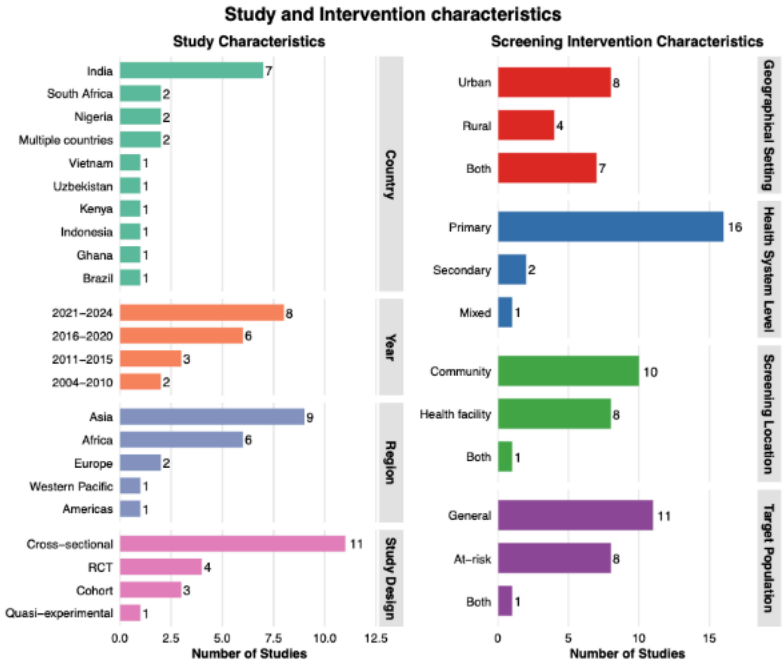


Figure 2

Study and Intervention Characteristics

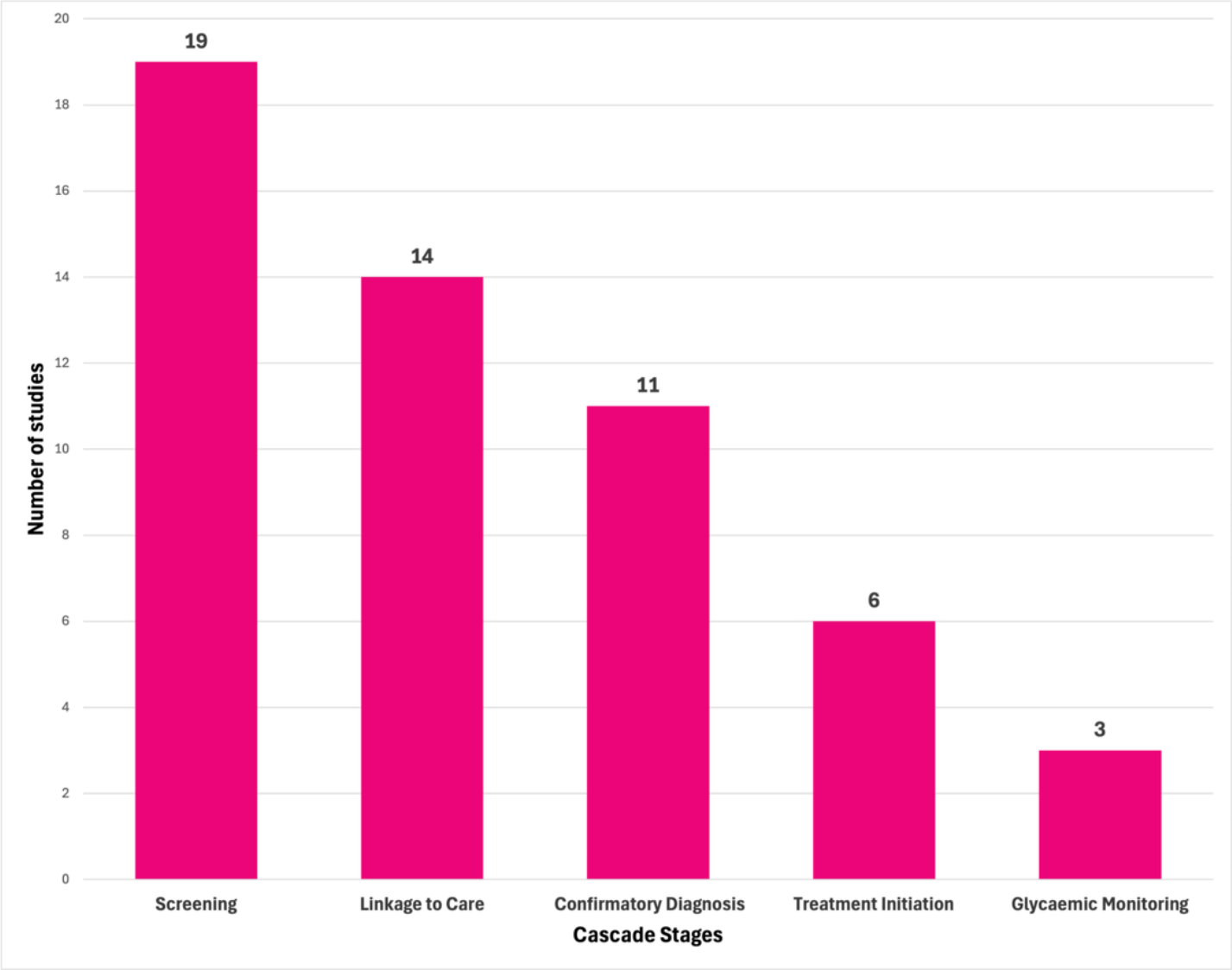


Figure 3

4. Care cascade stage reported

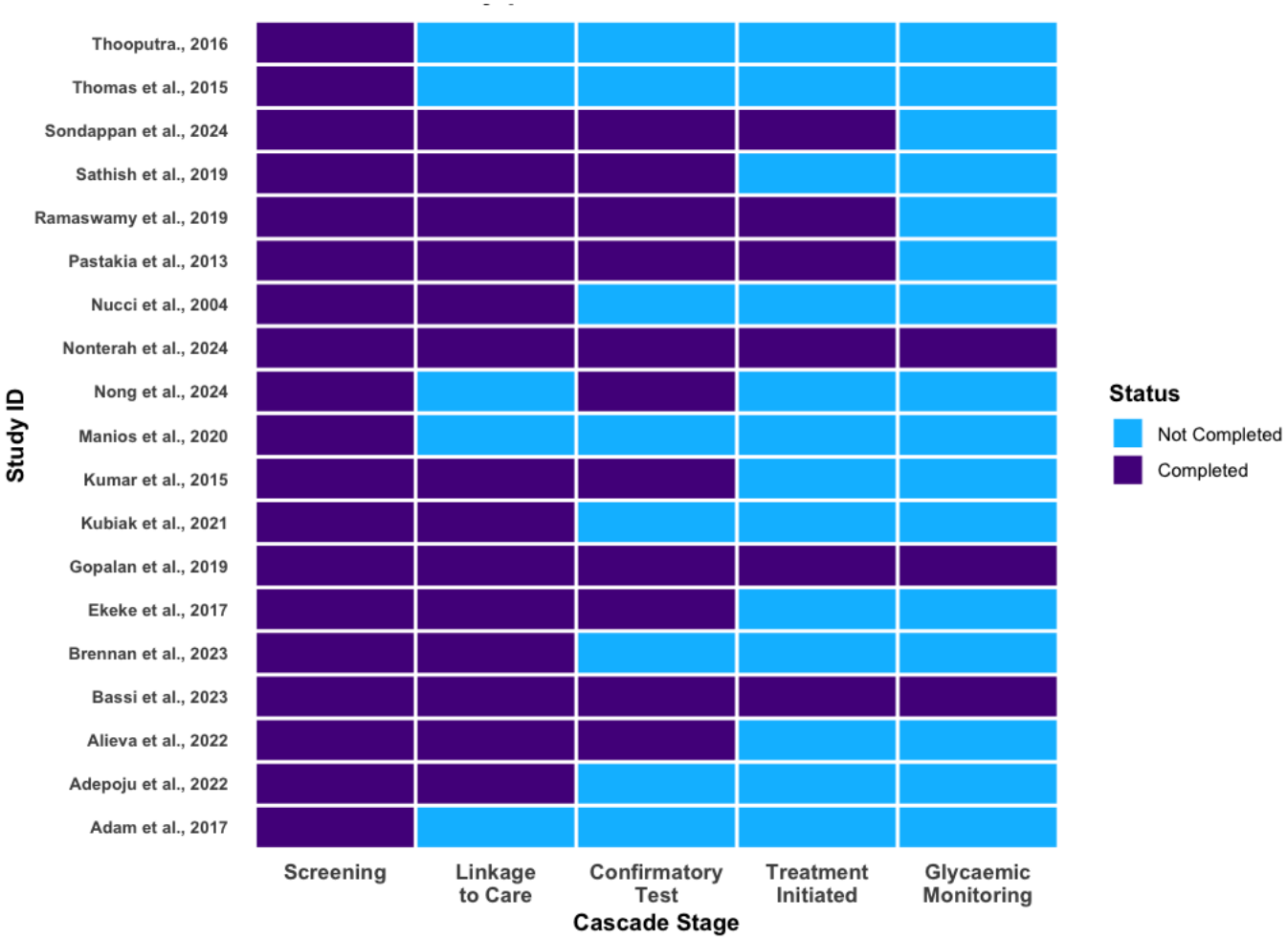


Figure 4

5. Individual study implementation of cascade stages

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table6.docx
- SearchStrategy.docx