Economic Evaluation of Cardiovascular and Diabetes Prevention in Primary Care: A Systematic Review

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ARTICLE INFO

Article history:
Received : 25 July 2025
Revised : 20 August 2025
Accepted : 30 September 2025

Keywords
Cost;
Cardiovascular;
Diabetes;
Primary;

ABSTRACT

Cardiovascular disease (CVD) and diabetes are major contributors to global morbidity and mortality. Prevention programs implemented in primary care settings—such as the WHO HEARTS initiative and lifestyle-based diabetes interventions—have gained attention for their potential clinical and economic impact. To systematically review economic evaluations of cardiovascular and diabetes prevention programs delivered in primary health care, focusing on cost-related outcomes and economic value. A systematic search of PubMed, Scopus, and ScienceDirect identified studies published from 2016 to 2025 that reported economic outcomes of CVD or diabetes prevention interventions in primary or community healthcare. Data extracted included intervention types, cost estimates, quality-adjusted life years (QALYs), incremental cost-effectiveness ratios (ICERs), and cost drivers. Study quality was assessed using the CHEERS checklist. Twelve studies met inclusion criteria. Most demonstrated favorable cost-effectiveness, with ICERs ranging from USD 105 to USD 14,011 per QALY. Integrated programs addressing both hypertension and diabetes were generally more cost-efficient. Medications, diagnostics, and human resources were the primary cost drivers. Economic evaluations indicate that preventive interventions for CVD and diabetes in primary care are cost-effective across various health system contexts. Scalable models like HEARTS, when adapted locally, can support both health impact and efficient resource use

1. INTRODUCTION

Cardiovascular disease (CVD) and diabetes mellitus are among the leading non-communicable diseases (NCDs) globally, accounting for over one-third of all deaths each year (Roth, G.A et. al, 2020). Their growing prevalence is fueled by aging populations, sedentary lifestyles, and unhealthy diets, posing serious challenges to health systems (NCD Risk Factor Collaboration, 2021). These conditions significantly impact both high-income and middle-income countries, where health care systems increasingly prioritize early detection and prevention (Atun, R et al., 2017). To address these burdens, the World Health Organization (WHO) launched the HEARTS technical package in 2016 to improve hypertension control and reduce cardiovascular risk through standardized clinical protocols in primary care (WHO, 2016). In parallel, several diabetes prevention programs—especially those based on lifestyle modification and community risk screening—have shown favorable health outcomes and gained global attention (Gilmer et. al. , 2018). In an era of limited health budgets, policy-makers need reliable economic evidence to guide resource allocation. Economic evaluations, such as cost-effectiveness and cost-utility analyses, use metrics like quality-adjusted life years (QALYs) and incremental cost-effectiveness ratios (ICERs) to assess the value-for-money of public health programs (Marseille et al. 2015). This is especially relevant in low- and middle-income countries (LMICs), where resource constraints necessitate evidence-based investment in scalable and cost-effective interventions.

Although many studies have evaluated the economic aspects of CVD and diabetes prevention initiatives, findings remain fragmented across countries and program types. This systematic review aims to synthesize economic evaluations of CVD and diabetes prevention programs delivered through primary care, with a focus on cost-effectiveness, key cost drivers, and implications for policy and practice).

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doi.org/10.31334/bijak.v22i2.5487

2. THE PROPOSED METHOD

Search Strategy and Study Selection:This systematic review followed PRISMA guidelines. A comprehensive search was conducted using PubMed, Scopus, and ScienceDirect for studies published from January 2016 to March 2025. Search terms included "cost," "economic evaluation," "cardiovascular disease," "diabetes mellitus," "hypertension," and "primary care." Only peer-reviewed articles published in English and available in full text were included.
Inclusion and Exclusion Criteria. Studies were included if they:

1. Evaluated preventive interventions for CVD and/or diabetes implemented in primaryor community-based healthcare;
2. Reported economic outcomes such as total costs, unit costs, ICERs, or QALYs;
3. Applied a recognized economic evaluation framework (e.g., cost-effectiveness, cost-utility, or cost analysis);
4. Were published between 2016 and 2025 in English.

Studies from all country income levels were eligible. Studies were excluded if they lacked economic data, focused only on treatment rather than prevention, or were not conducted in primary care contexts. Data Extraction:Data were extracted using a standardized form capturing publication details, study country, intervention type, economic evaluation method, outcome metrics (e.g., QALY, ICER), cost categories, and time horizons. Disagreements were resolved through discussion. Quality Appraisal: The methodological quality of included studies was assessed using the CHEERS (Consolidated Health Economic Evaluation Reporting Standards) checklist. Studies scoring 8 out of 10 or higher were considered high quality.

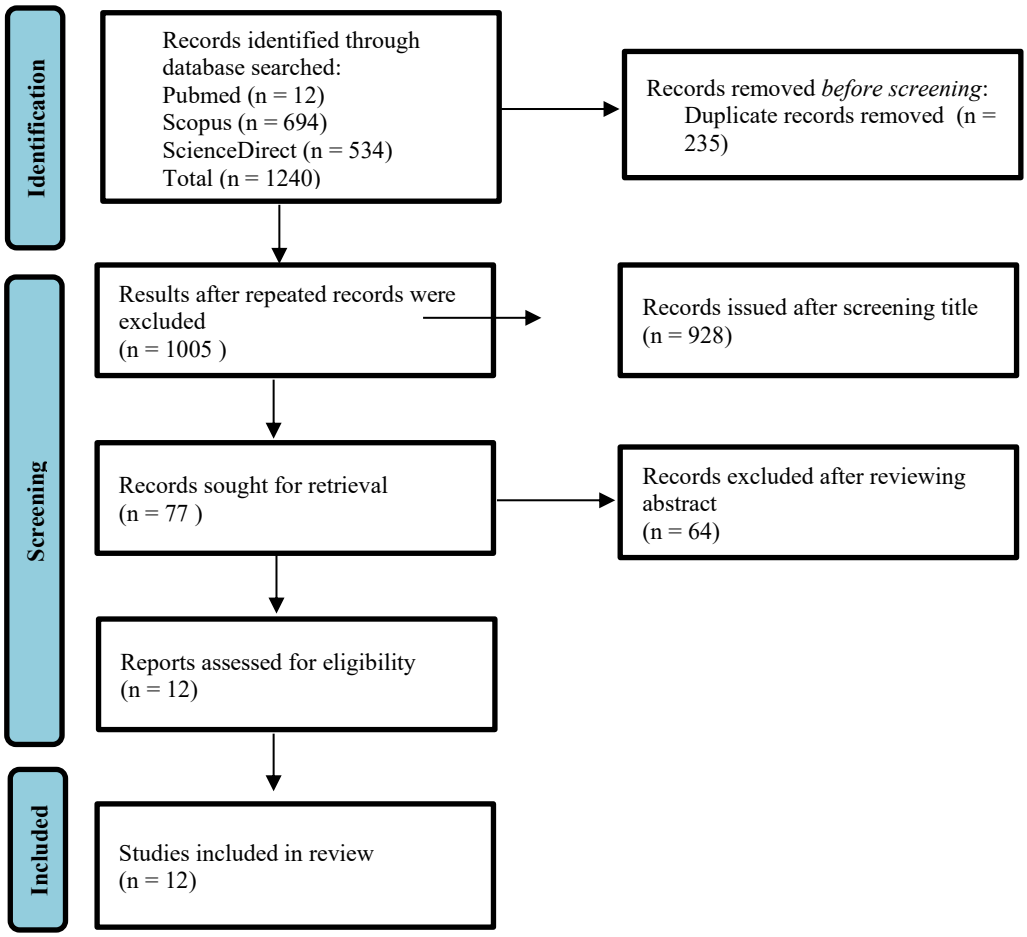

Fig 1. PRISMA diagram flow

3. RESULTS AND DISCUSSION

Results

Table 1 below describes the 12 articles selected based on the PRISMA protocol in Figure 1.

Table 1. Results

No	Title	Author(s)	Year	Location	Findings
1	Cost analysis of the WHO-HEARTS program for hypertension control and CVD prevention in primary health facilities in Ethiopia [7]	SA Beshah, MJ Husain, GA Dessie	2023	Ethiopia	The implementation of the WHO-HEARTS program in Ethiopia demonstrated cost-effective primary care strategies for hypertension and cardiovascular risk prevention, with medications being the dominant cost driver.
2	Cost of primary care approaches for hypertension management and risk-based cardiovascular disease prevention in Bangladesh: a HEARTS costing tool application [8]	MJ Husain, MS Haider, R Tarannum	2022	Bangladesh	The scale-up of the HEARTS intervention in Bangladesh showed cost-effective management of hypertension and integrated CVD care, emphasizing the need for workforce redistribution to optimize resource use.
3	Assessing costs of a hypertension program in primary care: evidence from the HEARTS program in Mexico [9]	C Chivardi, B Hutchinson	2023	Mexico	HEARTS implementation in Mexico revealed economic feasibility and potential cost savings when using standardized treatment protocols compared to existing medication regimens.
4	Cost-Effectiveness of a community-based diabetes prevention program with participation incentives for medicaid beneficiaries [5]	T Gilmer, PJ O'Connor, JS Schiff	2018	USA	A community-based diabetes prevention program among Medicaid beneficiaries proved cost-effective over the long term, reducing CVD risks and delivering measurable health gains for low-income populations.
5	Health benefits and cost-effectiveness of asymptomatic screening for hypertension and high cholesterol and aspirin counseling for primary prevention [10]	SP Dehmer, MV Maciosek	2017	USA	Modeling of primary prevention strategies like hypertension and cholesterol screening in the US yielded high QALY gains and favorable cost-effectiveness, especially for underserved populations.
6	Costs of the HEARTS hypertension program in primary care in Lampang province, Thailand [11]	P Aramrat, C Aramrat, TT Kim, MJ Husain	2025	Thailand	The cost of HEARTS implementation in Thailand's Lampang province was comparable to usual care, with additional

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doi.org/10.31334/bijak.v22i2.5487

					training offset by reduced medication costs, indicating system-level cost-effectiveness.
7	The Healthy Hearts program to improve primary care for hypertension in seven rural health units of Iloilo Province, Philippines: a comparative cost study [12]	HY Lam, HA Valverde, D Mugrditchian	2025	Phillipines	Comparative cost analysis in the Philippines revealed that hypertension control through pooled procurement and better management was more cost-effective than local or private procurement schemes.
8	Integrating hypertension and diabetes management in primary health care settings: HEARTS as a tool [13]	D Flood, EW Edwards	2023	Latin America	Integrating diabetes care into HEARTS-based hypertension programs was found to be a cost-efficient model for CVD prevention at the primary care level across Latin America.
9	Estimated cost for cardiovascular disease risk-based management at a primary healthcare center in Nepal [14]	A Aryal, D Citrin, S Halliday, A Kumar, P	2020	Nepal	Cost modeling for CVD prevention in Nepal showed that risk-based screening and treatment at PHC level is economically viable, with moderate increases in provider workload.
10	Cost-effectiveness of implementing risk-based cardiovascular disease (CVD) management using updated WHO CVD risk prediction charts in India [15]	P Sivanantham, MK S, S Essakky, M Singh, S Ghosh…	2023	India	Two-stage WHO risk-based CVD screening in India was more cost-effective than universal lab-based screening, supporting phased implementation in resource-limited settings.
11	Cost-effectiveness of the SLIMMER diabetes prevention intervention in Dutch primary health care: economic evaluation from a randomised controlled trial [16]	G Duijzer, AJ Bukman	2019	Netherland	The SLIMMER lifestyle intervention for diabetes prevention in Dutch primary care showed modest health gains and moderate cost-effectiveness depending on evaluation perspective.
12	Cost effectiveness of case-finding strategies for primary prevention of cardiovascular disease: a modelling study [17]	C Crossan, J Lord, R Ryan	2016	UK	Simulation-based modeling indicated that targeting high-risk patients for CVD prevention in primary care is more cost-effective than universal screening of all adults.

ICER and QALY Outcomes. ICERs reported across the 12 included studies ranged from USD 105 to USD 48,500 per quality-adjusted life year (QALY) gained. The most favorable ICER was identified in India's two-stage WHO risk-based screening approach, estimated at USD 105/QALY. In

contrast, the least cost-effective intervention was universal cardiovascular disease (CVD) screening in the United Kingdom, with an ICER of USD 162,280/QALY. The SLIMMER lifestyle intervention in the Netherlands reported ICERs of €13,605 from a healthcare perspective and €28,094 from a societal perspective, both within acceptable cost-effectiveness thresholds used in European settings. A community-based diabetes prevention program among Medicaid beneficiaries in the United States demonstrated a favorable long-term ICER of USD 14,011/QALY. Additionally, integrated service delivery models combining hypertension and diabetes care—particularly in Latin American settings—were found to be more cost-effective than single-disease programs, indicating economic advantages of integrated primary care interventions.

A thematic synthesis across the 12 included studies reveals several recurring patterns. First, integrated intervention models, particularly those combining hypertension and diabetes screening and treatmentdemonstrated more favorable ICERs than stand-alone programs. This was evident in studies from Latin America, India, and Nepal, where shared delivery infrastructure reduced overall program costs (Flood et al, 2023; Aryal et al, 2020; Sivanantham et al, 2023). Second, cost-effectiveness improved when standardized treatment protocols such as WHO HEARTS were used, which allowed for pooled procurement and streamlined care pathways, as seen in Mexico, Ethiopia, and the Philippines (Beshah et al, 2023; Chiyardi et al, 2023); Lam et al, 2025). Third, task shifting to non-physician health workers emerged as a key enabler of cost-efficiency, particularly in Bangladesh and Nepal (Husain, et al, 2022); Aryal et al, 2020). Finally, preventive programs tended to yield more cost-effective outcomes when evaluated over longer time horizons and from broader perspectives, such as the societal perspective adopted in the SLIMMER trial (Duijzer et al ,2019).

Discussion

This systematic review confirms the growing body of evidence that risk-based cardiovascular disease (CVD) and diabetes prevention strategies are cost-effective in both high-income countries and low- and middle-income countries (LMICs). Most studies reported ICERs (Incremental Cost-Effectiveness Ratios) well below commonly accepted thresholds, such as one to three times a country's gross domestic product (GDP) per capita. For instance, a two-stage WHO risk-based screening in India yielded an ICER of USD 105 per QALY, substantially below the cost-effectiveness threshold (Sivanantham et al ,2023).

Integrated interventions addressing both hypertension and diabetes, such as those within the HEARTS framework in Latin America, demonstrated superior cost-effectiveness compared to disease-specific (approaches. Shared risk profiles and infrastructure requirements contribute to these efficiencies (Beshah et al , 2023; Flood et al, 2023). Similarly, centralized procurement (as seen in the Philippines) and task shifting to community health workers (as in Bangladesh and Nepal) align with WHO recommendations and further improve cost-effectiveness (Lam et al. 2025); Aryal et al, 2020)..

While most evaluations were conducted from the health system perspective, programs like SLIMMER in the Netherlands adopted a societal perspective, allowing for broader consideration of indirect costs and productivity gains. This approach highlights the added value of prevention strategies when long-term and societal impacts are taken into account (Duijzer et al, 2019). There is a critical need for more such evaluations, particularly in LMICs where indirect costs often impose significant burdens.

These findings are consistent with a broader body of literature emphasizing the cost-effectiveness of NCD prevention at the primary care level. A global modeling study by Nugent et al. estimated that scaling up preventive interventions for CVD and diabetes in LMICs could yield economic returns of up to USD 7 for every USD 1 invested, largely due to averted productivity losses and health care costs (Nugent et al ,2018). Similarly, Bertram et al. showed that implementing WHO "best buy" interventions for NCDs, including hypertension and diabetes screening, was among the most cost-effective health policy options worldwide (Bertram et al, 2018).. These external sources support the notion that prevention at the primary care level offers not only clinical benefit but also economic efficiency.

From an economic perspective, the results indicate that Corporate Social Responsibility (CSR) functions as a value-creating strategy rather than a cost burden. The significant effect of CSR on Debt

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doi.org/10.31334/bijak.v22i2.5487

to Equity Ratio (DER), Gross Profit Margin (GPM), and Net Profit Margin (NPM) suggests that CSR contributes to both financial stability and profitability in manufacturing firms.

The negative relationship between CSR and DER implies that higher CSR engagement is associated with lower financial leverage, reflecting increased investor confidence and reduced financing risk. Economically, this strengthens firms' capital structures and enhances resilience to market uncertainty. Meanwhile, the positive impact of CSR on GPM and NPM indicates improved operational efficiency and profitability, likely driven by enhanced reputation, stronger customer trust, and better stakeholder relationships.

These findings support the view that CSR generates economic value by improving firm performance while reducing financial risk. For managers and investors, CSR should therefore be considered a strategic economic investment that supports long-term competitiveness and sustainable growth in the manufacturing sector.

Methodological heterogeneity among studies, ranging from differences in model structures to variation in time horizons and perspectives, limited the ability to conduct meta-analysis. However, the overall consistency in favorable ICERs across different settings and interventions remains encouraging. The inclusion of real-world implementation data, rather than relying solely on modelled projections, strengthens the external validity of the findings (Beshah et al, 2023).

This review has several limitations. First, there was substantial methodological heterogeneity among included studies, ranging from variations in time horizons, cost components, and outcome measures, which limited the ability to perform meta-analysis. Second, the inclusion was restricted to articles published in English, potentially excluding relevant evidence from non-English language journals. Third, most studies were model-based and did not incorporate real-world implementation data, which may affect the generalizability of findings. Finally, potential publication bias may have skewed the review toward studies reporting favorable cost-effectiveness outcomes, a common limitation in economic evaluation literature.

4. CONCLUSION

This systematic review reinforces the cost-effectiveness of primary prevention strategies for cardiovascular disease and diabetes across a range of health system contexts. Integrated models such as the WHO HEARTS package, especially when combined with diabetes prevention strategies, offer scalable, efficient approaches for resource-limited settings. The findings suggest that countries seeking to maximize the value of health spending should prioritize integration of services, standardized treatment protocols, pooled procurement mechanisms, and task shifting to non-physician cadres.

Policymakers should invest in building robust economic evaluation capacity to inform scale-up decisions, especially in low- and middle-income countries. Furthermore, future research should adopt both health system and societal perspectives and utilize real-world implementation data to better capture the broader value of preventive interventions. Efforts should also be made to harmonize economic evaluation methods to facilitate cross-country comparisons and policy learning.

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