Obstacles to the Utilization of Preventive Cardiovascular Risk Prediction Tools: A Scoping Review

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KEYWORDS

Cardiovascular Disease, Risk Assessment, Preventive Medicine

ABSTRACT:

Cardiovascular risk prediction tools are recognized for their effectiveness in identifying, managing, and mitigating cardiovascular diseases (CVD). Despite their advantages, many primary care clinicians hesitate to adopt these systems. This study aims to comprehensively assess the barriers that hinder using cardiovascular risk prediction tools in clinical decision-making. A thorough literature search was conducted across four databases: CINAHL, Medline, PubMed, and Embase. The review focused on studies that identified obstacles to the clinical implementation of cardiovascular risk prediction algorithms. The JBI critical appraisal tool was employed to evaluate the quality of the included studies. Based on ten studies, the analysis identified three categories of barriers - primary, secondary, and tertiary - to using cardiometabolic risk prediction tools. Primary barriers included lack of information, fear, unfamiliarity, and limited resources. Secondary barriers involved time constraints, workload, patient awareness, disruptions, support, communication, and trust. The tertiary barrier highlighted was the lack of electronic health system integration. Addressing obstacles through targeted education for providers and patients and multidisciplinary support and integration could optimize workflows and adoption to enhance cardiovascular prevention and treatment.

1. Introduction

Cardiovascular diseases (CVDs) such as hypertension, heart failure, stroke, and myocardial infarction, continue to cause mortality and morbidity worldwide. These conditions bring about significant healthcare costs and at the same time compromise the general health standards of individuals. Notably, many of the CVDs are manageable by changing some habits and treating them as early as possible (1). There has been a push to design many risk prediction tools for predicting CVD risk and for informing the management of clients. These are the Framingham Risk Score (FRS), Systematic Coronary Risk Evaluation (SCORE) algorithm and the QRISK risk score. According to the ESC, SCORE2 and SCORE2-OP can be used for the older population to estimate the 10-year probability of any fatal and non-fatal CVD; the ACC and AHA have endorsed the combined cohort risk equations with ASCVD events for predicting the risk over ten years (2).

Several professional bodies have provided numerous CVD risk prediction tools that may be location dependent. Many of them are intended to help explain variations in the risk factors of cardiovascular diseases between different populations or races. Thus, while the algorithms are refreshed based on fresh findings, existing ones are modified to suit population characteristics

(3). One of the critical areas of creating and deploying these tools is to assess genetic differences since they vary from person to person and may characterise users' risk levels to different extents. In the case of some genetic variations that affect individuals' risk towards developing CVDs, populations with unique genetic attributes may experience different prevalence rates, and this may affect the accuracy of tools that are developed based on specific populations (4).

Variations in sample size also impacts the risk prediction algorithms, in term of precision and the extent to which it can be generalized among the different population group. Analyses stemming from operations in a small sample base may be much less accurate than those generated from larger samples. Furthermore, the risk prediction from the information of a given group does not necessarily apply to other groups with different characteristics (5). Another way that validation procedures also affect the reliability and validity of these systems is in the undertakings of variations in procedures. Tools that work have not been tested with other data sets may be less accurate; tools not tested for different population may not work on the diverse groups. Some studies described no loss of precision during independent validations this is why it is appropriate to control genetic, sample size, and validation differences across the locations and associations in order to have precise, reliable and valid results (6).

Several recognized CVD risk prediction systems are effective in research; however, translating this into clinical practice has remained rather limited. These can be in the form of a lack of awareness among the health professionals regarding these tools, apprehensive about the effect of these tools on clinical decision making, time constraints, additional load, and difficulty in integrating risk calculators software in the electronic health systems. It is essential to classify these barriers systematically because the definition of the challenges makes it possible to determine the groups of barriers to be addressed in different healthcare contexts to avoid making general conclusions (7, 8).

To achieve the above goal, addressing the factors affecting the acceptance and utilization of CVD risk prediction tools is required. It creates a prospect for facilitating the quicker identification of patients with preexisting cardiovascular disease, better real-life results, and overall lower expenses of cardiovascular treatment (9). Hence, this systematic investigation aims to extend the existing literature by examining the primary, secondary, and tertiary obstacles regarding the CVD risk prediction systems' application. Such an approach can enable the study to formulate best practice-based interventions that can assist in overcoming hindrances to the application of CVD risk prediction tools thus enhancing patients' treatment as well as health status.

Methods

Search Strategy

The search approach employed Boolean operators (AND and OR) and truncations to ascertain pertinent items. The EBSCOhost research platform was utilized to conduct a comprehensive search across the electronic databases MEDLINE, ERIC, and CINAHL (10, 11). The search terms employed were explicitly related to the field of cardiovascular risk prediction, decision-making tools, barriers, primary and secondary prevention, as well as additional keywords such as enhancing prognosis and preventive cardiology tools. The search was performed in accordance with the predetermined inclusion and exclusion criteria as described in the Methods section of this research article. In order to optimize the retrieval of articles pertinent to the research inquiry, the utilization of specific keywords or their amalgamations, in accordance with the Medical Subject Headings, was employed. These keywords encompass cardiovascular risk prediction,

decision-making tools, barriers, primary and secondary prevention, prognosis enhancement, and preventive cardiology tools.

Inclusion and Exclusion Criteria

The present study will utilize inclusion and exclusion criteria to determine the eligibility of participants for inclusion in the research. These criteria will be established based on specific characteristics and factors that are relevant to the research objectives. The inclusion criteria encompass several key aspects. Firstly, both qualitative and quantitative primary research will be included. Secondly, the papers must be published within the last 10 years, from 2013 to 2023, to ensure the relevance and timeliness of the findings. Thirdly, articles must be published in the English language. Lastly, studies are required to describe the barriers encountered in the clinical adoption of CVD risk prediction tools. This study incorporates peer-reviewed primary research investigating the obstacles healthcare providers, such as physicians, nurses, and pharmacists, face in adopting CVD risk prediction systems. However, specific research will be excluded: (1) studies where only the abstract is accessible and (2) studies describing the use of cardiovascular risk assessment tools in community settings. The limited adoption of CVD risk prediction techniques can be ascribed to several causes, including insufficient awareness, inadequate internal resources, and concerns about the potential effects on clinical decision-making. The fundamental causes of the delayed adoption rate of CVD risk prediction systems among healthcare professionals have been recognized as these considerations.

Statistical Methods

Given the heterogeneous nature of the included studies, a meta-analysis was not feasible. Instead, we employed a narrative synthesis approach to analyze and summarize the findings. This involved systematically extracting data on barriers from each study, categorizing these barriers, and synthesizing the findings across studies. The categorization of barriers into primary, secondary, and tertiary was based on the frequency of reporting across studies and the perceived direct impact on tool adoption as judged by the review team. This categorization is a novel approach proposed by this review and requires further validation in future studies.

Appraisal of the literature

The selected articles were appraised using the recent Joanna Briggs Institute (JBI) version with the least bias risk (12). Using JBI helps evaluate the methodological quality of the included articles to assess the possible biases in the methodological approach used. As shown in Tables 1 and 2, ten studies met the methodological quality for inclusion in the study.

Table 1. JBI appraisal checklist for cross-sectional studies

Author, year	Study Type	Items on JBI Appraisal Checklist								Overall appraisal
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	
Al-Ashwal et al., 2022	Cross-sectional	No	Yes	Yes	Yes	No	No	Yes	Yes	Include
Al-Ruwaili et al., 2019	Cross-sectional	No	Yes	Yes	Yes	No	No	Yes	Yes	Include
Ban et al., 2020	Cross-sectional	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Include
Brown et al., 2016	Cross-sectional	No	No	Yes	Yes	No	No	Yes	Yes	Include
Greaves et al., 2020	Cross-sectional	No	No	Yes	Yes	No	No	Yes	Yes	Include
Ofori et al., 2016	Cross-sectional	No	Yes	Yes	Yes	No	No	Yes	Yes	Include
Tawfik et al., 2015	Cross-sectional	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Include

Table 2. JBI appraisal checklist for qualitative studies

Author, year	Study Type	Items on JBI Appraisal Checklist										Overall appraisal
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	
Barfoed et al., 2015	Qualitative interview	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Unclear	Yes	Include
Brown et al., 2016	Focus groups	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Include
Liew et al., 2013	Qualitative interview	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Tuzzio et al., 2021	Qualitative	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Include

Results

As shown in the study selection flowchart (Fig. 1), ten articles were included in this literature review. These eleven articles resulted from the screening of 1995 articles. Details of individual studies, including the barriers to adopting CVD risk prediction tools, have been provided in the extraction Table 3. To improve clarity and facilitate comprehension, we have reorganized the presentation of results into a more structured format, focusing on categorizing barriers.

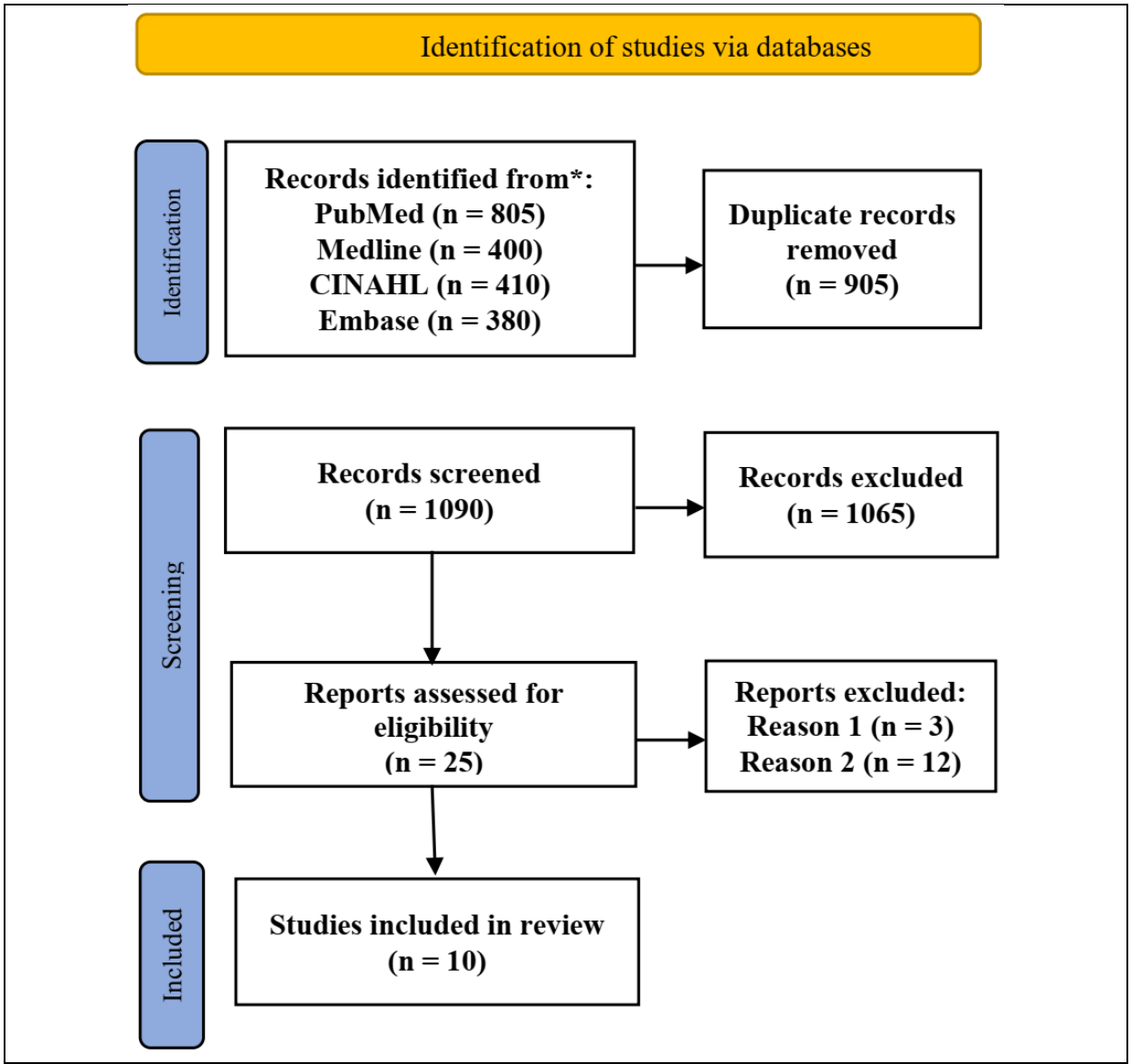

Fig 1. A PRISMA flowchart of the study selection

Table 3. Extraction table for the ten studies included in the literature review

Author's Name and Year	Title	Objective	Methodology	Cardiovascular Risk Prediction Tool Assessed	Barriers	Limitations
Al-Ashwal et al., 2022	Knowledge, attitude, perceived barriers, and practices among pharmacists regarding risk assessment of cardiovascular disease: A cross-sectional study in Yemen	To assess the barriers, as well as knowledge and attitude, of pharmacists with regard to risk assessment of ASVD	Cross-sectional design	-The 10-year ASCVD risk Calculator -The Framingham general CVD risk calculator	- lack of support by other healthcare providers and healthcare facility -lack of resources, including access to guidelines and medical records -lack of adequate training on CVD risk assessment -low public awareness and acceptance of assessing CVD risk -lack of time	-study included pharmacists in Sana'a, Yemen, only and thus lacks generalizability -sampling bias -self-reports by pharmacists could lead to social desirability bias
Ban et al., 2020	GPs' familiarity with and use of cardiovascular clinical prediction rules: A UK survey study	To assess use of clinical prediction tools by general practitioners	Online survey	-QRISK scores -ABCD scores -CHADS scores -HAS-BLED score -Wells scores -JBS risk calculator -Framingham risk scores - New Zealand tables	-low familiarity with the CVD risk predictors	-sampling bias caused by overrepresentation of those enthusiastic in the subject -low generalizability to other practitioners
Barfoed et al., 2015	GPs' perceptions of cardiovascular risk and views on patient compliance: A qualitative interview study	To explore the experiences and attitudes of general practitioners in using lipid-lowering drugs for treatment	semistructured qualitative interviews	-SCORE	-reluctance to convert patients into charts -the risk tools did not provide adequate communication support -no patient involvement in communicating and making clinical decisions	-sampling bias caused by overrepresentation of those enthusiastic in the subject
Brown et al., 2016	Understanding clinical prediction models as 'innovations': A mixed methods study in UK family practice	To investigate the use of clinical prediction models by family physicians	Mixed methods (online survey and focus groups)	No specific model	-time limitations -failure to integrate the models into the electronic health records -lack of relevance to some patients -oversimplification of risk assessment	-low response rate of 14.4% -survey mainly included newly qualified clinicians leading to lack of generalizability
Greaves et al., 2020	Cross-sectional survey describing general practitioners' absolute cardiovascular disease risk assessment practices and their relationship to knowledge, attitudes and beliefs about cardiovascular disease risk in Queensland, Australia	To describe the risk assessment practices of GPs with regard to ACVDR	Cross-sectional survey	Australian ACVDR calculator	-low knowledge levels on use of Australian ACVDR calculator -lack of sufficient time -low patient education -lack of incentives in terms of funds -Insufficient nurses' support	-lack of geographical generalizability (limited to Queensland) -subjectivity due to self-reporting
Liew et al., 2013	Cardiovascular risk scores: qualitative study of how primary care practitioners understanduse them	To explore the level of understanding of cardiovascular risk scores and their use by GPs	Qualitative study	-QRISK - Framingham	-uncertainty on the type of risk score to use -Insufficient knowledge on when to use the risk score (before or after starting treatment?)	-lack of geographical generalizability (limited to Oxfordshire) -sampling bias caused by overrepresentation of those enthusiastic in the subject
Al-Ruwaili	Knowledge, attitude and barriers using	To assess the use of ASCVD by	Cross-sectional study	- ASCVD risk assessment calculator - Framingham risk score	-inadequate knowledge on the use of the risk score	-single center study, which lacks generalizability -self-reported data

et al., 2019	atherosclerotic cardiovascular disease (ASCVD) risk assessment calculator in management of dyslipidemia among primary health care providers	primary care providers, with regard to attitude, knowledge, and barriers			-difficulty interpreting the results -time constraints -lack of integration into the e-system -increased workload	
Ofori et al., 2016	Awareness and attitudes towards total cardiovascular disease risk assessment in clinical practice among physicians in Southern Nigeria	To determine the knowledge, as well as use and attitudes, with regard to CVD risk assessment by physicians	Cross-sectional study	General cardiovascular risk assessment tools	-lack of familiarity with the risk assessment tools -time-wasting in clinical practice	-non-response bias -small sample size
Tawfik et al., 2015	Barriers to the utilization of cardiovascular risk prediction tools as perceived by primary health care and family physicians	To determine the barriers that hinder the use of cardiovascular risk prediction tools by physicians	Cross-sectional study	- WHO CVR score -Framingham -British risk score	- use of a single score is considered insufficient by some -distrust in stakeholders/sponsors of the risk prediction tools	-small sample size
Tuzzio et al., 2021	Barriers to implementing cardiovascular risk calculation in primary care: Alignment with the Consolidated Framework for Implementation Research	To identify the barriers that hinder adoption of CVD risk calculators	Qualitative study	General CVD risk calculator	-competing demands and time constraints -failure to integrate the risk calculator into the electronic health system -low buy-in from the healthcare providers -use of calculator not documented in the clinic workflow	-lack of generalizability to small clinics -barriers were assessed at only one point in time

Barriers

The classification of barriers in our study is organized into three categories: primary, secondary, and tertiary barriers as demonstrated in Table 4. This categorization is based on the frequency of reporting across studies and the perceived direct impact on tool adoption as judged by the review team. It should be noted that this is a novel categorization proposed by this review and requires further validation in future studies. Primary barriers are characterized by constraints that directly affect the implementation of CVD risk prediction tools. These constraints include a lack of knowledge, fear/uncertainty of the impact of the tools on clinical decision-making, lack of familiarity, and lack of adequate resources. Secondary barriers encompass constraints that have an indirect influence on the adoption of tools, including time constraints and increased workload, patient/public awareness, interference with workflow, lack of stakeholder support, lack of communication, and low trust levels. Tertiary barriers encompass factors that lie outside the immediate control of healthcare providers, such as the incorporation of risk prediction technologies into the electronic healthcare system. The aforementioned categorization facilitates the provision of a coherent and organized assessment of the recognized obstacles and their respective significance in the implementation of cardiovascular disease risk prediction tools

Table 4: Barriers to Adoption of Cardiovascular Risk Prediction Tools		
Barrier	Classification	Description
Insufficient knowledge/information	Primary	Healthcare providers lack knowledge about the use and interpretation of CVD risk prediction tools.
Fear/uncertainty	Primary	Healthcare providers are uncertain about the impact of CVD risk prediction tools on clinical decision making.
Lack of familiarity	Primary	Healthcare providers are less likely to use unfamiliar risk prediction tools.
Lack of adequate resources	Primary	Healthcare providers lack adequate resources to support the adoption of risk prediction tools.
Time constraints and increased workload	Secondary	Healthcare providers have limited time to use CVD risk prediction tools due to competing demands.
Patient/public awareness	Secondary	Patients and the public are not aware of the benefits of CVD risk prediction tools.
Interference with workflow	Secondary	The use of CVD risk prediction tools interferes with the workflow of healthcare providers.
Lack of support by stakeholders	Secondary	Healthcare providers lack support from stakeholders and other caregivers in the adoption of CVD risk prediction tools.
Lack of communication	Secondary	There is a lack of communication between healthcare providers and patients regarding the use of CVD risk prediction tools.
Low trust levels	Secondary	Healthcare providers have low trust in the intentions and interests of stakeholders promoting the adoption of CVD risk prediction tools.
Failure to integrate into electronic health system	Tertiary	The failure to integrate the calculator into the electronic health system discourages physicians from using the tool.

Primary barriers

The primary barriers encompass the underlying limitations associated with the initial implementation of risk prediction models. The adoption of risk assessment methods and models was directly impacted by these considerations (13). The factors contributing to knowledge gaps in the utilization of risk prediction models encompass limited understanding among both physicians and patients, fears among physicians regarding the influence of these tools on clinical decision-making, insufficient familiarity with the risk assessment tools, and inadequate availability of resources.

Insufficient knowledge

Across four study investigations, healthcare practitioners expressed their dissatisfaction with their insufficient knowledge regarding cardiovascular assessment tools. This deficiency significantly impacted their willingness to adopt these techniques for making clinical decisions. In their study, Al-Ashwal et al. (14) discovered that a significant proportion of the pharmacists

involved in their research, specifically 48.7%, had received insufficient training in cardiovascular disease (CVD) risk assessment. In addition, Greaves et al. conducted a cross-sectional study examining the utilization of the Australian ACVDR calculator. According to the findings of the survey, a notable proportion of general practitioners, specifically 11%, indicated a deficiency in their understanding of the groups that are eligible for assessment under the ACVDR (Annual Comprehensive Vascular Disease Risk) framework. Furthermore, a qualitative study conducted by Liew et al. (13) unveiled a notable deficiency in understanding (lack of knowledge) regarding the appropriate utilization of risk assessment techniques. Certain practitioners expressed concerns regarding the efficacy of risk ratings following the commencement of treatment. The authors stated that the risk scores were intended for patients who had not initiated treatment. Furthermore, Al-Ruwaili et al. conducted a cross-sectional study in which they found that a significant proportion (47.3%) of physicians possessed a limited understanding of the ASCVD risk assessment calculator, primarily attributed to insufficient training (15).

Fear/uncertainty

In three separate papers, physicians expressed apprehension regarding the potential influence of risk prediction tools on clinical decision-making. In their study, Brown et al. (16) employed a mixed methods approach to investigate the concerns of physicians on the utilization of risk assessment tools in evaluating patients for cardiovascular risk. The researchers found that physicians expressed apprehension that these tools tended to oversimplify the evaluation process, which they perceived as a potential danger to their professional duty (16). Given that the risk measurement cutoffs are collected from the general population, the risk scores may not be applicable to specific patients. The concerns expressed in the study conducted by Barfoed et al. (17) were also observed among general practitioners, as they exhibited a lack of enthusiasm for documenting patient information (17). In a study conducted by Tawfik et al., (18) it was shown that 82% of physicians expressed the belief that relying just on a single score was inadequate for accurately determining the risk of cardiovascular disease (CVD). As a result, these physicians were hesitant to use risk prediction systems (18).

Lack of familiarity

Two studies underscored the healthcare providers' inadequate familiarity with cardiovascular risk prediction technologies. The survey study conducted by Ban et al. shown that general practitioners had a decreased propensity to utilize risk prediction methods that were unfamiliar to them (19). In a cross-sectional survey conducted by Ofori and Wachukwu, it was found that a significant proportion of physicians, specifically 52.8%, identified unfamiliarity as an impediment to the use of risk prediction tools (20).

Lack of adequate resources

Two studies underscored the inadequacy of available resources in facilitating the use of risk prediction methods. The survey conducted by Al-Ashwal et al. (14) revealed that a significant proportion of pharmacists, specifically 70.6%, expressed concerns over the lack of accessibility to laboratory data, medical records, and guidelines. According to the findings of Greaves et al., a significant majority of general practitioners, amounting to 70%, acknowledged the necessity of further financial resources and incentives to promote the utilization of the Australian ACVDR calculator in the context of clinical decision-making (14).

Secondary barriers

These constraints persist despite the resolution of the primary ones. The potential emergence of these issues can be attributed to the utilization of risk prediction models. The identification and

resolution of these hurdles are crucial in order to guarantee the sustained implementation of the risk assessment tools.

Time constraints and increased workload

The implementation of clinical prediction methods for cardiovascular risk assessment has been hindered by time limits and increased workload, as revealed in six separate investigations. In accordance with the research conducted by Al-Ashwal et al., (14) a significant proportion of pharmacists (20.6%) expressed concerns over insufficient time to effectively employ risk assessment methods (14). According to a study conducted by Brown et al. (16), the utilization of clinical prediction models by family physicians was impeded due to time constraints. This primarily pertained to risk prediction models of a more intricate kind, necessitating a greater amount of time for their completion. As indicated by Greaves et al., a significant proportion (65%) of general practitioners expressed that the utilization of the Australian ACVDR calculator would experience a rise if there was a conscious allocation of time dedicated to utilizing the tool (21). Furthermore, a study conducted by Al Ruwaili (15) revealed that 43.5% of family physicians reported that the utilization of the Australian ACVDR calculator was a time-consuming process. Additionally, Ofori and Wachukwu (year) found that a significant proportion of physicians, specifically 62.9%, had the belief that utilizing risk assessment tools was a non-productive use of time (20). Tuzzio et al. (22) reported a lack of adequate time for utilizing risk prediction calculators across the 23 clinics that were examined.

Patient/public awareness

Two research indicated that patients have insufficient knowledge regarding cardiovascular risk prediction methods. According to the findings of Al-Ashwal et al., (14) a significant proportion of pharmacists (22.1%) expressed concerns regarding the inadequate level of public awareness and the limited adoption of risk assessment methods for cardiovascular disorders. Furthermore, it was noted by Greaves et al. (21) that a significant majority of general practitioners, specifically 80%, placed emphasis on the necessity of enhancing patient education in order to facilitate the effective implementation of risk prediction tools.

Interference with workflow

Tuzzio et al. (22) reported that several physicians expressed criticism regarding the absence of documentation pertaining to the risk prediction calculator inside the workflow. The absence of a structured workflow methodology serves as a deterrent for clinicians in utilizing the calculator.

Lack of support by stakeholders and other caregivers

Two studies have shown the absence of support from other stakeholders. According to the study conducted by Al-Ashwal et al., (14) a significant proportion of pharmacists, namely 74.85%, expressed concerns with the insufficient assistance provided by other caregivers and management. These individuals were hesitant to embrace the utilization of risk assessment tools. According to a study conducted by Greaves et al., (21) a significant majority of general practitioners, namely 71%, expressed the belief that nurses should be involved in the process of conducting risk assessments.

Lack of communication

In their study, Barfoed et al. (17) found that the risk prediction tools lacked effective communication assistance and hindered patients from fully participating in the decision-making process.

Low trust levels

The results of a study conducted by Tawfik et al, (18) a significant majority of physicians, namely 88.7%, expressed a lack of trust towards the objectives and interests of the stakeholders

advocating for the implementation of risk prediction tools. In a similar vein, Tuzzio et al. (22) observed that physicians exhibited a lack of confidence in the risk assessment standards and tools, primarily stemming from apprehensions regarding the motives of the entities, such as pharmaceutical companies, that advocated for their adoption.

Tertiary factors

These are factors that are identified when analyzing the primary and secondary barriers. Also, technology is also considered a tertiary factor as it supports the primary and secondary components.

Failure to integrate the risk prediction tools into the electronic health system

Three studies have documented the influence of technology on the adoption of risk prediction systems. According to the findings of Brown et al.,(16) the utilization of the clinical prediction model was found to be influenced by the integration of the model into the electronic health system. This integration facilitated the ease of score calculation. Furthermore, as reported by Al-Ruwaili et al. (15), a significant proportion of family physicians (58%) refrained from using the ASCVD risk calculator due to its lack of integration within the e-medical system. In a similar vein, Tuzzio et al., (22) highlight the lack of successful integration of the calculator into the electronic health system as a contributing factor that deterred clinicians from adopting the tool.

Discussion

The conducted literature search resulted in the discovery of ten research papers that have contributed to the identification of issues that impede the application of cardiovascular risk prediction tools. The research conducted in these studies utilized either quantitative or qualitative methodologies, with the majority of studies adopting a cross-sectional research design. Despite the limitations of cross-sectional studies in establishing causation and the potential for bias due to confounding factors, they are characterized by their ease of implementation and cost-effectiveness (23).

The employment of qualitative methodologies, such as focus groups and interviews, followed by thematic analysis, facilitates a more comprehensive investigation into the subject matter of concern (24). The inclusion of qualitative research in this particular situation has significantly enhanced the literature analysis by offering a thorough examination of the obstacles that impede the use of cardiovascular risk assessment methods.

This review identified 11 barriers, which have been categorized into primary, secondary, and tertiary factors. The primary barriers identified in this study, including insufficient knowledge, fear/uncertainty, lack of familiarity, and lack of adequate resources, highlight the need for healthcare providers to receive adequate training and support in the use and interpretation of cardiovascular risk prediction tools. This training should include education on the benefits of these tools, their limitations, and how to integrate them into clinical decision-making processes effectively. Additionally, healthcare providers should be provided with adequate resources, such as access to electronic health records and decision support tools, to support the adoption of these tools (25).

The secondary barriers identified in this study, including time constraints and increased workload, patient/public awareness, interference with workflow, lack of support by stakeholders and other caregivers, lack of communication, and low trust levels, highlight the need for a multidisciplinary approach to risk prediction. This approach should involve collaboration between healthcare providers, patients, and other stakeholders, such as policymakers and insurers, to address these barriers effectively. For example, policymakers could provide

incentives for healthcare providers to adopt cardiovascular risk prediction tools, while insurers could provide coverage for the use of these tools (25).

The study identifies a tertiary barrier, which is the failure to integrate the calculator into the electronic health system. This finding emphasizes the importance of healthcare providers having access to decision assistance tools that are both user-friendly and integrated. The seamless integration of cardiovascular risk prediction technologies into electronic health records is crucial, since it enables healthcare providers to conveniently access and utilize these tools.

The implementation of cardiovascular risk prediction systems holds promise in delivering substantial clinical and therapeutic benefits, such as superior patient outcomes, decreased healthcare expenditures, and improved communication between healthcare professionals and patients. Nonetheless, the failure to embrace these tools may lead to missed prospects for timely intervention and heightened healthcare expenditures attributable to avoidable cardiovascular incidents. Consequently, it is imperative for healthcare stakeholders to acknowledge and tackle the hurdles that hinder the integration of cardiovascular risk prediction technologies, while concurrently advocating for their extensive implementation within clinical settings (26).

Recommendations to Overcome the Barriers

The identification of barriers to the implementation of cardiovascular risk prediction systems has prompted a recognition of the necessity to comprehend the actions that might effectively mitigate these restrictive elements. It is imperative that physicians and other primary healthcare providers receive comprehensive training regarding the diverse range of cardiovascular risk prediction tools and their respective functionalities. According to Rossello et al., risk prediction tools serve as a means of supporting decision-making rather than replacing the role of physicians. It is imperative to underscore the merits of risk prediction tools in the management of cardiovascular disease (CVD), particularly in terms of enhanced clinical outcomes, with the aim of fostering greater acceptance and utilization of these tools among physicians. It is recommended that healthcare professionals should avail themselves of and employ the clinical practice standards that regulate the utilization of risk prediction tools (27).

Furthermore, the utilization of technology can effectively mitigate the workflow issues and time restrictions that are encountered. As indicated in the current investigation, medical practitioners express apprehension regarding the potential disturbance to their established workflow and the additional workload associated with integrating risk prediction tools into the process of clinical decision-making. In light of this matter, it is imperative to incorporate risk prediction calculators into the electronic health system to provide automated and streamlined computation of risk scores (14, 28). By implementing this approach, clinicians will experience enhanced ease in utilizing the risk score, hence mitigating the potential strain associated with a convoluted workflow.

Additionally, it is recommended that a multidisciplinary approach be employed in order to facilitate the deployment of cardiovascular prediction systems. Physicians have recognized lack of assistance as a significant barrier. Therefore, the inclusion of multidisciplinary support from nurses and pharmacists can enhance the attitudes of primary care providers (29). This practice modification will additionally reduce the perceived strain experienced by physicians.

Likewise, it is crucial to recognize that patients play a pivotal role as essential stakeholders in the care process. As such, it is imperative to ensure that they are provided with sufficient education regarding cardiovascular risk prediction tools. It is advisable for patients and physicians to engage in collaborative clinical decision-making, as the inclusion of patients in this process is expected to enhance their dedication to the proposed risk reduction strategies (27). It is essential for patients to possess knowledge regarding diverse risk prediction tools that can aid in the

facilitation of personalized health care. As reported in Table 5, the use of this approach is also expected to improve the level of communication between the patient and the physician, which is crucial for achieving optimal treatment outcomes.

Table 5: Recommended Solutions for Barriers to Adoption of Cardiovascular Risk Prediction Tools

Barrier	Recommended Solutions
Insufficient knowledge	Adequate training of healthcare providers and patients on cardiovascular risk prediction tools
Fear/uncertainty	Education on the benefits and limitations of cardiovascular risk prediction tools, and effective integration into clinical decision-making processes
Lack of familiarity	Educate on the benefits and limitations of cardiovascular risk prediction tools, and effective integration into clinical decision-making processes
Lack of adequate resources	Access to electronic health records and decision support tools to support the adoption of cardiovascular risk prediction tools
Time constraints and increased workload	Adopt a multidisciplinary approach involving collaboration between healthcare providers, patients, and other stakeholders for risk prediction
Patient/public awareness	Educate patients on the benefits of cardiovascular risk prediction tools and how they support individualized health management
Interference with workflow	Integrate cardiovascular risk prediction tools into clinical workflows and decision-making processes
Lack of stakeholder support	Collaborate between healthcare providers, patients, policymakers, and insurers to address barriers to the adoption of cardiovascular risk prediction tools
Lack of communication	Improve communication between healthcare providers and patients to support the adoption of cardiovascular risk prediction tools
Low trust levels	Educate on the benefits and limitations of cardiovascular risk prediction tools, and effective integration into clinical decision-making processes
Failure to integrate the calculator into the electronic health system	Design electronic health records to seamlessly integrate cardiovascular risk prediction tools

Contribution of this Work to Healthcare Decision-Makers

This study has identified the primary, secondary, and tertiary barriers to the adoption of cardiovascular risk prediction tools in clinical practice. By providing a comprehensive overview of these barriers, this study aims to inform healthcare decision-makers of the challenges that must be addressed to promote the widespread adoption of these tools.

Furthermore, this study has identified potential solutions to these barriers, including adequate training of healthcare providers and patients, integration of technology, and a multidisciplinary approach to risk prediction. By highlighting these solutions, this study aims to provide healthcare decision-makers with actionable recommendations for promoting the adoption of cardiovascular risk prediction tools in clinical practice.

Gaps Addressed by this Work

The present study has made noteworthy contributions to healthcare decision-makers by the identification and categorization of the primary, secondary, and tertiary barriers hindering the

implementation of cardiovascular risk prediction systems. The paper presents practical suggestions for overcoming these obstacles, including the provision of comprehensive training for healthcare professionals and patients, the integration of technology into the existing workflow, and the promotion of a multidisciplinary approach to the prediction of risks.

This study aims to fill multiple gaps identified in the existing body of research. This study offers a complete examination of the obstacles hindering the process of adoption, a topic that has not been extensively addressed in previous research. Moreover, it discerns prospective remedies for these barriers, providing significant perspectives for the formulation of interventions. Additionally, the research underscores the potential advantages of implementing these instruments, placing emphasis on enhanced patient outcomes, diminished healthcare expenditures, and improved communication between healthcare practitioners and individuals.

Limitations

The present study possesses a number of limitations that warrant careful consideration during the interpretation of the findings. The studies encompassed in this review predominantly consisted of cross-sectional designs, hence constraining our capacity to establish a causal relationship between barriers and the delayed uptake of cardiovascular risk prediction tools. Further research is required to conduct future randomized controlled trials in order to show a definitive causal relationship between the aforementioned hurdles and the use of these tools.

Furthermore, it is important to note that the scope of the papers analyzed in this review was restricted to publications in the English language. Consequently, the findings may not fully capture the various obstacles encountered in non-English speaking nations regarding the use of cardiovascular risk prediction tools. Subsequent investigations should strive to incorporate research conducted in a more diverse array of nations and linguistic contexts, in order to foster a more all-encompassing comprehension of the obstacles impeding the implementation of these tools.

Additionally, it is important to note that the scope of this analysis was restricted to studies that were published within a specific timeframe, specifically the period from 2013 to 2023. The selection of this era was made with the intention of include recent studies into the evaluation. However, it is conceivable that pertinent studies published before to 2013 may have been inadvertently overlooked.

This study primarily examined the obstacles associated with the implementation of cardiovascular risk prediction systems, while not extensively delving into the possible advantages offered by these tools. Following that, research ought to be directed towards the examination of the prospective advantages associated with these tools, including their influence on patient outcomes, healthcare expenditures, and the interaction between healthcare practitioners and patients.

Notwithstanding these constraints, the present work offers a thorough examination of the obstacles impeding the implementation of cardiovascular risk prediction tools, as well as prospective remedies for these impediments. By acknowledging and addressing these limitations in future research endeavors, we can further enhance our comprehension of the obstacles hindering the acceptance of these tools. Consequently, we can build efficacious treatments aimed at fostering their extensive utilization within clinical practice.

Conclusion

The present study has revealed that a number of factors serve as prevalent obstacles to the implementation of cardiovascular risk prediction tools. These include lack of knowledge, fear/uncertainty, time constraints, heavy workload, and failure to integrate risk prediction tools

into the electronic health system as the most common barriers to the adoption of cardiovascular risk prediction tools. These barriers might potentially be mitigated by implementing comprehensive training programs for healthcare providers and patients, incorporating advanced technology into healthcare systems, and adopting a multidisciplinary approach to predicting and managing risks. Given that the majority of the papers assessed in this work were of a cross-sectional nature, it is imperative that future research endeavors prioritize the inclusion of randomized controlled trials. Such trials would greatly contribute to the establishment of a causal relationship between barriers and the delayed adoption of risk prediction tools.

Declarations

Ethical Approval:

This review study analyzes existing literature to identify obstacles to the clinical implementation of cardiovascular risk prediction algorithms. Ethical approval was not required as the analysis is based solely on previously published research and does not involve collecting original data from human participants. The studies included in this review were sourced from related databases. The author declares no conflicts of interest related to this study.

Data availability statement:

This study did not generate or analyze any new data. Consequently, data sharing is not applicable to this article. However, pertinent literature and data from prior studies can be accessed through established academic databases and repositories. For additional information, please consult the references cited within the article.

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Conflicts of Interest:

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