



Review Article

Barriers and Facilitators Influencing Nurses in Genetic Services Provision: A Systematic Review

T Latha¹, C Soniya², Rinchen Dem Dukpa², Jayvardhan Singh³, *Shiv Kumar Mudgal⁴.

¹College of Nursing, All India Institute of Medical Sciences, Bibinagar, Telangana, India, ²All India Institute of Medical Sciences, Kalyani, West Bengal, India, ³Indian Council of Medical Research National Institute for Implementation Research on Non-Communicable Diseases, Jodhpur, Rajasthan, India, ⁴College of Nursing, All India Institute of Medical Sciences, Deoghar, Jharkhand, India

Abstract

Background: Nurses play a crucial role in the provision of genetic services, yet their capacity to deliver these services is often constrained by various barriers. Understanding these barriers and identifying facilitators is essential for optimizing genetic services delivery in nursing practice. This systematic review aimed to explore the barriers and facilitators influencing nurses' roles in providing genetic services, including genetic counseling, testing, and patient management.

Methodology: A comprehensive search across multiple databases yielded 1,275 articles. After de-duplication and screening, 12 studies published between 2001 and 2024 were included. These studies, conducted in nine countries, utilized qualitative and quantitative approaches. Data was synthesized narratively, focusing on key themes related to barriers and facilitators.

Results: Barriers were identified across six domains: gaps in educational preparedness, insufficient knowledge, administrative hurdles, negative attitudes, logistical difficulties, and environmental limitations. Common challenges included knowledge deficits, role ambiguity, time constraints, and cultural variations. Facilitators were grouped into five domains: educational support, role expansion, integration across specialties, positive attitudes, and policy/institutional support. Key enablers included genomic education programs, multidisciplinary teamwork, and structured institutional policies.

Conclusion: Barriers and facilitators to nurses' provision of genetic services are multifaceted, spanning individual, institutional, and systemic factors. Addressing these challenges through targeted interventions, such as enhancing genomic education and fostering interdisciplinary collaboration, can significantly improve genetic services delivery in nursing practice.

Keywords: Barriers; Facilitators; Genetic Services; Nurses; Systematic Review.

***Correspondence:** Dr. Shiv Kumar Mudgal, College of Nursing, All India Institute of Medical Sciences, Deoghar, Jharkhand, India, **Email:** shiv.nur@aiimsdeoghar.edu.in

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Introduction

Genetic and genomic health care has become an essential aspect of modern medicine, with vast implications for personalized treatment and preventive care strategies. As health care systems advance in genomics, the role of nurses, often the most accessible and trusted health care providers, has gained recognition in providing genetic services. This critical role involves activities ranging from collecting family health histories and assessing genetic risks to interpreting test results and providing genetic counseling to patients. These responsibilities align with the nursing profession's mission to promote health, prevent illness, and optimize patient care, yet integrating genetics into everyday nursing practice remains challenging [1,2].

Despite the growing importance of genetics and genomics in health care, studies show that genetic services are often underutilized or insufficiently integrated into routine nursing practice. Several barriers, including a lack of education, limited genetic knowledge, and various logistical and policy constraints, hinder the ability of nurses to fully embrace their roles in genetic and genomic care. Research indicates that, while nurses acknowledge the importance of genetics in patient care, they often feel unprepared to address genetic concerns due to inadequate training and institutional support [3,4]. Furthermore, genetic services have been primarily concentrated within specialized settings, limiting broader access in general practice settings where most patients initially seek health care [5].

The need for genetics and genomics training for nurses is well-documented, yet the practical implementation of this knowledge within clinical settings is lacking.⁶ The existing educational programs often fall short of equipping nurses with the comprehensive skills needed for genetic services. For example, while many programs include genetic literacy, fewer address the complex counseling skills required for managing genetic and psychosocial aspects of patient care, which are vital for patient-centered approaches in genomics [4,6].

The barriers to integrating genetic services into clinical practice are multi-faceted, including limited knowledge and skills in genetics, low confidence in initiating genetic discussions, a lack of resources and guidelines, and concerns about discrimination and psychological harm.⁶ Additionally, nurses face attitudinal barriers, including a lack of confidence and fear of causing harm due to potential misinterpretation of genetic information. These barriers are compounded by the rapid pace of advancements in genetic technology, which requires continual learning and adaptation on the part of health care providers [7,8].

There is also a gap in policy frameworks that support genetic service integration. While genetic counseling and testing have been recognized as crucial in preventive health care, there remains a lack of clear policies guiding the role of nurses in these services. Many health systems have yet to establish protocols for nurses providing genetic care, which can create inconsistencies and limit the reach of these services. Furthermore, without adequate reimbursement structures, nurses may be less incentivized to pursue the additional training required for genetics, hindering service expansion [6].

The primary objective of this study is to conduct a systematic review to identify and analyze the barriers and facilitators that affect nurses' ability to provide genetic services to adult patients. By examining the range of challenges, from individual knowledge gaps to systemic policy constraints, this review aims to provide a comprehensive understanding of the current landscape of genetic services within nursing. Findings from this research will inform recommendations for education, training, and policy changes that can empower nurses to deliver genetic services more effectively, ultimately improving patient care outcomes in genomics.

Methods

This systematic review was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines [10]. Additionally, the review was registered with the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD420251010592.

Eligibility Criteria

Studies of any design—quantitative, qualitative, or mixed-methods—were considered if they provided relevant data to address the research questions. Inclusion criteria required that studies examine barriers and facilitators affecting nurses' delivery of genetic services, including genetic counselling, testing, and follow-up care. Studies had to be published in English between January 2001 and December 2024. Participants included Registered Nurses, Advanced Practice Nurses, Nurse Practitioners, and Clinical Nurse Specialists working in settings such as primary care, hospitals, and community health facilities. Studies needed to explicitly explore nurses' roles in genetic services, highlighting challenges and supports in clinical practice.

Exclusions comprised studies focusing solely on patient perspectives without addressing nurses' roles, as well as editorials, opinion pieces, and conference abstracts lacking full-text availability or sufficient methodological detail. No geographical restrictions were applied to ensure a global perspective. If full-text articles were unavailable online, authors were contacted for access. Studies with inaccessible data, even after contacting authors, were excluded to maintain the integrity of the review.

Information Sources and Search Strategy

A comprehensive search was conducted across databases such as PubMed, CINAHL, Scopus, and Web of Science. Keywords included "nurses," "genetic services," "barriers," and "facilitators," with Boolean operators, truncation, and proximity operators used to refine the search. The strategy was piloted and adjusted for optimal sensitivity and specificity (Supplementary file 1 Table 1).

Manual screening of reference lists included studies identified additional relevant publications. Grey literature, including government reports and organizational guidelines, was also reviewed to supplement findings. Two independent reviewers screened titles and abstracts for relevance, followed by full-text assessments to confirm eligibility based on predefined criteria. Disagreements were resolved through discussion or consultation with a third reviewer.

Quality Assessment

Two researchers independently evaluated the methodological quality of included studies using the Mixed Methods Appraisal Tool (MMAT) [9] (Supplementary file 1 Table 2). Discrepancies were resolved through discussion or input from a third reviewer. All studies, regardless of quality, were included to ensure comprehensive evidence analysis.

Data Extraction

A predefined data extraction form was used to collect key details, including study characteristics (author, year, location, setting), participant information (nurse types and roles), methodology, phenomena of interest (barriers and facilitators in genetic services), context, analytical processes, and conclusions. Findings were categorized into three levels of plausibility: unequivocal, credible, and unsupported.

Data Synthesis and Integration

Quantitative data were transformed into descriptive narratives and integrated with qualitative findings within a qualitative synthesis framework. This approach aimed to provide a deeper understanding of the research topic.

Quantitative data were "qualitised" by converting numerical information into textual descriptions, which were then combined with qualitative data. The integrated data were categorized based on thematic similarities, and findings were synthesized to generate actionable insights for future research or practice. Results were presented narratively and in tabular format for clarity and comprehensiveness.

Result

Study Selection

The initial search yielded 1,372 articles. Following de-duplication and a rigorous screening process of titles, abstracts, and full texts, a total of 12 studies met the eligibility criteria and were included in the final review. Of these, nine were quantitative studies, two were qualitative studies and one study used both quantitative and qualitative design. There were no mixed method studies. The selected studies were published between 2001 and 2024, reflecting a broad temporal range of research on the topic. The study selection procedure and results can be found in the flowchart in figure 1.

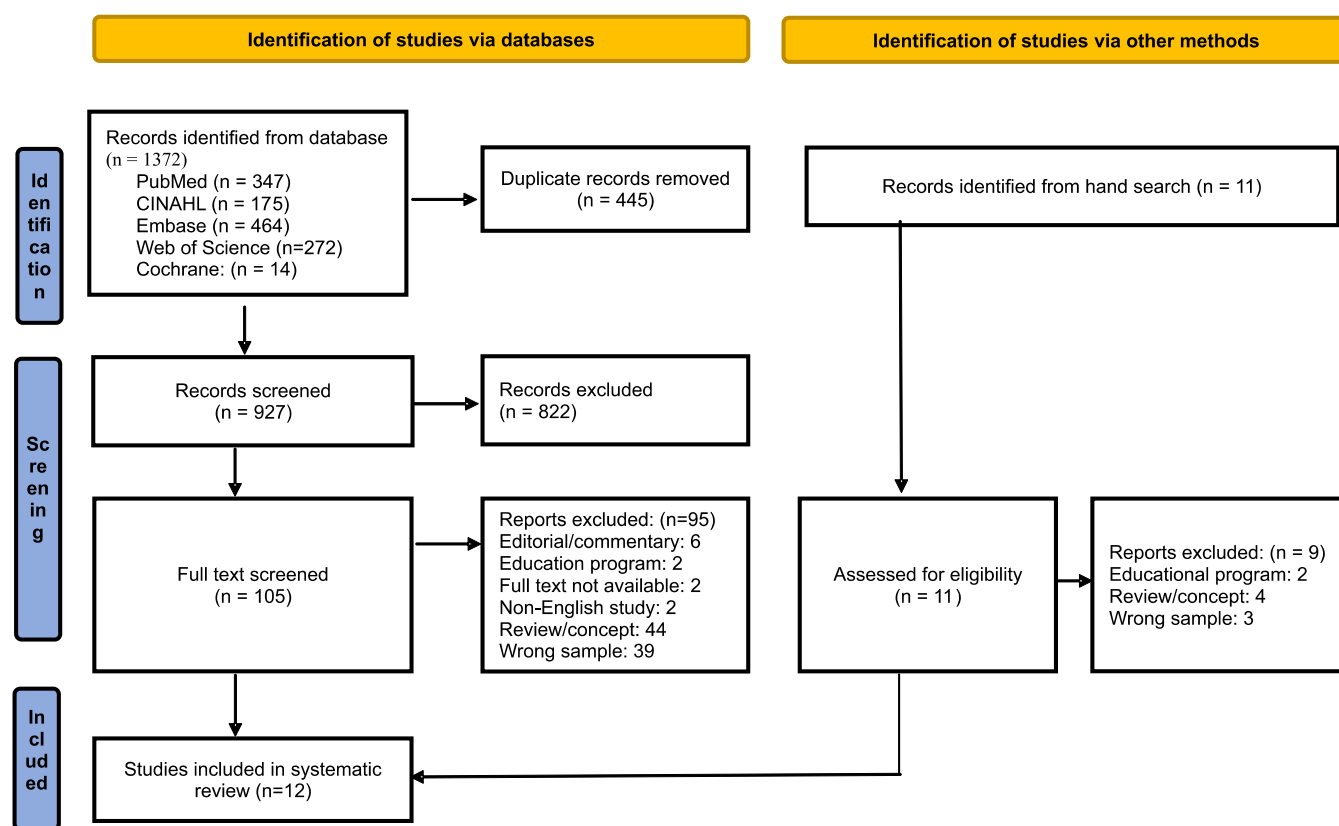


Figure 1: Flow diagram of study selection

Study Characteristics

The studies were conducted across - nine countries, with the largest representation from USA (3 studies), followed by Australia (2 studies), and one study each from Canada, Italy, UK, Malaysia, Turkey, China and Jordan. The total sample size across all studies was 4,985 participants working in different hospital and public health settings. Table 1 provides a detailed summary of each of the 12 studies, categorized by authors and year of publication, geographical context, objectives, study design, interventions, variables, measurement instruments, participants, and main findings.

| Table 1: Study characteristics of included studies | | | | | | | |
|---|-----------------------|-------------------------------|--------------------|---|---|--------------------------------------|--|
| Author, year | Country | Participants | Sample size | Study design | Tool used for data collection | Method of data collection | Type of genetic services |
| Gaff et al., 2001 | Australia and Finland | Oncology Nurses | 18 | Quantitative and qualitative different phases | NA (Course was evaluated by the students at the conclusion of each module by using Open ended and Likert Scale) | NA | Assessing a family's inherited risk category, facilitate referral to the relevant services, explore expectations of services, and provide brief counselling for issues such as anxiety and/or grief. |
| Irwin et al., 2004 | USA | Public Health Nurse | 292 | Survey | Self-administered survey | Self-administered survey | Taking family health history |
| Bottorff et al., 2005 | Canada | Nurses | 22 | Qualitative Study | open-ended questions | Semi-structured telephone interviews | Providing genetic services related to adult-onset hereditary disease (e.g., education, counselling, psychological support, risk assessment, screening) to individuals, families, or communities. |
| Calzone et al., 2012 | USA | Licensed registered nurses | 239 | Cross-sectional study | Structured questionnaires | Online Survey | Competency of integrating genomics into nursing practice |
| Godino et al., 2013 | Italy | Registered Nurse and midwives | 102 | Cross-sectional survey | Anonymous Questionnaire (multiple choice questions and free-text boxes) | Questionnaire | Genetic counselling |
| Calzone et al., 2013 | USA | Nurses | 619 | Cross-sectional study | Genetic/Genomic Nursing Practice Survey | Online Survey | Utilization of genomics in practice |

| | | | | | | | |
|--------------------------|-----------|---|------|---|---|---|---|
| Kirk et al., 2014 | UK | Cardiac Genetic Nurses | 9 | Case study | Maturity Matrix used for staged self-assessment, six-point scale | Focussed group interview | assessing the genetic risk |
| Wright et al., 2020 | Australia | Oncology nurses | 9 | Qualitative | Questionnaire | Semi-structured interviews | Incorporation of genomics in nursing practice |
| Liu et al., 2021 | Malaysia | Nurses | 150 | Descriptive cross-sectional study | Self-administered questionnaire with knowledge and attitude scales | self-administered questionnaire | Identifying an individual with or at risk of a genetic condition |
| Kocatepe et al., 2022 | Turkey | Nurses working in oncology | 101 | Descriptive study | “Socio-demographic and Nurses’ characteristics about Genetics Data form” and the “Genetic Knowledge test” | Face to face interview | providing genetic information to a patient |
| Zhao et al., 2022 | China | Nurses | 2673 | Cross-sectional Survey | Electronic questionnaires | Chinese professional survey website (www.sojump.com). | Taking family health history, assessing the genetic risks |
| Allouba ni et al., 2023 | Jordan | Registered Nurse, Supervisors and Nurse Manager | 751 | Descriptive, Cross-sectional, and Correlation designs | Genomic Nursing Concept Inventory (GNCI©) | Face to face approach | Providing genetic health care to patients, families and communities |
| NA: Not available | | | | | | | |

Domains of Barriers and Facilitators

The review of identified barriers and facilitators influencing genetic services in the five key domains, are summarized in Table 2 and Table 3 (i) educational barriers and facilitators: training gaps and continuing education opportunities, ii) administrative barriers and facilitators: institutional policies and resource allocation, iii) attitudinal barriers and facilitators: perceptions, beliefs, and attitudes of nurses and patients, iv) logistical barriers and facilitators: availability of resources and infrastructure challenges and v) environmental barriers and facilitators: workplace culture and interdisciplinary collaboration.

Each domain reflects critical factors influencing the delivery of genetic services, highlighting areas for potential improvement and intervention.

| Theme | Subtheme | Codes | References |
|---|--|--|------------|
| Educational Support | Course and Skills Development | Course relevance, improvement in counseling skills, enhanced assessment and referral skills | 1 |
| | Genomic Education Interest | High interest in genomic education, willingness to pursue education independently | 4, 6 |
| | Undergraduate and Postgraduate Education | Need for genetics in nurse training, importance of genetic counseling knowledge | 5, 11 |
| | Specialized Education Programs | Need for targeted education in BRCA testing, need for oncology-focused genomics training | 9, 10 |
| Role Expansion and Support | Family History in Public Health | Recognition of family history's role, need for training in family history assessment | 2 |
| | Multidisciplinary Teamwork | Benefits of mentorship, integration with multidisciplinary teams, expansion of genetic nursing roles | 3 |
| Integration Across Specialties | Cross-Specialty Collaboration | Role of cardiac nurses in genomics, integration across specialties | 7 |
| Attitudinal Factors | Positive Attitudes Towards Genomics | Nurses' positive attitudes towards genomics, enthusiasm for oncology-based genomics | 8, 9 |
| Policy and Institutional Support | Structured Genomic Education Programs | Recommendations for integrating genomics into nursing curricula, importance of genomic literacy | 12 |

| Table 3: Identified barriers for provision of genetic services by Nurses | | | |
|---|--|---|-------------------|
| Theme | Subtheme | Codes | References |
| Gaps in Educational | Genomic Competency & Knowledge Deficit | Inadequate genomic competency, insufficient genetic knowledge, poor genomic literacy | 1, 4, 5, 6, 12 |
| | Training Deficits | Limited genetics education in training, lack of postgraduate training, educational deficits | 1, 5, 6, 11, 12 |
| | Familiarity with Genomic Guidelines | Unawareness of Essential Nursing Competencies, lack of knowledge about referral protocols | 1, 6 |
| Insufficient Knowledge | Practical Application of Genomics | Limited knowledge on applying genomics, lack of confidence in providing genetic care | 5, 6, 8, 11 |
| | Genetic Counseling Awareness | Limited awareness about BRCA testing, limited perception of genetic counseling | 5, 9 |
| Administrative Hurdles | Role Clarity and Ambiguity | Role ambiguity, unrecognized nursing expertise in genetics, struggle with nursing identity | 3 |
| | Institutional Support & Resources | Limited resources, variable support from host organizations, funding shortages | 2, 7 |
| | Prioritization Issues | Genetics seen as low priority within health departments | 2, 5 |
| Negative Attitudes | Confidence Levels | Lack of confidence in genetic care provision | 5, 11 |
| | Perception of Relevance | View those genetics is irrelevant to nursing, limited positive attitudes toward genetic testing | 5, 9 |
| Logistical Difficulties | Time Constraints | Limited time for appointments, insufficient time for family history collection | 2 |
| | Staffing & Language Barriers | Shortage of staff, language barriers with patients | 2 |
| Environmental Limitations | Cultural & Regional Variations | Reliance on international resources, lower genomic profile in specific countries (e.g., Jordan) | 12 |
| Policy Restrictions | Discrimination Concerns | Insurance discrimination as a barrier to genomic integration | 6 |

Barriers

The provision of genetic services by nurses is hindered by various barriers that can be grouped into six domains. Educational gaps are a prominent challenge, with many nurses lacking the necessary genomic knowledge and competency to incorporate genomics into their practice effectively. Limited access to training programs exacerbates this issue, leaving nurses unfamiliar with updated genomic guidelines, which in turn leads to inconsistent care delivery. Closely related to these gaps is insufficient knowledge in the practical application of genomics, as well as a lack of awareness about genetic counseling processes, further complicating their ability to deliver comprehensive genetic services.

Administrative hurdles are another significant barrier, particularly due to ambiguities in the roles and responsibilities of nurses in genomic service delivery. Many nurses report inadequate institutional support, citing a lack of resources and insufficient prioritization of genomics within healthcare systems as key obstacles. Attitudinal barriers also emerge as a critical factor, with low confidence levels among nurses undermining their ability to provide genetic services. Additionally, some perceive genomics as being less relevant to their everyday clinical practice, which reduces their motivation to engage with these services.

Logistical difficulties, including time constraints within busy clinical workflows and workforce shortages, create further challenges. Language barriers in diverse patient populations compound these issues, limiting the reach and effectiveness of genetic services. Environmental limitations, such as cultural and regional variations, also play a role, influencing how genomic practices are received and implemented. Lastly, policy restrictions, including concerns about discrimination and inadequate institutional policies, further restrict the integration of genomics into nursing care.

Facilitators

Despite these barriers, several facilitators have been identified that enhance nurses' ability to deliver genetic services. Educational support plays a vital role, with genomic training programs and structured courses significantly improving nurses' competencies and confidence. Many nurses express a strong interest in expanding their knowledge through genomic education integrated into undergraduate and postgraduate nursing curricula. Specialized training programs tailored to clinical practice also prove effective in equipping nurses with the skills necessary for delivering genetic services.

Role expansion and institutional support are also critical facilitators. Encouraging the incorporation of family history assessments into routine care provides nurses with an entry point into genomics. Collaboration within multidisciplinary teams offers additional support, fostering shared expertise and a more comprehensive approach to genetic services. Integration across specialties further enhances this collaboration, promoting a unified effort in genomic care delivery.

Positive attitudes among nurses towards genomics serve as a motivating factor, enabling greater engagement and adoption of genetic services into their workflows. Institutional policies and support systems, including structured genomic education programs, play a pivotal role in creating an environment conducive to integrating genomics into nursing practice. These initiatives not only build nurse competencies but also address broader systemic barriers, facilitating the seamless delivery of genetic services.

Quality assessment

The quality assessment conducted using the MMAT, Version 2018, revealed that the studies included in the analysis scored between 80% (indicating four criteria met) and 100% (indicating all criteria met). Generally, studies employing qualitative designs successfully met all five criteria, while quantitative descriptive studies frequently achieved between four to five criteria. Overall, the methodological quality of the included studies ranged from moderate to high, as indicated in (supplemental file).

Discussion

This systematic review examined the barriers and facilitators affecting nurses' involvement in genetic services provision, emphasizing the complexities of integrating genomics into nursing practice. The findings indicate that while nurses recognize the significance of incorporating genetics into standard care, their capacity to do so is impeded by various challenges, such as knowledge gaps, ambiguous role expectations, and insufficient institutional support. These insights not only align with but also expand upon prior research in this field.

The findings of this review align with previous research indicating that nurses frequently lack the essential knowledge and training required to engage confidently in genetic services provision. Seibel et al [8] emphasized that primary care providers in the southeastern United States encounter obstacles such as insufficient training, limited access to genetic counselors, and ambiguity in their roles—issues that reflect the challenges identified in this review related to nursing practice.

Furthermore, White et al [6] highlighted that effectively integrating genetics and genomics into nursing and medical practices necessitated educational interventions and institutional changes that clarified roles and offered ongoing mentorship. These findings align with those of Calzone et al [1] and Zhao et al [11], which indicated that nurses who participated in structured education and mentorship programs reported enhanced confidence and competence in delivering genetic services. Likewise, Kirk et al [2] showed that the adoption of frameworks such as the Maturity Matrix significantly improved the integration of genetic services among cardiac nurses.

A key theme emerging from this review is the prevalent lack of genomic literacy and unclear role expectations, leaving nurses unsure about their responsibilities in genetic care. This observation echoes the findings of Bottorff et al [12], who revealed that Canadian nurses grappled with defining their roles in genetic nursing, leading to a hesitance to engage in genetic counseling or referral processes. Similarly, Kocatepe et al [13] underscored the significant knowledge gaps among oncology and chemotherapy nurses, highlighting the vital opportunity for targeted education and training that can empower them to embrace their potential in this crucial field.

Institutional barriers, such as the lack of policy frameworks, limited support from healthcare organizations, and insufficient mentorship, are often recognized as challenges to the integration of genomics in nursing practice. These structural issues align with the observations made by Limoges et al [3], which underscore the importance of institutional support in promoting equitable access to genomic education and services. While there is an increasing emphasis on genomic literacy, the absence of well-defined policies and standardized protocols presents a hurdle for nurses striving to engage effectively with genetic services.

The provision of continuing education and competency-based training is essential in enhancing nurses' genomic literacy. Research by Calzone et al [1] and Zhao et al [11] unequivocally demonstrates that structured genomic education dramatically increases nurses' confidence and readiness to provide genetic services. Furthermore, White et al [6] confirms that integrating genomic education into nursing curricula and ensuring access to continuing education programs empowers nurses to effectively utilize genetic knowledge in clinical settings.

Institutional support plays a crucial role in the implementation of policy frameworks that clearly outline the scope of nursing practice in genetics. Kirk et al [2] found that structured frameworks, such as the Maturity Matrix, empowered cardiac genetics nurses to define their roles and actively participate in genetic care. This emphasizes the importance of institutional frameworks in offering guidance and support, helping nurses to engage more confidently in genomic services.

The significant impact of nurses' genomic competency on patient outcomes is clearly demonstrated in studies like Limoges et al [3], which reveal that genomically literate nurses enhance patients' understanding of genetic risks, drive higher rates of genetic testing uptake, and promote greater adherence to preventive measures. Furthermore, Shevach et al [14] found that nurse-led cancer genetics programs dramatically increased the completion rates of genetic testing among Black veterans, highlighting the essential role that skilled nurses play in advancing patient care and outcomes.

The findings of this review suggest promising avenues for advancing genomic literacy across diverse healthcare settings, although certain exceptions are poised to require careful consideration. For example, Alloubani et al [15] anticipate that nurses in Jordan will continue to face substantial challenges in maintaining genomic literacy, primarily due to high workloads and limited institutional resources. This indicates that educational intervention alone may not suffice in resource-constrained environments, prompting a future exploration of innovative solutions. Additionally, Wright et al [16] foretold a future where, despite their positive attitudes toward genomics, Australian nurses may struggle to fully integrate genetic services into their practice due to infrastructural limitations and a lack of mentorship.

Keels et al [17] further expect to uncover more knowledge gaps and unmet informational needs regarding genetic testing and decision support. Their scoping review highlights the anticipated necessity for enhanced interprofessional collaboration between nursing and genetic counseling, which may be crucial for meeting the escalating demand for genomic healthcare and developing person-centered approaches to genetic counseling and decision support. There is a study which reported that organizing workshops can be an option to facilitate nurses to do better [18]

This systematic review has several strengths that contribute to its reliability and relevance. First, it provides a comprehensive synthesis of literature on the barriers and facilitators influencing nurses in genetic service provision by incorporating studies from multiple countries, the review offers a global perspective, making its findings applicable across diverse healthcare settings. Additionally, the study employs a mixed-methods approach, integrating both qualitative and quantitative research, which enhances the depth of analysis. Furthermore, the categorization of barriers and facilitators into specific domains (educational, administrative, attitudinal, logistical, and environmental) allows for targeted interventions, making the findings more actionable. The inclusion of Mixed Methods Appraisal Tool (MMAT) further strengthens the credibility of the selected studies by assessing their methodological quality.

Despite these strengths, the study has some limitations that should be acknowledged. One key limitation is the variability in study designs and contexts, which may affect the applicability of these findings to specific settings. Furthermore, the majority of the studies included are from high-income countries (e.g., USA, Australia, UK), with limited representation from low- and middle-income countries (LMICs). This could bias the findings, as barriers and facilitators in LMICs may differ significantly due to resource constraints and different healthcare systems. Additionally, the potential for publication bias, as only peer-reviewed studies were included, excluding unpublished research that may provide additional insights.

Future research is encouraged to delve into the long-term effects of educational interventions and institutional policies on nurses' engagement with genomic services, outlining a pathway for improved healthcare delivery. Additionally, future reviews could consider including mixed-method studies to provide a more holistic understanding of the topic.

Conclusion

This review highlights the complex interplay of barriers and facilitators affecting nurses' roles in genetic services. Barriers such as educational gaps, knowledge deficits, role ambiguity, and logistical challenges underscore the need for systemic improvements in nursing education, institutional support, and policy frameworks. Simultaneously, facilitators including genomic education programs, multidisciplinary collaboration, and positive attitudes among nurses demonstrate promising avenues for intervention.

By addressing these barriers and leveraging facilitators, healthcare systems can enhance the integration of genomics into nursing practice, ultimately improving patient care. Future efforts should prioritize structured genomic education, clear role delineation, and robust institutional policies to empower nurses in delivering comprehensive genetic services. This synthesis serves as a foundation for designing targeted strategies to optimize the contributions of nurses in the evolving field of genomics.

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