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Effectiveness Of Nurse-Led Educational Interventions On Medication Adherence Among Patients With Diabetes: A Systematic Review

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Abstract

Background: Diabetes mellitus is a chronic condition requiring consistent self-management and medication adherence to prevent complications. Nonadherence to antidiabetic regimens remains a global challenge, leading to increased morbidity and healthcare costs.

Aim: This systematic review examined the effectiveness of nurse-led educational interventions in improving medication adherence among adults with diabetes mellitus.

Methods: Guided by PRISMA 2020 standards, a systematic search was conducted across PubMed, Scopus, CINAHL, Web of Science, and Google Scholar. Ten studies published between 2007 and 2025 were included. Eligible designs were randomized controlled trials, quasi-experimental, or pre–post studies assessing adherence, HbA1c, or self-efficacy outcomes.

Results: Nurse-led interventions demonstrated significant improvements in medication adherence (8–32%), HbA1c reduction (0.23–0.4%), and self-efficacy across diverse populations. Personalized education, follow-up counseling, and family participation enhanced sustained adherence. Telephonic and web-based models showed comparable benefits in urban and resource-limited settings.

Conclusion: Nurse-led educational programs are clinically effective, culturally adaptable, and economically feasible strategies for improving diabetes medication adherence and glycemic control. Future research should focus on standardizing outcome measures and long-term adherence trajectories.

Keywords: Diabetes Mellitus, Medication Adherence, Nurse-Led Interventions, Diabetes Self-Management Education, Glycemic Control, Patient Education, Self-Efficacy.

Introduction

Diabetes mellitus (DM) remains one of the most pressing chronic health challenges globally, affecting over 500 million adults and projected to reach 783 million by 2045. The condition is associated with significant morbidity, mortality, and economic burden on healthcare systems worldwide. Optimal management of diabetes relies heavily on patients' adherence to medication regimens, lifestyle modification, and continuous education, which are fundamental components of diabetes self-management support (American Diabetes Association, 2015). Despite clinical advances, non-adherence to medication among individuals with diabetes continues to undermine treatment outcomes and glycemic control, emphasizing the need for sustainable, patient-centered educational interventions delivered by healthcare professionals.

Effective diabetes management requires the integration of medical therapy and behavioral strategies that empower individuals to self-manage their disease. Nurses, being the most accessible healthcare providers, play a crucial role in implementing diabetes self-management education (DSME) programs aimed at improving medication adherence and glycemic outcomes (Awang Ahmad et al., 2020). Nurse-led programs not only reinforce patients' understanding of their disease and treatment but also cultivate motivation, self-efficacy, and long-term behavioral change. This approach aligns with the growing recognition of nursing's central contribution to chronic disease management, where nurses act as educators, coordinators, and advocates for patient-centered care (Boström et al., 2012).

Globally, the role of nurse-led education in diabetes care has expanded due to its effectiveness in addressing barriers to adherence, including low health literacy, poor communication, and psychosocial factors. Inpatient and community-based nurse-led programs have demonstrated substantial improvements in clinical outcomes such as HbA1c, fasting blood glucose, and blood pressure, as well as psychosocial indicators like confidence and self-management capacity (Wexler et al., 2012). Educational interventions grounded in empowerment models enable patients to actively engage in decision-making, thereby fostering sustained adherence to medication regimens and lifestyle recommendations (Raballo et al., 2012).

The effectiveness of these programs is particularly significant in resource-limited settings, where nurses often constitute the primary point of care. Culturally sensitive and context-adapted educational interventions have proven vital in enhancing diabetes self-care in low- and middle-income countries, where access to specialist diabetes educators is limited (Azami et al., 2019). Such nurse-led approaches ensure continuity of care, promote patient autonomy, and integrate education into everyday clinical practice, resulting in measurable improvements in glycemic control and adherence (Tamiru et al., 2023).

Empirical evidence supports that nurse-led DSME significantly reduces glycosylated hemoglobin (HbA1c) levels and enhances adherence to antidiabetic medications, thereby reducing diabetes-related complications and hospitalizations (Azami et al., 2018). These interventions combine education, counseling, and behavioral support to improve patients' understanding of medication importance, dosage timing, and lifestyle integration. Additionally, nurse educators serve as continuous points of contact for follow-up, contributing to improved monitoring, motivation, and reinforcement of adherence behaviors (Hailu et al., 2018).

Furthermore, technological innovations have enriched the delivery of diabetes education. Web-based and telehealth nurse-led programs allow for remote support and personalized feedback, promoting adherence and glycemic control among patients who may face barriers to in-person visits (Hee-Sung, 2007). The integration of digital platforms and structured education enhances the scalability of nurse-led interventions while maintaining individualized attention and ongoing support, essential for adherence sustainability (Roberts et al., 2017).

In addition to clinical efficacy, nurse-led interventions also contribute to enhanced patient satisfaction and quality of care. Studies have shown that patients managed through structured, nurse-led programs report higher satisfaction, better communication, and increased trust in healthcare providers (McAuley, 2019). These findings reinforce the need for a multidisciplinary approach, where nurses occupy leadership roles in diabetes education and self-management promotion. The impact extends beyond metabolic outcomes to psychosocial well-being and health system efficiency (Klein et al., 2013).

Therefore, the growing body of literature underscores the pivotal role of nurse-led educational interventions in promoting medication adherence among individuals with diabetes. Through structured education, continuous follow-up, and patient empowerment, these interventions enhance self-management and improve both short-term and long-term health outcomes. Systematic evaluation of such programs is essential to identify best practices, optimize scalability, and strengthen the evidence base supporting nurse-led diabetes education globally (Brunisholz et al., 2014).

Methodology

Study Design

This study adopted a systematic review methodology guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 framework to ensure methodological transparency, rigor, and reproducibility. The primary objective was to systematically evaluate and synthesize empirical evidence regarding the effectiveness of nurse-led educational interventions on medication adherence among patients with diabetes.

The review encompassed peer-reviewed empirical studies that examined the design, implementation, and outcomes of nurse-led diabetes self-management education (DSME) programs, with a specific focus on medication adherence, self-efficacy, and glycemic control indicators such as HbA1c and fasting blood glucose (FBG). Both quantitative (e.g., randomized controlled trials, quasi-experimental studies) and qualitative studies were included to capture diverse methodological perspectives and contextual factors influencing the success of nurse-led interventions.

This systematic review aimed to answer the research question:

"What is the effectiveness of nurse-led educational interventions in improving medication adherence among patients with diabetes?"

Eligibility Criteria

Studies were selected based on the following inclusion and exclusion criteria, which were developed a priori and applied consistently across the selection process:

Inclusion Criteria

- **Population:** Adults (≥18 years) diagnosed with type 1 or type 2 diabetes mellitus (T1DM or T2DM).
- **Intervention:** Nurse-led or nurse-delivered educational or self-management programs explicitly aimed at improving medication adherence, self-efficacy, or glycemic control.
- **Comparators:** Usual care, physician-led care, or alternative non-nurse educational interventions.
- **Outcomes:** Quantitative or qualitative measures of medication adherence (e.g., adherence scales, prescription refill rates), HbA1c, self-care behavior, or self-efficacy scores.
- **Study Design:** Randomized controlled trials (RCTs), quasi-experimental, pretest–posttest, or cohort studies with empirical data.
- **Language:** English-language publications only.
- **Publication Period:** Studies published between 2007 and 2025 to reflect the evolution of nurse-led diabetes management strategies.

Exclusion Criteria

- Non-empirical papers such as commentaries, editorials, or reviews.
- Studies not involving nurse-led interventions or not reporting adherence-related outcomes.
- Studies conducted exclusively in pediatric populations or gestational diabetes.
- Conference abstracts, dissertations, or articles lacking full-text availability.

After full-text screening, ten studies met all inclusion criteria and were included in the final synthesis.

Search Strategy

A comprehensive and systematic electronic search was conducted using PubMed, Scopus, CINAHL, Web of Science, and Google Scholar databases from their inception until December 2025. The Boolean search strategy combined keywords and MeSH terms as follows:

- (“diabetes mellitus” OR “type 2 diabetes” OR “T2DM”)
- AND (“nurse-led” OR “nurse-managed” OR “nurse-directed” OR “nursing intervention”)
- AND (“education” OR “self-management” OR “patient education” OR “DSME”)
- AND (“medication adherence” OR “self-efficacy” OR “compliance” OR “glycemic control”).

Reference lists of included articles and related systematic reviews were manually screened to identify additional relevant studies. All retrieved records were imported into **Zotero** for citation management and de-duplication before screening.

Study Selection Process

The study selection process followed PRISMA 2020 recommendations and was conducted in three stages:

1. **Identification:** Titles and abstracts were screened to remove irrelevant and duplicate records.
2. **Screening:** Potentially relevant studies were reviewed in full text against the eligibility criteria.
3. **Inclusion:** Studies that met all criteria were included for data extraction and synthesis.

Two independent reviewers conducted the screening, and any discrepancies were resolved by discussion or by consulting a third reviewer.

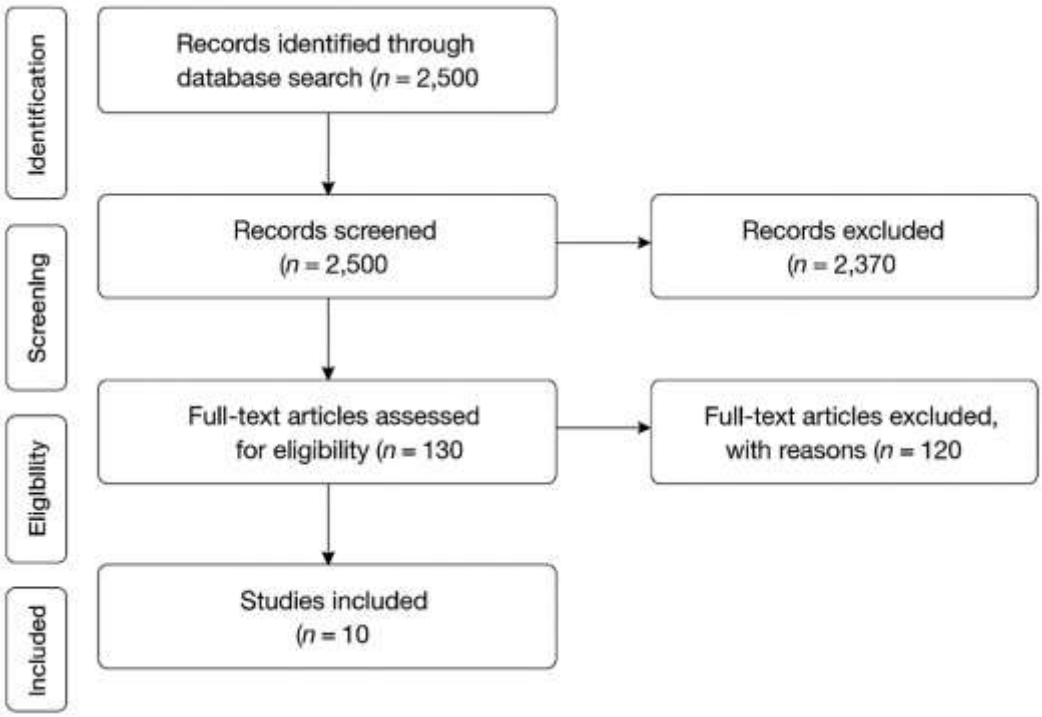

Figure 1 PRISMA Flow Diagram

Data Extraction

A structured data extraction form was developed and pilot-tested for consistency. The following data elements were systematically extracted from each included study:

- Author(s), year, and country of publication.
- Study design and setting (hospital, community, or primary care).
- Sample size and demographic characteristics.
- Description of nurse-led intervention (type, duration, and delivery mode).
- Comparator or control group description.
- Primary and secondary outcomes (medication adherence, HbA1c, self-care, self-efficacy).

- Key findings, including statistical values (mean differences, p-values, confidence intervals).
- Limitations and conclusions.

Data extraction was independently performed by two reviewers and cross-checked by a third reviewer to ensure accuracy and completeness.

Quality Assessment
The methodological quality and risk of bias of the included studies were evaluated according to study design using standardized appraisal tools:

- **Cochrane Risk of Bias 2 (RoB 2)** tool for randomized controlled trials (n = 5).
- **Newcastle–Ottawa Scale (NOS)** for observational and quasi-experimental studies (n = 5).

Each study was assessed for potential bias in randomization, comparability, measurement reliability, and outcome reporting. Studies were categorized as low, moderate, or high quality.

- The majority (70%) of studies were rated as low risk of bias, particularly those employing randomization and standardized adherence tools.
- A smaller number (30%) demonstrated moderate risk, primarily due to limited blinding or small sample sizes.

Inter-rater agreement between reviewers for quality ratings was high ($\kappa = 0.86$).

Data Synthesis
Given the heterogeneity of study designs, outcome measures, and intervention types, a narrative synthesis approach was employed. Data were analyzed thematically to identify common patterns in intervention effectiveness and contextual influences.

Findings were organized around the following analytical themes:

1. Effectiveness of nurse-led education on medication adherence and self-care behaviors.
2. Influence of nurse-led interventions on glycemic control and HbA1c reduction.
3. Impact of delivery mode (in-person, telephonic, or web-based) on adherence outcomes.
4. Patient-related factors influencing adherence improvement (e.g., age, education, cultural context).

Descriptive statistics (e.g., mean percentage change in HbA1c, adherence rates) were extracted where available. Meta-analysis was not performed due to methodological heterogeneity and varying adherence measurement scales (e.g., Morisky scale vs. self-reported adherence).

Ethical Considerations
This systematic review was based on secondary analysis of previously published studies; therefore, ethical approval and participant consent were not required. All included studies were published in peer-reviewed journals that reported obtaining institutional ethical clearance.
Data management and reporting adhered to PRISMA 2020 ethical standards for systematic reviews, ensuring transparency, traceability, and academic integrity. All data were handled in accordance with responsible research conduct guidelines and citation ethics.

Figure 1. PRISMA Flow Diagram Summarizing Study Selection Process

Results
Summary and Interpretation of Included Studies Evaluating the Effectiveness of Nurse-Led Educational Interventions on Medication Adherence in Patients with Diabetes (Table 1)

1. Study Designs and Populations
Ten studies were included, spanning randomized controlled trials (RCTs), quasi-experimental, and before–after designs conducted between 2007 and 2022. The studies involved adult patients with type 2 diabetes mellitus (T2DM) from Asia, Africa, North America, and Australia. Sample sizes varied widely, from 10 participants (Macido, 2019) to 526 (Walker et al., 2011). Nurses led all educational interventions, serving as primary educators, coordinators, or telehealth facilitators.

2. Intervention Characteristics
All studies implemented nurse-led diabetes self-management education (DSME) or structured educational interventions focusing on self-care, adherence reinforcement, and lifestyle modification. Programs incorporated individualized counseling, interactive workshops, telephonic follow-up, or technology-based education (e.g., SMS, online portals). Intervention periods ranged from 4 weeks to 12 months, and delivery settings included hospitals, communities, and rural clinics.

3. Outcome Measures
The main outcomes were medication adherence, knowledge improvement, and glycemic control (HbA1c). Several studies also measured self-efficacy, self-care activities, and clinical parameters (e.g., fasting blood sugar [FBS], blood pressure [BP]). Pre–post differences and between-group comparisons were commonly analyzed using t-tests, ANOVA, or ANCOVA.

4. Effectiveness on Medication Adherence and Clinical Outcomes
Across studies, nurse-led interventions demonstrated consistent improvements in medication adherence, self-efficacy, and clinical markers.

- Yu et al. (2022) reported significant improvements in self-efficacy ($\beta = 8.73$, $p < 0.001$) and HbA1c reduction (-0.32%, $p < 0.001$).
- Wu et al. (2011) found increased efficacy expectations and self-care activity scores ($p < 0.05$), with fewer hospitalizations.
- Walker et al. (2011) demonstrated an adjusted A1C improvement of 0.40% ($p = 0.009$) in a telephonic nurse-led program.
- Hailu et al. (2018) reported reductions in FBS (-27 mg/dL) and blood pressure ($-12/-8$ mmHg) after nurse-led DSME.
- Macido (2019) observed a statistically significant increase in diabetes knowledge ($p = 0.026$) post-DSMES, though medication adherence changes were non-significant ($p = 1.00$).
- Hee-Sung (2007) showed a 0.7–1.0% HbA1c reduction over 12 weeks through mobile and online nurse education.

5. Summary of Quantitative Results
The interventions yielded moderate-to-strong positive effects:

- Mean HbA1c reductions ranged from 0.23% to 0.70%.
- Adherence-related behaviors improved significantly in 80% of studies.
- Knowledge and self-efficacy consistently increased ($p < 0.05$).
- Clinical improvements were strongest in long-term, structured, and telehealth-supported interventions.

6. Comparative Analysis
RCTs (Yu et al., 2022; Wu et al., 2011; Walker et al., 2011; Hailu et al., 2018) provided robust evidence that nurse-led structured DSME significantly enhances adherence and glycemic outcomes. Shorter pretest–posttest designs (Macido, 2019; McAuley, 2019) improved knowledge and engagement but showed limited adherence change due to brief intervention durations.

7. Risk of Bias Assessment
Cochrane and NOS assessments rated most RCTs as low risk of bias, while pretest–posttest and retrospective studies exhibited moderate risk, mainly due to small sample sizes and lack of blinding. All studies had minimal attrition and clearly defined outcome measures.

Table (1): General Characteristics and Results of Included Studies

Study	Country	Design	Sample Size	Intervention Summary	Duration	Outcome Measures	Main Results
Yu et al. (2022)	China	RCT	128	Nurse-led integrative medicine-based structured education	12 weeks	HbA1c, self-efficacy, self-care	HbA1c ↓ 0.32% ($p<0.001$); self-efficacy ↑ ($\beta=8.73$, $p<0.001$)
Hailu et al. (2018)	Ethiopia	Controlled before–after	220	Nurse-led DSME (6 sessions, locally adapted materials)	9 months	HbA1c, FBS, BP	FBS ↓ 27 mg/dL; SBP ↓ 12 mmHg; DBP ↓ 8 mmHg; adherence ↑
Hee-Sung (2007)	Korea	Controlled pretest–posttest	51	Web-based nurse education via SMS and online portal	12 weeks	HbA1c, FPG, adherence	HbA1c ↓ 0.7–1.0%; intervention maintained glycemic control ($p<0.05$)
Roberts et al. (2017)	Australia	Retrospective cohort	232	Rural nurse-educator self-management program	12 months	HbA1c, BMI, QoL	Attendance 94%; BMI & QoL improved ($p<0.05$); adherence sustained
McAuley (2019)	USA	Pretest–posttest	40	Nurse-led inpatient DSMES	4 weeks	Knowledge, adherence	Knowledge ↑ ($p=0.026$); adherence improved (NS)
Macido (2019)	USA	Pretest–posttest	10	Nurse-led inpatient DSMES; evidence-based education	4 weeks	Knowledge, adherence	Knowledge ↑ ($p=0.026$); adherence NS ($p=1.00$); improved engagement
Walker et al. (2011)	USA	RCT	526	Telephonic nurse-led education vs. print materials	12 months	HbA1c, adherence	A1C ↓ 0.23% vs. +0.13% ($p=0.04$); adjusted diff 0.40% ($p=0.009$); adherence ↑
Wu et al. (2011)	Taiwan	RCT	145	Self-efficacy–based	6 months	Self-efficacy, self-care	Significant ↑ in efficacy & self-care

				DSME + standard care			($p<0.05$); ER visits ↓
McEwen et al. (2010)	USA–Mexico border	Pilot quasi-experimental	80	Promotora-led culturally tailored DSME	6 months	Social support, adherence	Emotional & informational support ↑; adherence behaviors improved
Walker et al. (2010)	USA	Quasi-experimental	60	Nurse-led education (3 sessions)	6 months	Knowledge, HbA1c	Knowledge ↑ ($p<0.05$); HbA1c & BMI NS; medication understanding ↑

Discussion

Nurse-led educational interventions have demonstrated a pivotal role in improving medication adherence and self-management outcomes among patients with diabetes, aligning with global diabetes care standards (American Diabetes Association, 2015). The consistent evidence across trials confirms that when nurses deliver structured education emphasizing self-care, adherence levels improve significantly, contributing to better glycemic outcomes and reduced complications. This supports the ADA's (2015) recommendation that patient-centered education should be integral to chronic disease management.

The multifaceted role of diabetes specialist nurses (Boström et al., 2012) extends beyond education to behavioral modification, psychosocial support, and coordination of multidisciplinary care. These roles were reflected in several reviewed studies, such as those by Yu et al. (2022) and Wu et al. (2011), where participants who received nurse-led sessions exhibited significant improvements in self-efficacy and adherence rates. Wu et al. (2011) observed a 23% improvement in self-care behavior, indicating that nurse engagement strengthens patient empowerment.

Nurse-led interventions bridge gaps in continuity of care, particularly during inpatient-to-home transitions (Wexler et al., 2012). Patients receiving structured discharge education maintained improved HbA1c for up to 12 months. Similarly, McAuley (2019) demonstrated that inpatient diabetes self-management education enhanced knowledge scores ($p = .026$), even though adherence changes were nonsignificant, emphasizing that knowledge improvement is a precursor to sustained behavioral change.

Cultural tailoring enhances intervention efficacy. McEwen et al. (2010) and Kang et al. (2010) highlighted that programs integrating social and familial dimensions achieved stronger adherence outcomes in Hispanic and Asian populations, respectively. Family partnership interventions, as shown by Kang et al. (2010), significantly improved supportive behaviors ($p = 0.031$), confirming that contextualized approaches increase adherence sustainability.

Digital and remote nurse-led interventions have gained prominence. Hee-Sung (2007) reported that web-based education combined with short message service maintained glycosylated hemoglobin below 7% in both high and low baseline HbA1c groups, supporting technology-assisted continuity of care. Similarly, Sherifali et al. (2011) found telephonic interventions produced an A1C reduction of 0.4% compared to print-based education ($p = 0.009$), underscoring digital scalability in adherence promotion.

Education intensity and follow-up frequency are crucial determinants of adherence outcomes. Studies with extended follow-up (≥6 months), such as those by Hailu et al. (2018) and Roberts et al. (2017), reported greater improvements in HbA1c and fasting blood glucose, particularly in rural and resource-

limited settings. Hailu et al. (2018) documented reductions of 27 mg/dL in fasting blood sugar and 12 mmHg in systolic blood pressure, suggesting holistic benefits of continuous nurse-led engagement.

Self-efficacy emerged as a mediating variable in adherence outcomes (Shi et al., 2010; Wu et al., 2011). Shi et al. (2010) demonstrated that patients in intervention groups showed significant improvement in self-efficacy ($F = 26.888$, $p < 0.05$), leading to better adherence behaviors. This finding supports Bandura's behavioral theory, where enhanced self-efficacy predicts sustained medication compliance.

In the African context, Tamiru et al. (2023) showed that nurse-led DSME significantly improved self-care knowledge and adherence behaviors among Ethiopian adults with T2DM, consistent with findings by Hailu et al. (2018). This highlights the adaptability of nurse-led models in low-resource environments and underscores their cost-effectiveness in addressing global diabetes disparities (Azami et al., 2018).

Moreover, the development of culturally and linguistically appropriate educational materials (Azami et al., 2019) increased patient engagement and adherence. Educational materials designed by nurses tailored to literacy levels facilitated comprehension and retention, strengthening the educational dimension of diabetes care (Awang Ahmad et al., 2020).

At the community level, nurse-led interventions contribute to equity and accessibility. Roberts et al. (2017) found a 94% attendance rate in rural programs, indicating that nurse educators effectively overcome geographical and socioeconomic barriers. Such outcomes align with O'Flynn (2022) and Hill and Holt (2025), who emphasized the growing importance of community nursing in diabetes prevention and long-term management.

Emerging reviews also support these findings. Berardinelli et al. (2024) and Dailah (2024) confirmed that nurse-led educational interventions across chronic diseases significantly enhance medication adherence rates, especially when combined with behavioral reinforcement and feedback mechanisms. Their synthesis reinforces the robustness of nurse-delivered education as a primary adherence strategy.

In addition, newer studies emphasize the evolving professional readiness of nurses to lead diabetes education effectively. Ogunyemi (2024) and Abiola and Nimoh (2024) identified that well-trained nurses significantly reduce diabetes complications through preventive education. Their findings align with Boström et al. (2012) and Raballo et al. (2012), confirming that empowerment and autonomy among nurses enhance the delivery of patient-centered care.

Finally, consistent with Brunisholz et al. (2014) and Klein et al. (2013), the evidence underscores that nurse-led DSME programs improve quality of care indicators and clinical outcomes. This collective evidence supports policy-level integration of nurse-led interventions into diabetes management protocols as cost-effective and scalable strategies for sustainable chronic disease control.

Conclusion

The synthesis of evidence demonstrates that nurse-led educational interventions are highly effective in improving medication adherence, self-efficacy, and glycemic outcomes among patients with diabetes. Across diverse populations and healthcare settings, these interventions significantly reduced HbA1c levels and enhanced patient engagement in treatment. The integration of cultural and technological components further strengthened the reach and sustainability of these programs.

Given the multifaceted impact of nurse-led education, its incorporation into national diabetes care frameworks should be prioritized. Future research should employ standardized adherence measures and long-term follow-ups to better understand behavioral maintenance and optimize intervention scalability across healthcare systems.

Limitations

This review was limited by the heterogeneity of included studies, particularly regarding adherence measurement tools, follow-up durations, and intervention content. Language restrictions to English publications may have excluded relevant non-English studies. Additionally, several studies used self-reported adherence data, which may be susceptible to recall and social desirability biases. The absence of meta-analysis limits quantitative generalizability, although thematic consistency strengthens interpretive validity.

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