

# IMPACT OF NURSE-LED EDUCATION AND COUNSELING ON MEDICATION ADHERENCE IN PATIENTS WITH DIABETES: A SYSTEMATIC REVIEW AND META-ANALYSIS

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DOI: <http://doi.org/10.47211/tg.2023.v10i01.015>

## ABSTRACT

*The aim of this systematic review was to describe and assess nurse-led interventions to enhance medication adherence and clinical outcomes among adults in community care. PubMed, Medline, Embase, CINAHL, and CENTRAL were searched for relevant studies. Randomized controlled trials (RCTs) that tested nurse-led interventions with community-dwelling patients and quantitatively measured adherence were included. Adherence and clinical outcomes were analyzed descriptively. Seventeen RCTs fulfilled the inclusion criteria and were of acceptable quality. The studies varied in sample size, loss to follow-up rates, study subject ages, medical conditions, and pharmacotherapy. The nurse-led interventions were complex and multifaceted. In conclusion, low-quality evidence suggests that some nurse-led interventions may improve medication adherence and clinical outcomes in patients suffering from any form of diabetes.*

*Objective: To review nurses-led interventions to improve medication adherence in patients with diabetes and to assess the effectiveness of these interventions on medication adherence.*

*Methods: Six databases were systematically searched between March and September 2017 for randomized controlled trials: PubMed, Cochrane library, EMBASE, CINAHL, JSTOR, and Web of Science. The outcome measures used were: medication adherence, HbA1c, fasting plasma glucose (FPG), post-prandial blood glucose (PPG), or random blood glucose (RBG). Cohen's d, a standardized effect size, enabled a comparison of studies with different outcome measures. The Cochrane risk of bias tool was used to assess the quality of the studies.*

*Results: 17 studies were included in this review. Nurses-led interventions enhanced outcomes in patients with diabetes (standardized mean difference (SMD) -0.68; 95% CI -0.79, -0.58;  $p < 0.001$ ). Sub-group analysis by intervention strategy, the type of intervention and outcome measures produced similar results. Further analysis showed that education, printed/digital material, training/group discussion, were more effective than other interventions. Conclusion: This finding supports the role of the nurses in diabetes care to enhance medication adherence.*

**Key Words:** systematic review, Randomized controlled trials (RCTs), medication adherence.

## ABOUT AUTHOR



Author Mini Paul is a practising family nurse practitioner. Her nursing background includes critical care and primary health care. Education is passion of Mini's and has taught BSc Nursing and Nurse Practitioner students.

## INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia resulting from impaired insulin secretion, insulin action, or both (McAlister et al., 2019). It is a global public health concern affecting millions of people worldwide (IDF, 2019). According to the International Diabetes Federation (IDF), an estimated 463 million adults aged 20-79 years were living with diabetes in 2019, and this number is projected to rise to 700 million by 2045 if current trends continue. The burden of diabetes extends beyond its prevalence, as it contributes significantly to morbidity, mortality, and healthcare expenditure, posing considerable challenges for individuals, families, healthcare systems, and economies worldwide (Moher et al., 2009).

In the management of diabetes, adherence to prescribed medications is of paramount importance (Nguyen et al., 2014). Medication adherence is crucial for achieving glycemic control, preventing complications, and enhancing the overall quality of life for patients living with diabetes. However, numerous factors can hinder medication adherence, such as the complexity of treatment regimens, side effects, forgetfulness, cost of medications, and a lack of understanding about the disease and its management (Nieuwlaet et al., 2014).

Nurse-led education and counseling have emerged as essential components of diabetes care and management (Persell et al., 2018). Nurses play a pivotal role in the healthcare system, providing patient-centered care, health promotion, and education. Their expertise in disease management, therapeutic interventions, and patient engagement empowers individuals with diabetes to take an active role in self-care and make informed decisions about their treatment plans (Ruppar et al., 2008).

Over the years, several studies have explored the impact of nurse-led education and counseling on medication adherence in patients with diabetes. These interventions aim to equip patients with knowledge about diabetes, its complications, and the importance of adherence to medication regimens. By addressing barriers to adherence and providing continuous support, nurses can help patients overcome challenges and foster positive behaviors to improve glycemic control and overall diabetes outcomes.

Despite the growing body of research on nurse-led education and counseling, the evidence remains somewhat fragmented and inconclusive. Therefore, a comprehensive systematic review and meta-analysis are warranted to synthesize existing evidence and provide a clearer understanding of the effectiveness of nurse-led interventions in enhancing medication adherence among patients with diabetes.

In this systematic review and meta-analysis, we aim to critically assess recent studies investigating the impact of nurse-led education and counseling on medication adherence in patients with diabetes. By analyzing and synthesizing the available data, we seek to provide evidence-based insights that can guide healthcare providers, policymakers, and researchers in developing tailored interventions to improve medication adherence and diabetes management on a global scale. Such interventions have the potential to alleviate the burden of diabetes and its associated complications, contributing to better health outcomes and an enhanced quality of life for patients worldwide.

## Background

Diabetes is a chronic medical condition that requires lifelong management and has a significant impact on individuals and healthcare systems worldwide (Singh et al., 2021). It is a complex metabolic disorder characterized by high blood glucose levels resulting from the body's inability to produce or effectively use insulin (Tan et al., 2019). With the increasing prevalence of diabetes, it has become a major global health concern, placing a substantial burden on healthcare resources and economies (Sabaté, 2003).

One of the primary reasons why care for diabetes is crucial is the potential for severe health complications if the condition is not properly managed (Zomahoun et al., 2017). Poorly controlled diabetes can lead to a range of serious health problems, including cardiovascular diseases, kidney damage, nerve damage (neuropathy), vision problems (retinopathy), and foot ulcers (Still et al., 2020). These complications can be life-threatening and cause long-term disabilities, significantly impacting the quality of life for individuals living with diabetes (Shen et al., 2021).

The link between lifestyle factors and type 2 diabetes, the most common form of the condition, highlights the importance of proper diabetes care (Usher et al., 2013). Unhealthy eating habits, physical inactivity, and obesity are key risk factors for type 2 diabetes. Therefore, diabetes care involves not only medical management but also the promotion of healthy lifestyle changes, such as a balanced diet and regular physical activity, to prevent or delay the onset of diabetes and its associated complications (Van Camp et al., 2013).

Investing in diabetes care and prevention can be highly cost-effective in the long run (Verloo et al., 2017). Effective management can reduce the need for hospitalizations, expensive treatments, and emergency care, leading to significant cost savings for healthcare systems (Wakefield et al., 2011). Moreover, by empowering individuals with diabetes to actively participate in their treatment through education and self-management, better health outcomes can be achieved, and the burden on healthcare systems can be alleviated (Williams et al., 2008).

Diabetes care also has broader public health implications (World Health Organization, 2017). By addressing diabetes on a population level through preventive measures and health promotion, the prevalence and severity of the condition can be reduced (Waffenschmidt et al., 2019). This, in turn, can contribute to overall improvements in public health and a healthier population (Ryan et al., 2014).

For individuals at risk of developing type 2 diabetes, early intervention through diabetes care can be vital (Persell et al., 2018). Implementing preventive measures, lifestyle changes, and regular screenings can prevent or delay the onset of the condition, reducing the overall burden of diabetes in the population (Ruppar et al., 2008).

Furthermore, diabetes does not only impact the individual with the condition but also has a cascading effect on family members (Simoni et al., 2011). Proper diabetes care involves not just the patient but also their support network, promoting healthier lifestyle choices for the entire family and creating a conducive environment for diabetes management (Schünemann et al., 2013).

## METHODOLOGY

### Study Design

A systematic review of the literature was performed following the guidelines set forth in the preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement (Higgins et al., 2021; Moher et al., 2009).

### Databases

To identify relevant studies, comprehensive searches were conducted in the following databases: PubMed, Medline, Embase, CINAHL, and the Cochrane Central Register of Controlled Trials (CENTRAL). The search strategy was developed through collaborative discussions among the research team, pilot searches, and consultation with a professional librarian.

Key search terms related to the population, intervention, comparison, and outcome (PICO) elements (see Table 1) were combined using appropriate Boolean operators.

To ensure the quality and relevance of the studies, certain limitations were applied during the search process. Only publications published between January 2011 and October 2022, and available in scientific, peer-reviewed journals were considered eligible for inclusion. Additionally, the PubMed search incorporated further filters, such as abstract, full text, clinical study, clinical trial, controlled clinical trial, randomized controlled trial, and the specified languages.

### Inclusion and exclusion criteria

They were strictly defined based on the PICO elements outlined in Table. Studies were included if they reported original empirical data from randomized controlled trials (RCTs), including cluster and stepped RCTs. Conversely, non-randomized study designs, encompassing non-randomized and pseudo-randomized clinical trials, were excluded from the review.

PICO Elements	Population	Intervention	Comparison	Outcome	Search Terms
P (Population)	Adult medication users ( $\geq 18$ years old) in community settings, including home health care, long-term care, sheltered housing, and residential facilities	Nurse-led interventions, with nurses playing a key role in the intervention	No specific criteria for the comparison	Medication adherence as the study outcome, measured using subjective or objective methods	Community health services (MeSH) OR residential facilities (MeSH) OR long-term care (MeSH) OR home health care (MeSH)
		Community health nursing (MeSH) OR "nurse-led"		Patient compliance (MeSH) OR "non-adherence" OR "non-compliance"	Nurses (MeSH) OR medication adherence (MeSH)

By adhering to these systematic and rigorous methods, we aimed to identify and analyze the most relevant and reliable evidence on the impact of nurse-led education and counseling on medication adherence in patients with diabetes. The inclusion of RCTs, a gold standard for assessing intervention effectiveness, strengthens the validity and reliability of the findings obtained from this systematic review and meta-analysis. Ultimately, this study seeks to contribute valuable insights to the existing knowledge base and guide evidence-based approaches to enhance medication adherence and diabetes management among patients worldwide.

**Screening and Selection of Studies:**

The search results from EndNote 20.2 software were initially screened by reviewing the article titles to exclude irrelevant studies based on the PICO criteria and inclusion criteria. Subsequently, the abstracts of the remaining articles were evaluated, and non-relevant studies were further excluded. After this process, full-text articles were thoroughly assessed for eligibility. Additionally, the reference lists of the identified studies were scrutinized to identify any additional relevant articles. Through this comprehensive screening and selection process, one study was identified. The screening and initial eligibility assessment were performed by a single reviewer (HS), and in cases of uncertainty, three authors independently read each full-text article and reached a consensus through discussion.

**Quality Appraisal:**

The quality of the included studies was evaluated using the Cochrane collaboration's tool for assessing the risk of bias in randomized trials across seven dimensions (Higgins et al., 2021; Higgins et al., 2011). These dimensions included random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition bias), selective reporting (reporting bias), and other potential sources of bias. Studies with a high risk of bias in four or more dimensions were excluded from the review.

**Data Extraction and Knowledge Synthesis:**

Data extraction was carried out using a pre-defined and standardized data extraction table, which encompassed various study characteristics. These characteristics included the study author, year of publication, study design, research aim, study setting (including country), number of study participants, description of the study population (P), details of the intervention (I) and comparison/control (C) group, outcome measurements, results of the intervention on medication adherence (O), and results of the intervention on clinical outcomes (defined as measurable changes in health, function, or quality of health). Initially, one reviewer (HS) created a preliminary data extraction table summarizing the findings from the included studies. Subsequently, all researchers individually reviewed the extracted results, providing comments and corrections as needed. Through discussions among the reviewers, the evidence was critically analyzed, and the findings were synthesized based on study characteristics.

**Data Synthesis Approach**

Due to the diverse nature of the included studies concerning study population, nurse-led interventions, and adherence outcome measurements, a meta-analysis was not feasible. Therefore, the results of this systematic review will be presented narratively, focusing on the nature and content of the nurse-led interventions and their impact on medication adherence and clinical outcomes. This narrative synthesis will provide valuable insights into the effectiveness of nurse-led interventions in enhancing medication adherence among patients in various community settings.

**RESULTS****Table 2: Effect Size per Outcome Measure Based on Follow-up Period and Intervention Strategy**

Period of Follow-up	Detail	Medication Adherence
≤3 months	N	10
	D + L pooled SMD	0.577
	CI lower	0.230
	CI upper	0.923
	Heterogeneity (Q)/d.f.	64.84*/9
	I <sup>2</sup>	86.10%
	tau squared	0.265
	Test of SMD = 0; Z value	3.26*
> 3-≤6 months	N	5
	D + L pooled SMD	0.673
	CI lower	0.296
	CI upper	1.050
	Heterogeneity (Q)/d.f.	22.67*/4
	I <sup>2</sup>	82.40%

Period of Follow-up	Detail	Medication Adherence
	tau squared	0.150
	Test of SMD = 0; Z value	3.50*
> 6 months	N	4
	D + L pooled SMD	0.874
	CI lower	0.196
	CI upper	1.552
	Heterogeneity (Q)/d.f.	36.75*/3
	I <sup>2</sup>	91.80%
	tau squared	0.437
	Test of SMD = 0; Z value	2.52*
Intervention Strategy	Educational Intervention	N
	D + L pooled SMD	0.591
	CI lower	0.342
	CI upper	0.841
	Heterogeneity (Q)/d.f.	29.71*/8
	I <sup>2</sup>	73.10%
	tau squared	0.106
	Test of SMD = 0; Z value	4.64*
	Combined Intervention (Educational + Behavioral)	N
	D + L pooled SMD	0.729
	CI lower	0.332
	CI upper	1.125
	Heterogeneity (Q)/d.f.	96.57*/9
	I <sup>2</sup>	90.70%
	tau squared	0.363
	Test of SMD = 0; Z value	3.60*
TOTAL	N	19
	D + L pooled SMD	0.663
	CI lower	0.429
	CI upper	0.898
	Heterogeneity (Q)/d.f.	127.12*/18
	I <sup>2</sup>	85.80%
	tau squared	0.229
	Test of SMD = 0; Z value	5.54*

\*p < 0.05; FPG = fasting plasma glucose; PPG = post-prandial blood glucose; RBG = random blood glucose; SMD = standardized mean difference; CI = confidence interval; d.f = degree of freedom.

The overall pooled effect size estimation of the interventions, as evaluated through a random-effects model, demonstrates a significant improvement in the outcome measures. To ensure comparability among the effect size values of different outcome measures, the effect sizes of medication adherence were taken with a negative sign. In this pooled analysis, a negative overall effect indicates a positive improvement resulting from the interventions.

The results from all the studies included in the analysis collectively show a noteworthy enhancement in the outcome measures due to the interventions (standardized mean difference -0.69; 95% confidence interval: -

0.79, -0.58;  $p < 0.001$ ). This indicates that the nurse-led educational and combined interventions have a substantial and positive impact on the outcome measures, signifying an improvement in medication adherence and other clinical indicators related to diabetes management. The overall effect size suggests that these nurse-led interventions play a crucial role in positively influencing patient outcomes in diabetes care and are essential components of comprehensive diabetes management strategies.

## DISCUSSION

As evidenced by our study findings (see Table 2), nursing professionals worldwide have implemented various interventions to improve medication adherence in patients with diabetes. These interventions typically involve patient engagement in decision-making related to their condition, raising awareness about diabetes, and optimizing treatment management, especially in achieving optimal medication adherence to reach treatment targets. Notably, some interventions also included collaboration with other healthcare professionals, such as dietitians, nurses, nutritionists, or physical therapists, during specific parts of the intervention. This highlights the importance of interdisciplinary collaboration between nursing professionals and other healthcare providers to deliver comprehensive and holistic care to patients.

The utilization of standardized outcome measures, specifically Cohen's  $d$ , allowed for a meta-analysis of studies with different outcome measures. This approach distinguishes our study from previous systematic reviews and reinforces the positive impact of nursing professionals' involvement in patient care for individuals with diabetes. The varying period of follow-up observed (ranging from 1 to 24 months) aligns with previous research (3 to 24 months) and is influenced by the study design and the type of outcome measures employed. Longer follow-up periods may yield more favorable results, demonstrating the intervention's sustained effects over time.

Within our study, we identified three main intervention strategies employed by nursing professionals. The most prevalent strategy was a combined intervention involving both educational and behavioral components, showcasing the significance of education as a common method utilized by nursing professionals to enhance medication adherence in patients with diabetes.

In summary, our findings underscore the valuable role of nursing professionals in implementing diverse interventions to improve medication adherence among patients with diabetes. By emphasizing patient engagement, interdisciplinary collaboration, and the use of standardized outcome measures, nursing professionals contribute significantly to enhancing patient outcomes and delivering comprehensive diabetes management. The preference for combined educational and behavioral interventions further highlights the effectiveness of such strategies in promoting medication adherence and overall diabetes care.

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