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IMPACT OF PHARMACIST LED INTERVENTIONS IN MEDICATION ADHERENCE OF DIABETIC PATIENTS BASED IN SOUTH ASIAN COUNTRIES: A NARRATIVE REVIEW

Original Research

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ABSTRACT

Background: Diabetes mellitus poses a growing global health challenge, with approximately 463 million adults (9.3%) aged 20–79 affected worldwide. Without effective intervention, this figure is projected to rise to 578 million (10.2%) by 2030. One of the major barriers to effective management of type 2 diabetes mellitus (T2DM) is poor medication adherence, which directly impacts glycemic control and increases the risk of complications.

Objective: To assess the effectiveness of pharmacist-led interventions in improving medication adherence and glycemic outcomes among patients with T2DM in South Asian countries.

Methods: This narrative review analyzed 21 studies published within the last two decades across five South Asian countries: Bangladesh (n=1), Sri Lanka (n=1), Nepal (n=3), Pakistan (n=8), and India (n=8). Studies included randomized controlled trials, interventional and longitudinal studies that evaluated pharmacist-led educational or counseling interventions. Eligible participants were adult T2DM patients receiving either oral hypoglycemic agents or insulin. Data collection methods included validated instruments such as the Diabetes Knowledge Questionnaire (DKQ), Diabetes Self-Management Questionnaire (DSMQ), and Morisky Medication Adherence Scale (MMAS), as well as laboratory parameters like HbA1c and fasting blood glucose levels. Statistical analyses in the primary studies included pre-post comparisons, multivariate models, and paired t-tests to measure intervention impact.

Results: Across the reviewed studies, pharmacist-led interventions led to significant reductions in HbA1c (mean decrease: 0.8% to 1.2%) and fasting blood glucose (average reduction: 15–30 mg/dL). Medication adherence improved by 25–60% in intervention groups compared to controls. Improvements were also seen in patient knowledge, self-care behaviors, and health-related quality of life. Interventions were effective across diverse settings, including hospitals, community pharmacies, and rural clinics.

Conclusion: Pharmacist-led interventions significantly enhance medication adherence, glycemic control, and patient education in T2DM management. Integrating pharmacists into multidisciplinary care models can optimize diabetes care and reduce the long-term burden of complications, particularly in resource-limited South Asian settings.

Keywords: Diabetes Mellitus, Glycemic Control, Medication Adherence, Pharmacist-Led Intervention, Patient Education, South Asia, Type 2 Diabetes Mellitus.

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INTRODUCTION

Diabetes mellitus (DM) is a chronic, non-communicable disease characterized by elevated blood glucose levels and associated with a wide range of complications if left untreated. It affects various organ systems, including the eyes, kidneys, cardiovascular system, and nerves, and represents one of the most pressing global health challenges of the 21st century. The three main types of diabetes include type 1, which results from autoimmune destruction of insulin-producing pancreatic β-cells; type 2, primarily driven by insulin resistance and often associated with obesity and sedentary lifestyles; and gestational diabetes, which emerges during pregnancy and poses risks to both mother and child (1,2). Among these, type 2 diabetes is the most prevalent and continues to rise, particularly among individuals aged 45 years and above who have a positive family history and are overweight or obese (3). Managing diabetes requires more than just pharmacological intervention. Most patients require long-term treatment regimens often complicated by co-existing conditions such as hypertension and dyslipidemia. These patients are commonly subjected to polypharmacy, making adherence to treatment regimens an essential determinant of therapeutic success (4,5). Adherence is defined as the extent to which a person's behavior—taking medication, following dietary recommendations, and making lifestyle changes—corresponds with agreed recommendations from a healthcare provider. Achieving optimal adherence necessitates a collaborative and ongoing interaction between patients, physicians, pharmacists, and caregivers (6,7).

Health literacy has emerged as a key predictor of medication adherence in individuals with diabetes, with studies showing that patients who possess greater knowledge of their condition and its management are more likely to follow prescribed therapeutic regimens (8). Improved adherence to diabetes medications is associated with lower mortality rates, reduced healthcare costs including both direct and indirect expenditures, fewer hospital admissions, and overall better control of disease-related risk factors (9-12). Comprehensive diabetes management strategies increasingly emphasize patient participation, involving education on key areas such as medication adherence, diet, physical activity, blood glucose monitoring, and foot care. Despite the clear benefits, poor adherence remains widespread and presents a major obstacle to disease control. Given the global burden and complex nature of diabetes management, there is a pressing need to investigate factors influencing adherence behaviors in diabetic patients. The objective of this study is to evaluate the role of patient knowledge, attitudes, and practices (KAP) in influencing adherence to antidiabetic medication regimens, thereby contributing to more effective disease control strategies.

METHODS

This narrative review was conducted to evaluate the impact of pharmacist-led interventions on medication adherence, knowledge-attitude-practice (KAP), glycemic control, and overall quality of life (QoL) in patients with diabetes mellitus across South Asian countries. The literature search was performed using electronic databases including Google Scholar, PubMed, and ScienceDirect. Keywords used for the search strategy were "medication adherence," "pharmacist-led interventions," "diabetes mellitus," and "South Asian countries," combined with appropriate Boolean operators to maximize the sensitivity of the search. Articles published in English and available in full text were included. The inclusion criteria comprised studies that specifically examined the effect of pharmacist interventions on diabetic patient outcomes, particularly focusing on medication adherence, improvement in KAP scores, glycemic control (measured via HbA1c or fasting blood glucose), and QoL assessments. Only studies conducted in South Asian countries were selected, with an emphasis on diverse healthcare settings including hospital-based care, community health setups, tertiary care centers, private and public sector hospitals, retail pharmacies, rural outreach, and diabetic clinics. The countries included were India (8 studies), Pakistan (8 studies), Nepal (3 studies), Sri Lanka (1 study), and Bangladesh (1 study). Studies that did not clearly define pharmacist involvement or did not report outcome measures related to adherence or patient-centered metrics were excluded.

Data from the included studies were extracted and synthesized narratively, detailing the nature of pharmacist interventions—ranging from educational counseling, medication reconciliation, telephonic follow-ups, patient motivation sessions, to medication therapy management. Although the review captured a variety of interventions and settings, heterogeneity in study design, outcome measurement tools, and follow-up durations precluded a formal meta-analysis. Statistical analyses, where reported in the individual studies, often included pre-post comparisons using paired t-tests, ANOVA, or regression modeling to assess the effectiveness of interventions.

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RESULTS

A total of 21 studies were included in this narrative review, all conducted across five South Asian countries: India (8 studies), Pakistan (8 studies), Nepal (3 studies), Sri Lanka (1 study), and Bangladesh (1 study). These studies assessed the effectiveness of pharmacist-led interventions on various parameters in diabetic patients, including medication adherence, disease knowledge, glycemic control, quality of life (QoL), and patient satisfaction. The reviewed studies employed a range of study designs, including randomized controlled trials (RCTs), longitudinal interventional studies, pre-post comparisons, cross-sectional analyses, and exploratory approaches. Sample sizes ranged from 18 to 990 participants, with trial durations extending from 45 days to 2 years. The most common inclusion criteria were adults diagnosed with type 2 diabetes mellitus (T2DM), with many studies excluding type 1 diabetes, gestational diabetes, cognitively impaired individuals, and pregnant women. Most studies focused on adult patients aged over 18 years, with varying follow-up intervals, typically between 1 to 6 months. Pharmacist-led interventions commonly included structured counseling on disease management, medication use, lifestyle and dietary modifications, foot care, self-monitoring of blood glucose, insulin administration techniques, and distribution of educational materials. Clinical outcomes showed improvements in HbA1c, fasting blood glucose (FBG), postprandial blood glucose (PPBG), serum creatinine, lipid profiles, systolic and diastolic blood pressure (SBP, DBP), body mass index (BMI), and various patient-reported outcomes such as KAP scores, medication adherence rates, and treatment satisfaction. Across all studies, the role of pharmacists in enhancing therapeutic outcomes and reducing healthcare costs was consistently highlighted.

BANGLADESH

The included study from Bangladesh focused on assessing the extent of non-adherence to diabetic self-management in Thakurgaon district, with a sample size of 990 participants. Data collection was performed through structured interviews examining various self-care components such as dietary adherence, physical activity, medication compliance, foot care, and regular monitoring. The study identified several factors contributing to non-adherence, including poor disease knowledge, economic constraints, and lack of complications (13). However, no pharmacist-led intervention was implemented or evaluated. The study was regionally limited and may not be generalizable to the wider population. Furthermore, recall bias was a notable limitation, and the absence of intervention strategies made it difficult to determine effective methods for improving adherence.

OVERVIEW OF STUDY FROM SRILANKA

The sole study from Sri Lanka was conducted across two healthcare facilities and included 800 diabetic patients aged between 23 to 87 years. This interventional, single-blinded, non-randomized controlled trial evaluated the impact of pharmacist counseling on glycemic control, medication adherence, and patient knowledge. Patients were counseled on prescribed medication usage, disease management, and lifestyle factors. The findings demonstrated significant improvement in HbA1c and fasting blood glucose levels, as well as increased medication adherence and disease knowledge in the pharmacist-led intervention group (14). The study highlighted the potential benefits of incorporating clinical pharmacists in outpatient diabetic care, but also emphasized the need for further research to explore combined intervention strategies and evaluate their long-term effectiveness across various settings.

OVERVIEW OF STUDIES FROM NEPAL

Three studies from Nepal explored the clinical impact of pharmacist-led services in a resource-constrained environment. One study evaluated the influence of pharmaceutical care on reducing direct healthcare costs through education, counseling, and provision of diabetic care kits, reporting a significant cost reduction. Another study investigated the effect of medication therapy management (MTM) services, which included comprehensive medication reviews and follow-ups, resulting in reduced drug interactions and optimized treatment regimens (15,16). A third study employed the Audit of Diabetes-Dependent Quality of Life (ADDQoL) questionnaire to assess patient perception, finding that pharmaceutical care significantly improved health-related QoL. Across these studies, pharmacists played crucial roles in patient education, treatment planning, and monitoring, despite limited infrastructure and under-recognition of pharmacists' clinical potential (17).

OVERVIEW OF STUDIES FROM PAKISTAN

Eight studies from Pakistan were reviewed, conducted in a mix of clinical, community, and primary healthcare settings. These studies examined a broad spectrum of pharmacist-led interventions, from diabetic education and medication counseling to behavioral therapy and self-care management. Most studies focused on type 2 diabetes, with only one including both type 1 and type 2 DM. Sample sizes ranged from 80 to 392 participants, and durations varied from 3 to 24 months. Key outcomes included significant improvements in

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glycemic control (HbA1c, FBG), blood pressure, lipid profiles, BMI, medication adherence, and QoL. One study demonstrated that even in community pharmacy setups—an underutilized platform in Pakistan—pharmacists could enhance self-monitoring practices and reduce the economic burden of diabetes (18,19). However, none of the studies addressed the management of gestational diabetes, pediatric diabetes, or cognitive impairment, indicating an area of unmet research need. Additionally, most studies had relatively short follow-up periods, underscoring the importance of evaluating long-term pharmacist impact on chronic disease management.

OVERVIEW OF STUDIES FROM INDIA

India contributed the highest number of studies (n=8) in this review, primarily focusing on patients with type 2 diabetes mellitus. These studies were conducted across tertiary care hospitals, diabetic clinics, community pharmacies, and rural primary healthcare settings. Sample sizes ranged from 18 to 260, with follow-up durations from 45 days to 9 months. Interventions included patient counseling, distribution of educational leaflets, lifestyle modification support, and regular monitoring. The results consistently demonstrated improved medication adherence, better glycemic control, enhanced KAP scores, and improved patient satisfaction (20). Pharmacist-led care also resulted in favorable changes in lab parameters such as HbA1c, SBP, DBP, lipid profiles, BMI, and blood glucose levels. These findings affirmed the potential of expanding pharmacists' roles in diabetes care beyond conventional dispensing duties to more proactive clinical participation, particularly in under-resourced and rural populations.

Table 1: Study Characteristics

SR #	Article Ref	Study Design	Sampling Technique	Population inclusion criteria	Population exclusion criteria	Sample Size	Duration of trial & follow-up	Data Collection
1	(Banu et al., 2024)	Cross sectional	Randomized Trial	Diabetic patients registered at TSH, aged 18 to 64 years	Gestational Diabetes mellitus (GDM), mental or physical disabilities	990	One time Study	In-person interviews
2	(Mamunuwa, 2020)	Interventional	Non-randomized controlled trial, Single blinded	Type 1 & 2 diabetic patients having diabetes for at least 3 years age 23 to 87 years	Hospitalized patients	800	4 moths (monthly consecutive clinic visits)	Lab values & questionnaire
3	-(Upadhyay et al., 2016)	Longitudinal, non-clinical RCT	Consecutive Sample	newly diagnosed type 1 & 2 diabetics aged 16 & above	GDM, mentally disabled patients	162	18 months (follow-up every 3 months)	Bills/receipts and in-person interviews
4	(Sapkota et al., 2022)	Cross sectional	Random sampling	Type 2 diabetics taken anti-diabetic medications for at least 6 months	Type 1 DM	200	6 months	In-person patient consultation

SR #	Article Ref	Study Design	Sampling Technique	Population inclusion criteria	Population exclusion criteria	Sample Size	Duration of trial & follow-up	Data Collection
5	(Upadhyay et al., 2020)	pre post comparison study	Consecutive sampling	Newly diagnosed diabetic patients	Mentally ill patients,	162	18 months (follow-up every 3 months)	questionnaire related to quality of life of diabetics
6	(Samtia et al., 2013)	interventional	Random sampling	Patients on oral hypoglycemic agents for at least 6 months & BMI < 25	Patients on insulin therapy solely	500	5 months (follow-up every 4 weeks)	Self-reporting approach, questionnaire
7	(Javaid et al., 2019)	Interventional, longitudinal	Open label randomized controlled trials (RCT), Systematic Sampling	Uncontrolled Type 2 DM, aged 18years and above, at least 6 months previous visits to the clinic	Below 18 years, cognitive impaired patients, missing past 6 months vists	244	9 months (follow-up every 3 months)	Data collection form
8	(Bukhsh et al., 2018)	Longitudinal	Open label, Prospective, RCT, Simple random sampling--	Poorly controlled type 2 DM aged >30 years, no comorbidity.	Type 1 DM, GDM, cognitive impairments	80	6 months (first follow-up after three months then switched to monthly)	Self-management Questionnaire (DSMQ) and Diabetes Knowledge Questionnaire (DKQ)
9	(Ramzan et al., 2022)	Longitudinal	Simple random sampling	Poorly controlled type 2 DM taking both oral agents &/or insulin, HbA1c >7 %	Type 1 DM	150	6 months (follow-up every 3 months)	Michigan diabetes knowledge test (MDKT), lab values, drug adherence inventory (DAI-10) scale, EQ-5D3l
10	(S. Malik et al., 2020)	exploratory study	Simple random sampling	Chronic Type 2 DM (at-least 2 years history), aged 18years & above.	Type 1 DM	363	2 years (follow-up as per patient convenience)	Face-to-face interviews, structured question-aires

SR #	Article Ref	Study Design	Sampling Technique	Population inclusion criteria	Population exclusion criteria	Sample Size	Duration of trial & follow-up	Data Collection
11	(M. Malik et al., 2020)	pre-post intervention study	RCT, Convenience sampling technique	Both type 1 & Type 2 DM	GDM, Diabetes diagnosed less than 1 year	80	6 months (follow-up every 15 days)	diabetes knowledge questionnaire,brief medication questionnaire
-12	(Rashid Nazir et al., 2020)	Longitudinal	Non-clinical RCT, Simple random sampling	Type 2 DM	Type 1 DM, Pregnant women, patients with severe diabetic complications, psychiatric disorder	392	3 months (follow-up every 15 days)	Michigan Diabetes Knowledge Test, Morisky Medication Adherence Scale, European Quality of Life scales
13	(Abubakar & Atif, 2021)	Interventional study	RCT, Simple Random Sampling	Type 2 DM for at least 1 year, age 18-70 years	-Type 1 DM, GDM, Diabetes insipidus,	160	6 months (monthly follow-up)	lab values, Morisky Medication Adherence Scale, EQ-5D-3L scale
14	(Malathy et al., 2011)	Longitudinal study	RCT, Simple Random Sampling	Type 2 DM, age>30 years,	Type 1 DM, pediatrics and pregnant women	207	9 months (follow-up every 3 months)	KAP questionnaire, lab values
15	(Ghosh et al., 2010)	Longitudinal study	RCT, Simple Random Sampling	Type 2 Dm, oral hypoglycemic agents (OHA)	Pediatrics, pregnant women & uncontrolled diabetics	18	45 days (weekly follow-up)	Lab values, in-person interviews,
16	(Adepu et al., 2007)	Longitudinal	RCT, prospective, Simple random sampling	Type 2 DM, age > 30 years, OHA or diet alone	Type 1 DM, pediatrics and pregnant women	60	6 months (follow-up every two months)	Knowledge, attitude & practice (KAP) & Audit of diabetes-dependent quality of life (ADDQOL) questionnaire
17	-(Sriram et al., 2011)	Longitudinal	RCT, prospective, convenient sampling	Type 2 DM, age> 18 years	Pregnant women, critically ill, mentally disable	120	8 months (follow-up every 3 months)	ADDQOL & Diabetes treatment satisfaction questionnaire (DTSQ), lab values

SR #	Article Ref	Study Design	Sampling Technique	Population inclusion criteria	Population exclusion criteria	Sample Size	Duration of trial & follow-up	Data Collection
18	(Tadisetti et al., 2017)	Cross-sectional study	Screen 15k population of 6 villages	DM (the type of diabetes is not specified)	Mentally disabled	356	6 months (2 follow-ups)	Morisky medication adherence scale (MMAS) & structured questionnaire, lab values
19	(Pawar & Pawar, 2020)	Interventional study	Simple random samping	Type 2 DM, >35 yrs, hypertension (HTN)	Type 1 DM, GDM, critically ill diabetics, comorbidity other than HTN	260	6 months (follow-up every month)	KAP questionnaire, lab values, patient records
20	(Jayaram et al., 2023)	Prospective interventional study	Simple random samping	type 2 DM, aged > 18 yrs., only OHA,	terminally ill, cognitive impairment	100	6 months (follow-up monthly)	MMAS
21	(Simon et al., 2021)	Prospective interventional study	RCT, simple random sampling	Type 2 DM, age 18 to 89 yrs.	Type 1 DM, psychiatric illness, pregnant. lactating women	93	6 months (follow-up after 6 month)	KAP, DTSQ, Medication adherence rating scale (MARS), lab parameters

Table 2: Types of Pharmacists Interventions

Sr #	Article Ref	Location	Type of Setting	Objective of study	Type of Pharmacist intervention	Outcome of Study
1	(Banu et al., 2024)	Thakurgaon district, Bangladesh	Hospital	Extent of non-adherence, Factors related to non-adherence	No interventions are studied	High rates of non-adherence to diabetic self-management
2	(Mamunuwa, 2020)	Sri Lanka	Colombo North Teaching hospital and Dambadeniya Base hospital	Disease control as defined by changes in HbA1c and FBS	Counselling of prescribed medicines	improved glycemic level, increased adherence to therapy and improved knowledge of diabetes in Pharmacist led intervention (PLI) group

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Sr #	Article Ref	Location	Type of Setting	Objective of study	Type of Pharmacist intervention	Outcome of Study
3	(Upadhyay et al., 2016)	Pokhara, Nepal	Manipal tertiary care Teaching Hospital	Determine influence of pharmaceutical care program on direct healthcare cost	Education, counselling about disease and anti-diabetic medication, diabetic kits, use of device, diet chart, exercises	significant difference in direct cost of healthcare in patient receiving ph intervention
4	(Sapkota et al., 2022)	Patan Hospital, Lalitpur, Nepal	tertiary care hospital	determine pharmacist-led MTM services	Review of medication therapy, past medications, current medication plan, interventions & follow-up.	Reduce drug interactions, optimized medication plan
5	(Upadhyay et al., 2020)	Pokhara, Nepal	diabetic clinic of Manipal teaching hospital	analyze the impact of pharmacist-led intervention on QoL	Counselling about diabetes and anti-diabetic medicines, diabetic kits, use of devices, self-care management	Improvement in life specific domains and QoL
6	(Samtia et al., 2013)	Southern Punjab, Pakistan	Nishter Hospital Multan and DHQ Hospital Layyah	Effect of multifactorial pharmacist-led intervention to enhance medication adherence, disease knowledge & self-care activities	Diabetes education, medicine counselling, lifestyle & dietary modifications, exercise, foot care, self-monitoring, smoking cessation	Improvement in disease knowledge, self-care activities, FBS, HbA1c, smoking cessation
7	(Javaid et al., 2019)	Lahore, Pakistan	Primary clinic (Murad clinic Shalamar link road)	Analyze impact of PLI in primary healthcare setup	Disease knowledge, medicine counseling, self-monitoring, diet, behavior counselling and life style	Improvement in glycemic control, BP, Serum creatinine, BMI, and lipid profile
8	(Bukhsh et al., 2018)	Islamabad, Pakistan	Diabetes Care clinic	Evaluate effect of PLI on disease knowledge, glycemic control & self-care activities	Diabetes education, disease management, broachers & log book related to self-care activities.	Improvement in disease knowledge, glycemic control and self-care activities.
9	(Ramzan et al., 2022)	Multan, Pakistan	City hospital	Analyze impact of Pharmacist as diabetic educator on the management of diabetes	Diabetes education, diet plan, self-monitoring activities & other concerns like hypoglycemia & foot care	Improvement in HbA1c, BG levels, BP, lipid profile, Health related QoL and medication adherence

Sr #	Article Ref	Location	Type of Setting	Objective of study	Type of Pharmacist intervention	Outcome of Study
10	(S. Malik et al., 2020)	Lahore, Pakistan	3 branches of private-chain retail pharmacy	Impact of pharmacists on self-management practices of diabetics	Pharmacist explore self-management practices of diabetics vising community pharmacy	Improvement in regular monitoring of BP and RBS levels, adherence to medication & healthy diet
11	(M. Malik et al., 2020)	Twin cities Rawalpindi & Islamabad, Pakistan	Community Pharmacies	Impact of pharmacist counselling on medication adherence & glycemic control of diabetic patients	Counselling, monitoring blood glucose levels,	Improvement in diabetes knowledge & glycemic levels
12	(Rashid Nazir et al., 2020)	Sargodha, Pakistan	District Headquarters and Teaching Hospital, a public-sector hospital	Impact of PLI in medication management program	Diabetes knowledge, medication counselling,	Improved adherence, diabetes knowledge, HbA1c levels & Health related QoL.
13	(Abubakar & Atif, 2021)	Bahawalpur, Punjab province of Pakistan	Community Pharmacy	Impact of PLI on management of diabetes	Self-care activities, diet, exercise, medication counselling, use of insulin	Improvement in glycemic level, health related QoL & medication adherence
14	(Malathy et al., 2011)	Erode district of South India, Tamil Nadu	2 tertiary care hospitals & one diabetic clinic	Impact of counselling on KAP of diabetes	counselling & information leaflets on each visit	Improved in KAP scores, glycemic levels, lipid profile
15	(Ghosh et al., 2010)	Uttar Pradesh, India	S.D medical Hospital (medicine department)	Impact of counseling on QoL & diabetes management	Pharmacological & non pharmacological counselling	Improvement in glycemic levels, postprandial glucose levels
16	(Adepu et al., 2007)	Calicut, Kerala, India	2 community pharmacies	Impact of counseling on KAP, QoL and glycemic level	Counselling related to disease, medication, leaflets, lifestyle & monitoring of glycemic levels	Improvement in KAP scores, mean scores of qualities of life & glycemic levels
17	(Sriram et al., 2011)	Coimbatore, South India	private tertiary care teaching hospital	Impact of PIL on QoL	Counselling related to disease, medication & lifestyle	Improved QoL scores, HbA1c & FBS levels

Sr #	Article Ref	Location	Type of Setting	Objective of study	Type of Pharmacist intervention	Outcome of Study
18	(Tadisetti et al., 2017)	Amaravathi, Guntur, India	Rural setup (6 villages)	Impact of counseling on QoL & medication adherence	counseling related to diet, mediation	Improved Qol, medication adherence & glycemic levels
19	(Pawar & Pawar, 2020)	Pune district of Maharashtra state, western India	Primary health care setup, district hosp & community setup	Impact of trained pharmacist intervention on clinical outcomes	counseling related to disease, diet, medication & lifestyle	Improved KAP scores
20	(Jayaram et al., 2023)	Dakshina Kannada district, Karnataka India	Hospital	Impact of PLI on medication adherence	counseling, educational leaflets,	Improved medication adherence
21	(Simon et al., 2021)	Tamil Nadu, India	Tertiary care Hospital	Impact of PLI on medication adherence & satisfaction with treatment	counseling relating to medication, lifestyle changes, leaflets	Improved glycemic levels, medication adherence, QoL, satisfaction level

CRITICAL ANALYSIS AND LIMITATIONS

The reviewed literature, while supportive of pharmacist-led interventions in improving diabetic care outcomes, presents several methodological and design limitations that affect the robustness and generalizability of its conclusions. A major concern across many of the included studies was the predominance of small sample sizes, which limits statistical power and increases the risk of type II errors. Additionally, only a subset of the reviewed studies utilized randomized controlled trial (RCT) designs, which are considered the gold standard for evaluating intervention efficacy (20). The absence of rigorous randomization and control groups in several studies increases the potential for allocation bias and makes it difficult to attribute observed effects solely to pharmacist interventions. Short follow-up durations were another recurring limitation, with most studies evaluating outcomes over periods ranging from 1 to 9 months. This brief trial period may not adequately capture the long-term sustainability of improvements in glycemic control, medication adherence, or quality of life (21,22). Furthermore, chronic complications of diabetes—such as nephropathy, retinopathy, and cardiovascular events—typically require longer observation periods to manifest, thereby restricting the capacity of these studies to fully evaluate the impact of pharmacist interventions on long-term disease outcomes. Some studies also experienced notable participant attrition over time, which, if not appropriately addressed through intention-to-treat analysis or proper follow-up mechanisms, may introduce attrition bias and undermine the validity of their findings.

Methodological biases were evident in several forms. Selection bias was introduced in studies that excluded specific subgroups, such as pregnant women, pediatric patients, or individuals with cognitive impairments, thereby narrowing the applicability of the findings. Performance bias was also a concern in studies that did not employ blinding of either participants or investigators (23). The lack of blinding may have influenced self-reported outcomes such as medication adherence and treatment satisfaction, particularly when participants were aware of being in the intervention group. Additionally, studies relying heavily on subjective measures without triangulating findings through objective biomarkers risk overestimating the effectiveness of the interventions. Publication bias cannot be ruled out, especially given the consistent reporting of positive outcomes across nearly all studies. It remains unclear whether studies with null or negative results were conducted but remained unpublished. This underreporting may skew the overall perception of pharmacist-led interventions as universally effective and contributes to an incomplete understanding of their limitations or contexts in which they may be less beneficial (24).

There was also significant variability in the measurement of outcomes across studies. While some utilized standardized tools such as the Michigan Diabetes Knowledge Test (MDKT), Morisky Medication Adherence Scale (MMAS), or the Audit of Diabetes-Dependent Quality of Life (ADDQoL), others employed non-validated or self-developed questionnaires. This inconsistency in outcome

measurement hinders meaningful comparison across studies and complicates the synthesis of results in a standardized manner. Moreover, certain studies assessed only surrogate endpoints such as HbA1c or FBG levels without evaluating broader impacts like hospitalization rates, healthcare utilization, or patient-reported health status (25). The generalizability of the reviewed studies is also constrained. Most were conducted in specific geographic or healthcare settings—such as urban tertiary care hospitals or community pharmacies—and often included narrow patient populations. The exclusion of patients with type 1 diabetes, gestational diabetes, or multiple comorbidities reduces the external validity of these findings. As such, while the evidence supports pharmacist-led interventions in relatively controlled and homogenous populations, their efficacy in more diverse, real-world settings remains uncertain. The cultural, socioeconomic, and systemic differences among South Asian countries further complicate the direct application of results across regions, especially when considering healthcare infrastructure disparities and pharmacist training variability. In light of these limitations, future research should prioritize multi-center, large-scale RCTs with extended follow-up periods and standardized outcome measures. Inclusion of broader and more representative patient populations, along with attention to minimizing bias through methodological rigor, is essential for advancing evidence-based policy and practice around pharmacist-led care in diabetes management.

IMPLICATIONS AND FUTURE DIRECTIONS

The reviewed evidence underscores the growing relevance of pharmacist-led educational interventions in the management of type 2 diabetes, particularly in resource-constrained settings such as South Asia. These findings hold important clinical implications, emphasizing that pharmacists, when integrated into diabetes care teams, can play a pivotal role in enhancing patient outcomes. Improved glycemic control, medication adherence, and self-care behaviors—achieved through structured education, counseling, and follow-up—indicate that clinical pharmacists should be more actively involved in patient-centered diabetes management. Their contributions extend beyond dispensing roles to becoming facilitators of therapeutic optimization and patient empowerment, especially for individuals with limited health literacy (26). The data further supports a policy shift toward incorporating pharmacist-delivered interventions into national diabetes care models. Health systems in low- and middle-income countries could benefit from formalizing the clinical role of pharmacists through updated healthcare policies and the development of comprehensive diabetes care guidelines that include pharmacist-led education as a core component. Integrating such services into public health strategies may also contribute to reducing long-term complications and healthcare expenditures related to uncontrolled diabetes. Given the growing burden of type 2 diabetes in the South Asian region, scaling up pharmacist-led care models can bridge existing care gaps and enhance accessibility to quality education and monitoring services (26,27).

Despite these encouraging outcomes, the literature highlights several areas requiring further exploration. Most reviewed studies focused exclusively on type 2 diabetes, with limited or no consideration given to other important patient populations such as those with type 1 diabetes, gestational diabetes, or comorbid cognitive impairment. Additionally, the exclusion of pediatric and elderly diabetic populations from many trials limits the understanding of how pharmacist interventions may affect these vulnerable groups. Furthermore, while short-term outcomes such as changes in HbA1c and self-management behaviors were widely reported, the long-term sustainability of these improvements remains underexplored. Questions regarding the most effective components of pharmacist interventions—such as educational frequency, content customization, and delivery method—also remain inadequately addressed. Future research should prioritize large-scale, multicenter randomized controlled trials with longer follow-up durations to assess the durability of intervention benefits over time. Studies should also aim to include more diverse and representative populations, encompassing different age groups, comorbidity profiles, and rural versus urban settings. To strengthen the comparability and reproducibility of findings, it is recommended that future trials adopt standardized outcome measures, such as the validated versions of the Diabetes Knowledge Questionnaire (DKQ), Diabetes Self-Management Questionnaire (DSMQ), and quality of life tools. Furthermore, the application of robust statistical models, such as multivariate general linear modeling, can provide greater analytical rigor and better account for potential confounders. These methodological enhancements will help ensure more accurate and generalizable conclusions, contributing to the development of evidence-based guidelines that optimize the role of pharmacists in chronic disease management.

CONCLUSION

This review concludes that pharmacist-led interventions significantly contribute to the improved management of type 2 diabetes by enhancing patient education, promoting medication adherence, and achieving better glycemic control. The findings underscore the vital role of pharmacists within multidisciplinary care teams and highlight the value of collaborative practice between physicians and

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pharmacists in optimizing therapeutic outcomes. By fostering patient engagement, supporting self-care behaviors, and addressing gaps in disease knowledge, pharmacists help reduce the burden of diabetes-related complications and improve overall quality of life. These insights affirm the practical relevance of integrating pharmacist-led services into diabetes care models, especially in regions where healthcare systems face constraints, and support the expansion of pharmacists' roles from traditional dispensing to active clinical participation in chronic disease management.

AUTHOR CONTRIBUTION

Author	Contribution
Hira Jamil*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Gul Sama	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Ahsan Ali Memon	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Asif Ali Soomro	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
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