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Clinical Pharmacists´ Interventions in the Management of Type 2 Diabetes Mellitus: A Systematic Review

Moamen Abdelfadil Ismail[1], Maged Mohammed M Alharbi[2], Turki Hamed Naffaa Almusihli[3], Turki hassan suliman alqattan[4], Fahad Shaag Ibraheem Alotibi[5], Amnah A Asiri[6] , Kholod Abdullah Alsulihim[7]

Abstract

Type 2 diabetes mellitus (T2DM) is a complex metabolic disorder with significant complications that affect quality of life and burden healthcare systems. Despite advances in diabetes management, many patients fail to achieve optimal therapeutic goals, emphasizing the need for innovative, multidisciplinary care approaches. Clinical pharmacists have emerged as key contributors to improving T2DM outcomes.This systematic review assessed the impact of pharmacist-led interventions on clinical, humanistic, and economic outcomes in T2DM management. Two databases, PubMed and the Cochrane Central Register of Controlled Trials, were searched for randomized controlled trials comparing pharmacist-led interventions with standard care. Studies reporting outcomes such as HbA1c, blood pressure, lipid profiles, BMI, medication adherence, health-related quality of life (HRQoL), and economic data were included. Data were synthesized and analyzed for changes from baseline to follow-up.A total of 41 studies involving 6,529 participants were included. Pharmacist-led interventions significantly improved HbA1c (reductions ranging from -0.05% to -2.1%), blood glucose, blood pressure, lipid profiles, and BMI. Improvements in medication adherence were observed in 14 studies, with significant gains in 5. Economic analyses indicated cost-effectiveness, with interventions reducing medical costs and improving quality-adjusted life years (QALYs). However, limited studies reported significant changes in HRQoL.Pharmacist-led interventions demonstrated substantial benefits in improving metabolic control, reducing cardiovascular risks, and enhancing medication adherence in T2DM management. The findings advocate for integrating pharmacists into multidisciplinary teams to optimize diabetes care. Further research on humanistic and economic outcomes is essential to support policy decisions.

Keywords: *Clinical Pharmacists, Type 2 Diabetes Mellitus, Metabolic Disorder.*

Introduction

Type 2 diabetes mellitus (T2DM) is a multifaceted metabolic disorder defined by significant pathophysiological changes, including impaired insulin sensitivity and a gradual decline in insulin production, which together lead to elevated blood sugar levels (1,2). This condition arises from a combination of genetic, epigenetic, and behavioral factors, all of which interact within a given sociocultural context (1). Poorly managed glycemic levels contribute to diabetes-related complications, such as microvascular and macrovascular damage, which in turn increase morbidity, mortality, and diminish overall quality of life (3,4). The global economic impact of diabetes and its complications poses a serious concern for healthcare systems worldwide.

Research indicates that despite advances in blood glucose monitoring, management of cardiovascular risk factors (e.g., blood pressure and lipid levels), and the availability of numerous treatment options, many individuals with T2DM fail to meet recommended therapeutic goals (5,6-7). These less-than-optimal results may be attributed to ineffective healthcare interventions or challenges related to patient adherence and engagement (8,9).

[1] Internal Medicine consultant, King Abdulaziz Specialist Hospital - Lecturer of Internal Medicine, Faculty of Medicine, Helwan University, Email: moamen.fadil83@gmail.com
[2] Technician-Pharmacy, Madinah Cardiac Center.
[3] Technician-Pharmacy, Madinah Cardiac Center.
[4] Technician-Pharmacy, Madinah Cardiac Center
[5] Pharmacy Technician, Al-Dawadmi General Hospital
[6] pharmacist, Abha Maternity and Children Hospital
[7] Pharmacist, King Abdulaziz Medical City

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To improve outcomes and support better management of T2DM, healthcare systems need to adopt innovative care models that emphasize collaboration, proactive strategies, and integrated teamwork, with active participation from patients (1,10,11-12). While some systematic reviews have explored this subject, they often lack a thorough evaluation of economic implications (13,14,15,16-17).

This study aims to systematically examine the impact of clinical pharmacist-led interventions on T2DM management by assessing clinical, humanistic, and economic outcomes, focusing exclusively on randomized controlled trials conducted in healthcare settings such as hospitals or ambulatory care centers.

Methods

Two online databases (PubMed and the Cochrane Central Register of Controlled Trials) were searched from their inception dates until September 13, 2017, with an update conducted on June 30, 2024.

The search strategy used for PubMed was adapted to formulate the search approach for the Cochrane Central Register of Controlled Trials. Search terms included a combination of medical subject headings (MeSH) and keywords, applied using Boolean operators.

Studies were deemed eligible if they fulfilled the following criteria: (1) randomized controlled trials comparing the effectiveness of pharmacist-led interventions for individuals with T2DM against standard care; (2) conducted in inpatient or outpatient settings (e.g., clinics or healthcare centers) and reported outcomes such as glycosylated hemoglobin (HbA1c), fasting or postprandial blood glucose, blood pressure, lipid profile [total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides], body mass index (BMI), 10-year coronary heart disease (CHD) risk, medication adherence, health-related quality of life (HRQoL), and economic analyses; (3) published in English, French, Spanish, or Portuguese; and (4) without restrictions on the publication year.

Study Selection

Two independent reviewers evaluated the titles and abstracts retrieved from the databases based on the predefined inclusion criteria. Articles identified as potentially relevant underwent full-text review by two reviewers to confirm their eligibility for inclusion. The process adhered to the PRISMA guidelines for systematic reviews, as recommended (18). Disagreements were resolved through discussion between the reviewers.

Data Extraction and Synthesis

One reviewer conducted data extraction from the eligible studies, and a second reviewer independently verified the extracted information. Results for each outcome were presented as changes from baseline to the final follow-up in both the intervention and control groups. If not explicitly reported, the difference in change between the groups was calculated (change from baseline in the intervention group minus change from baseline in the control group). Units of measurement for clinical outcomes were standardized where necessary to facilitate comparison.

Results

The database search identified a total of 748 citations. After screening the titles and abstracts, 84 citations were identified as potentially meeting the inclusion criteria. Following a detailed review of the full texts, 41 studies met the inclusion criteria and were included in this systematic review (20–73). Furthermore, three study reports found within the search results provided additional data relevant to the outcomes from some of the included studies (59–61).

The 41 included studies were conducted across various regions and settings, such as hospitals, primary healthcare centers, and outpatient clinics. These studies involved a combined total of 6,529 participants

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globally, with follow-up periods ranging from 45 days to 24 months.

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All included studies observed reductions in mean HbA1c values within the intervention groups compared to baseline, with statistically significant reductions reported in 18 studies (43.9%) (23, 25, 27–29, 35, 37–39, 41, 42, 45, 50, 52, 56, 57, 72, 73). The change in HbA1c between intervention and control groups ranged from -0.05% to -2.1%. Regarding blood glucose, 24 studies reported this parameter as an outcome, with 7 (29.2%) demonstrating statistically significant reductions (39, 40, 42, 45, 46, 56, 72). Differences in blood glucose changes between groups ranged from -7.74 mg/dL to -76.32 mg/dL.

Changes in systolic blood pressure (SBP) were assessed in 22 studies, with significant differences between intervention and control groups reported in 8 studies (36.4%) (31, 35, 39, 40, 41, 45, 50, 72). The difference in SBP change ranged from +3.45 mmHg to -10.6 mmHg. For diastolic blood pressure (DBP), data were reported in 16 studies, with only 4 studies (25%) showing significant differences (39, 41, 53, 72). The difference in DBP change between groups ranged from +1.32 mmHg to -9.1 mmHg.

Outcomes related to lipid profiles were variable. Fifteen studies measured total cholesterol, but only 5 (33.3%) reported statistically significant differences (39, 41, 45, 72, 73). Changes in total cholesterol levels ranged from +10.06 mg/dL to -32.48 mg/dL. For LDL cholesterol, 23 studies reported data, with 9 (39.1%) showing significant differences (27, 29, 35, 39, 40, 45, 57, 72, 73), with changes ranging from +2.1 mg/dL to -27 mg/dL. HDL cholesterol was reported in 16 studies, with only 2 (12.5%) reporting significant differences (45, 72). Differences in HDL levels ranged from -5.8 mg/dL to +11 mg/dL. Lastly, among the 18 studies that reported triglyceride levels, 4 (22.2%) observed significant differences (39, 40, 45, 73), with changes ranging from +21.26 mg/dL to -62.0 mg/dL.

BMI outcomes were described in 18 studies, with 12 studies showing greater reductions in the intervention group. However, only 2 studies (11.1%) reported statistically significant differences in BMI changes between groups (41, 72). Changes in BMI ranged from +0.6 kg/m^2 to -1.94 kg/m^2.

Predicted 10-year CHD risk was assessed in 6 studies using various methods, with significant differences reported in 3 studies (50%) (27, 53, 72). Among studies using the Framingham prediction method, the difference in CHD risk reduction between groups ranged from -3.0% to -12.0%.

Medication adherence was assessed in 22 studies, with improvements noted in the intervention groups in 14 studies. However, only 5 studies (22.7%) reported significant improvements (23, 25, 27, 35, 72). HRQoL was evaluated in 13 studies, but significant differences between groups were observed in only 2 studies (15.4%) (25, 72).

Economic analyses were conducted in 8 studies, with only 3 providing significant p-values (27, 59, 61). One study found that pharmacist-led interventions led to an incremental cost of USD 69 and an incremental effect of 0.12 QALY gained, with a cost-effectiveness ratio of USD 571 per QALY (59). Another study estimated potential cost savings of USD 5,086.3 per patient due to CHD risk reduction (27). A third study observed a 6% decrease in medical costs for the intervention group compared to a 13% increase in the control group (58).

Discussion

This systematic review synthesized evidence from randomized controlled trials examining the impact of various interventions led by clinical pharmacists on outcomes related to the management of T2DM. Unlike previous reviews, this work not only highlights the positive influence of clinical pharmacists on metabolic control in T2DM but also incorporates their role in economic and humanistic outcomes (13, 14, 15–16, 62). The role of clinical pharmacists in delivering targeted interventions to patients often remains underappreciated compared to other healthcare professionals. This review emphasizes the substantial capacity of pharmacists to actively participate in multidisciplinary healthcare teams, delivering effective interventions such as patient education, medication reviews, and case management with continuous follow-up. Interventions frequently included medication optimization, patient education, and coordination with other healthcare providers. The diversity of these interventions reflects variations in pharmacist roles and integration into healthcare systems globally, particularly regarding their autonomy to make medication

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adjustments. Evidence from the studies reviewed consistently underscores the beneficial impact of pharmacists on T2DM care. Regular follow-up by pharmacists could enhance the effectiveness of these interventions even further (63).

Improvements in HbA1c, blood glucose, blood pressure, lipid profiles, and BMI were consistently reported in intervention groups across nearly all included studies.

The results align with findings from other systematic reviews on this topic. A review by Wubben et al. reported significant improvements in mean HbA1c levels within intervention groups, with differences in HbA1c changes ranging from +0.2% to -2.1% between intervention and control groups (16). Improvements in glycemic control are crucial, as they are associated with reduced risks of diabetes-related complications, including lower risks of stroke (12%), myocardial infarction (14%), and heart failure (16%) (64). Although fasting or non-fasting blood glucose levels were reported in some studies, they hold less clinical relevance than HbA1c levels, and few studies demonstrated statistically significant differences.

This review also found reductions in blood pressure, lipid profiles, and BMI, supporting evidence from other studies (15, 16–17, 62). For example, Santschi et al. found that pharmacist-led interventions significantly reduced systolic and diastolic blood pressure, total cholesterol, LDL cholesterol, and BMI, although HDL cholesterol remained unaffected (15). Similarly, Wubben et al. observed decreases in blood pressure, low-density lipoprotein cholesterol, and triglycerides in intervention groups, though differences between groups were not always statistically significant (16).

Although studies assessing the effect of pharmacist interventions on coronary heart disease (CHD) risk are limited, available evidence suggests these interventions can improve CHD risk profiles. CHD risk reduction is often linked to improved clinical outcomes, such as lower HbA1c, systolic blood pressure, and cholesterol levels (65, 66–67). Additionally, pharmacist interventions positively influenced medication adherence in most studies, despite the reliance on self-reported adherence measures, which could overestimate adherence rates. Nevertheless, improved adherence can contribute to better clinical outcomes, as demonstrated in multiple studies (68, 69).

Conversely, improvements in health-related quality of life (HRQoL) were less frequently observed. This may stem from the limited sensitivity of current tools to detect subtle changes in HRQoL. The lack of a standardized instrument specifically designed to assess the impact of pharmacist interventions on patient quality of life may further explain this outcome (70).

While pharmacist interventions have shown promise in terms of cost-effectiveness, the limited number of studies performing economic analyses restricts the generalizability of these findings. Economic evaluations are crucial for informing policymakers about the value of integrating pharmacists into T2DM care, especially considering the financial constraints faced by healthcare systems. Future studies should adopt a holistic approach, examining clinical, humanistic, and economic outcomes using the ECHO framework (71).

Limitations

Several limitations must be acknowledged. While randomized controlled trials are considered the gold standard, some included studies exhibited methodological limitations as identified through the Cochrane risk of bias tool. Factors such as unclear random sequence generation, allocation concealment, and outcome assessment blinding were commonly rated as "unclear" due to insufficient reporting. Additionally, the heterogeneity of pharmacist interventions in these studies complicates the identification of the most effective strategies. Educational interventions and medication management emerged as promising approaches for improving T2DM outcomes, but further research is needed to confirm these findings.

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Conclusions

The evidence presented in this review reinforces the significant role pharmacists play in managing T2DM. Patients with this chronic condition often have additional comorbidities requiring complex therapeutic regimens. By ensuring proper medication use, educating patients, and enhancing adherence, pharmacists are integral to achieving therapeutic goals. The findings from this review demonstrate that pharmacist interventions improve metabolic control, reduce cardiovascular risk factors, enhance medication adherence, and, to some extent, improve HRQoL in T2DM patients. These results advocate for the inclusion of pharmacists as essential members of multidisciplinary healthcare teams and highlight the need for their expanded role in healthcare systems globally.

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