Pharmacist-Led Diabetes Education and Self-Management Support: Impact on Glycemic Control

Salem Olayan Almaghthawi[1*], Ahlam Rabee Alhujaili[1**], Bandar Awad Ayed Al-Jabri[2], Jumaa Hamed Suleiman Al-Juhani[2], Mahamad Musallam Alhejely[3], Ayman Musallam Salah Alsaedi[4], Husam Mohammad Al-Harbi[5], Majed Hameed Marzooq Al Harbi[6], Omar Marzook Salem Alharbi[6], Taher Sunaid Almutairi[7], Atiyah Ayed Al-Sehli[8], Salman Salim Salah Al-Suhaimi[9], Abdullah Abduslam M. Alessa[10], Turki Hassen Al Ahmadi[10], Fahad Hythem Mohammed Mugharbel[11]

[1]Pharmacy Technician, Madinah Cardiac Center, Khalid Ibn Al Walid Rd, Al Jamiah, Madinah 42351, Saudi Arabia
[2]Pharmacy Technician, Princess Fahda bint Al-Aasi Al-Shuraim Center, Madinah Health Cluster, Madinah Province, Saudi Arabia
[3]Family Medicine, Al-Aziziyah, Primary Health Care Center (Al Aziziyah PHC), Al Aziziyah, Riyadh 14515, Saudi Arabia
[4]Medina Central Blood Bank- Ministry of Health Branch in the Medina, Madinah, Saudi Arabia
[5]General Practitioner, Ministry of Health Branch in the Medina, Madinah, Saudi Arabia
[6]Pharmacy Technician, Ministry of Health Branch in the Medina, Madinah, Saudi Arabia
[7]Pharmacy Technician, Madinah Health Cluster-Pharmacy Department Madinah, Saudi Arabia
[8]Health Inspector, Al-Hindiyah Health Center, Madinah Health Cluster, Saudi Arabia
[9]Pharmacy Technician, Al-Hindiyah Health Center, Madinah Health Cluster, Saudi Arabia
[10]Ministry of Health Branch in the Medina, Madinah, Saudi Arabia
[11]Al Haram Hospital-Madinah, Al Madinah Al Munawwarah 42312, Saudi Arabia

[*]Corresponding author: Ahlam Rabee Alhujaili

Abstract

Diabetes mellitus is a chronic metabolic disorder requiring sustained, daily decisions regarding medication use, nutrition, physical activity, glucose monitoring, and prevention of complications. Despite advances in pharmacotherapy and diabetes technologies, many individuals do not achieve or maintain individualized glycemic targets. Pharmacists are accessible medication experts who can complement physician-led care through structured education, medication review, adherence support, and ongoing self-management coaching. This narrative review examines the contribution of pharmacist-led diabetes education and self-management support to glycemic control, with particular emphasis on glycated hemoglobin (HbA1c), medication adherence, self-care behaviors, and patient-centered outcomes. Evidence from systematic reviews and meta-analyses indicates that pharmacist-led interventions are associated with clinically meaningful reductions in HbA1c compared with usual care. A meta-analysis of 24 studies involving 3,610 participants reported a pooled HbA1c reduction of approximately 0.71 percentage points, while another review of 11 randomized trials involving 1,544 participants found a reduction of 0.66 percentage points. Interventions commonly include individualized counseling, diabetes and medication education, lifestyle guidance, glucose-monitoring instruction, medication reconciliation, identification of drug-related problems, and follow-up. Benefits are not uniform and may be influenced by baseline glycemia, intervention intensity, continuity,

healthcare setting, and the degree of collaboration with prescribers. Current standards recommend diabetes self-management education and support at diagnosis, periodically thereafter, and when treatment goals or circumstances change. Pharmacists can contribute to these services within their scope and in coordination with the multidisciplinary team. This review concludes that pharmacist-led education and support are valuable components of comprehensive diabetes care, while emphasizing that services should be individualized, outcome monitored, and integrated into collaborative practice.

Keywords: Diabetes Mellitus; Clinical Pharmacy; Pharmacist-Led Education; Self-Management; Hba1c; Medication Adherence; Diabetes Self-Management Education and Support**.**

1. Introduction

Diabetes mellitus represents a major and growing public health challenge, characterized by chronic hyperglycemia and an increased risk of microvascular and macrovascular complications. Its management extends beyond prescribing glucose-lowering medicines: patients make multiple decisions every day about food, activity, medication timing, monitoring, and responding to symptoms. The effectiveness of treatment therefore depends substantially on patients' knowledge, skills, confidence, access to care, and capacity to sustain self-care behaviors. A treatment regimen may be pharmacologically appropriate yet remain ineffective when medicines are not taken as prescribed, administration techniques are incorrect, adverse effects are not addressed, or practical barriers remain unresolved. Diabetes self-management education and support (DSMES) is a structured, person-centered process that helps individuals acquire and apply the knowledge, skills, and behaviors needed for diabetes care. The American Diabetes Association (ADA) recommends that people with diabetes participate in culturally and developmentally appropriate DSMES, with provision at diagnosis, annually or when targets are not met, when complications or psychosocial barriers arise, and during transitions in care. Education should not be limited to a single information session; ongoing reinforcement and collaborative problem-solving are essential [1-2].

Pharmacists are well positioned to contribute because they routinely interact with patients during medication dispensing, refill encounters, clinical reviews, and ambulatory visits. Their expertise includes medication selection and use, adherence assessment, drug interactions, adverse effects, storage, dosing devices, and treatment-related education. In diabetes care, these activities can be combined with counseling on lifestyle behaviors, glucose monitoring, risk reduction, and referral when additional clinical assessment is required. Evidence syntheses have consistently reported improvements in glycemic control following pharmacist-led interventions. The objective of this narrative review is to describe the mechanisms and components of pharmacist-led diabetes education and self-management support, evaluate the evidence concerning glycemic control, discuss additional patient-centered outcomes and implementation considerations, and identify priorities for effective pharmacy practice [3-5].

2. Review Approach

This article is a narrative review rather than a new systematic review or original clinical investigation. The discussion is based on relevant peer-reviewed systematic reviews, meta-analyses, randomized controlled studies, consensus reports, and professional guidelines identified through literature-oriented searches of PubMed-indexed and other scholarly sources. Key themes included pharmacist-led

diabetes education, self-management interventions, glycemic control, HbA1c, medication adherence, diabetes education and support, and collaborative pharmacy care. Priority was given to evidence syntheses and authoritative recommendations, alongside selected individual studies that illustrate service models. No new patient data were collected, no pooled analysis was conducted by the authors, and no original effect estimate is claimed. The narrative selection process is not presented as exhaustive; consequently, this review should not be interpreted as a PRISMA-compliant systematic review.

3. Diabetes Self-Management Education and Support

3.1 Concept and purpose

DSMES combines education with ongoing support to translate knowledge into daily practice. It addresses clinical, behavioral, emotional, and social dimensions of diabetes, and supports informed decision-making, self-efficacy, problem-solving, and collaboration with the healthcare team. Its purpose is not simply to deliver facts but to help patients develop routines that are feasible in their own circumstances. A person-centered approach acknowledges that work schedules, household responsibilities, food availability, health literacy, language, financial constraints, cultural beliefs, and family support may shape the ability to follow a care plan [2].

3.2 Core self-care domains

Commonly described domains include healthy eating, physical activity, medication-taking, monitoring, risk reduction, healthy coping, and problem-solving. These behaviors are interdependent. For example, understanding the relationship between meals and glucose readings may improve monitoring skills, while knowledge of medication-associated hypoglycemia can inform safe activity planning. Pharmacists can reinforce these domains and identify situations requiring referral to a dietitian, diabetes educator, physician, mental-health professional, or other specialist [2,3].

3.3 Timing and continuity

Education is most useful when linked to a clinical need or transition. Important opportunities include diagnosis, initiation or intensification of medication, changes in insulin or injectable therapy, persistently elevated HbA1c, recurrent hypoglycemia, newly identified complications, hospital discharge, and changes in life circumstances. The ADA recommends periodic reassessment and the use of behavioral strategies such as motivational interviewing, goal setting, and problem-solving. Repeated, brief contacts may help reinforce skills more effectively than relying on one-time counseling, although optimal frequency should be individualized [1].

4. Roles of the Pharmacist in Diabetes Education

4.1 Medication education and optimization

Pharmacists explain the purpose, expected benefits, administration, timing, missed-dose instructions, common adverse effects, and safety considerations of prescribed medicines. Counseling may cover oral glucose-lowering agents, insulin, and other injectable therapies. Correct use of insulin pens, injection-site rotation, needle disposal, storage, and device priming can be demonstrated and checked using teach-back. For medicines with hypoglycemia risk, patients should understand recognition and appropriate response, including when urgent assistance is required. Pharmacists should avoid

independently changing prescriptions unless authorized under local law and collaborative practice arrangements.

4.2 Medication adherence support

Nonadherence can be intentional or unintentional. Common contributors include complex regimens, forgetfulness, cost, concerns about adverse effects, low perceived necessity, stigma, limited understanding, and difficulty obtaining refills. Pharmacists can assess adherence without blame, explore the underlying cause, and collaborate on practical strategies such as regimen simplification by the prescriber, refill synchronization, reminders, pill organizers when appropriate, written schedules, and follow-up. A systematic review of 59 studies reported that pharmacist-led interventions improved adherence-related outcomes, with education and educational materials among intervention approaches associated with benefit [4].

4.3 Nutrition and physical activity counseling

Pharmacists can reinforce general healthy-eating principles, portion awareness, consistent meal patterns when relevant to medication safety, and the importance of individualized nutrition planning. Advice should respect local dietary patterns, affordability, religious or cultural practices, and patient preferences. Detailed medical nutrition therapy is best delivered in collaboration with a qualified dietitian. Physical activity counseling can promote regular activity adapted to functional status and clinical circumstances, while emphasizing precautions for people at risk of hypoglycemia, foot injury, or cardiovascular symptoms. Patients with complex conditions should be referred for individualized medical guidance [4].

4.4 Glucose monitoring and interpretation

Education includes the rationale for monitoring, device selection, technique, timing, meter maintenance, and interpretation of readings in relation to the agreed treatment plan. Pharmacists may teach patients to recognize patterns and record relevant contextual information such as meals, activity, and medication use. Continuous glucose monitoring (CGM) can provide additional information for selected patients, particularly those using insulin or therapies associated with hypoglycemia; recommendations and device choices should be individualized. Pharmacists should not encourage patients to make unsupervised medication adjustments based on isolated readings unless an approved self-titration protocol exists [1,5].

4.5 Prevention and early recognition of complications

Risk-reduction education may address foot care, eye and kidney screening, cardiovascular risk factors, smoking cessation, vaccination, and recognition of warning signs. Pharmacists can reinforce the importance of routine examinations and help patients access services. They should not substitute educational encounters for indicated clinical screening or diagnosis. Foot wounds, acute visual changes, symptoms of severe hypoglycemia, possible ketoacidosis, or other urgent concerns require timely referral or emergency care.

4.6 Psychosocial support and motivational interviewing

Diabetes distress, anxiety, depression, stigma, and treatment burden can interfere with self-management. Empathetic communication and motivational interviewing can help elicit the patient’s

own goals, explore ambivalence, and support achievable behavior change. Instead of judgmental language, pharmacists should use strengths-based phrasing and recognize effort. When psychological distress is significant, referral to qualified professionals is appropriate. Family involvement can be helpful when desired by the patient and when it supports autonomy.

5. Impact on Glycemic Control

5.1 HbA1c as a principal outcome

HbA1c reflects average glycemia over approximately the preceding two to three months and is commonly used to assess longer-term glycemic control. The target should be individualized based on factors such as age, comorbidities, hypoglycemia risk, life expectancy, preferences, and treatment burden. A change in HbA1c is an important outcome, but should be interpreted alongside safety, quality of life, adherence, and patient-defined goals [5].

5.2 Evidence from meta-analyses

Several evidence syntheses support a favorable effect of pharmacist-led education and self-management interventions. A systematic review and meta-analysis including 24 studies and 3,610 participants reported a mean HbA1c reduction of 0.71 percentage points compared with control conditions (95% confidence interval [CI], −0.91 to −0.51; $p<0.0001$) [6]. Interventions included education about diabetes and complications, medicines, lifestyle, and practical self-management skills. The review also reported improvements in selected secondary outcomes, including blood pressure, body mass index, lipid measures, medication adherence, and self-management skills. A separate meta-analysis of 11 randomized trials involving 1,544 adults with type 2 diabetes found that pharmacist-led educational interventions reduced HbA1c by 0.66 percentage points (95% CI, −0.83 to −0.50) relative to usual care [7]. The review also described improvements in self-monitoring of blood glucose and foot-care behaviors. Heterogeneity across studies was moderate to substantial for several outcomes, reflecting differences in intervention design, setting, duration, and participant characteristics.

A systematic review and meta-analysis focused on primary care included 12 studies and found a statistically significant improvement in HbA1c with pharmacist interventions (standardized mean difference −0.67; 95% CI, −0.87 to −0.48) [8]. Its subgroup observations suggested that the magnitude of benefit may vary with baseline HbA1c and intervention characteristics, although subgroup findings should be interpreted cautiously. In addition, a review of pharmacist-led interventions for medication adherence included 59 studies and found improvements across adherence and clinical outcomes. These estimates should not be treated as interchangeable: some reviews report weighted mean differences in HbA1c percentage points, while others report standardized mean differences. They also include overlapping trials, so their participant totals must not be added to estimate a single unique population. Collectively, the evidence supports the conclusion that structured pharmacist involvement can improve glycemic control compared with usual care, but the precise effect expected in an individual service depends on the population and intervention [4].

5.3 Findings from individual trials

Individual studies provide examples of how interventions may operate in practice. In a home-based randomized educational intervention involving 150 participants, pharmacist-delivered education was associated with improvements in diabetes knowledge, medication adherence, and HbA1c in the

intervention group [9]. A multicenter randomized trial of a community pharmacist-involved collaborative care model randomized 264 participants and found a greater HbA1c reduction in the intervention group than in the control group over six months, alongside improvements in self-management and quality of life. These findings support a model that combines patient education with clinical coordination rather than education in isolation [10].

5.4 Potential mechanisms of glycemic improvement

The impact of pharmacist-led support is likely multifactorial. Better understanding of medicines may improve correct administration and adherence; identifying adverse effects can prevent discontinuation; medication review can reveal interactions, duplication, or therapeutic gaps; and lifestyle counseling can support behaviors affecting glucose regulation. Monitoring education can help patients and clinicians recognize patterns, while timely communication with prescribers may facilitate treatment intensification when appropriate. Increased confidence and problem-solving ability may sustain these behaviors. Because many interventions are multicomponent, it is difficult to isolate the contribution of a single element [10].

6. Intervention Components and Delivery Models

6.1 Individual counseling

One-to-one sessions allow tailoring to medication regimens, literacy, glucose patterns, barriers, and preferences. The pharmacist can use open-ended questions, medication lists, teach-back, demonstrations, and a jointly developed action plan. Individual counseling may be particularly useful for insulin education, complex polypharmacy, recurrent hypoglycemia, or sensitive concerns.

6.2 Group education

Group sessions can provide peer support and reach more patients efficiently. Topics may include diabetes basics, healthy eating, physical activity, medication safety, monitoring, and complication prevention. Group formats should allow questions and practical skill practice, and should avoid presenting generalized guidance as a substitute for individualized care.

6.3 Follow-up and telepharmacy

Telephone, video, messaging, or app-supported follow-up may improve continuity, particularly for patients with transportation or scheduling barriers. Digital services can reinforce reminders, capture glucose logs, and provide education, but should account for privacy, digital literacy, connectivity, and accessibility. Remote contacts should include escalation pathways for abnormal readings, adverse effects, or urgent symptoms.

6.4 Collaborative practice

Pharmacist services are most effective when integrated with physicians, nurses, dietitians, diabetes educators, and other team members. A defined referral and communication pathway supports medication-related problem resolution and avoids conflicting recommendations. Collaborative drug therapy management or prescribing authority, where legally permitted, may allow pharmacists to adjust treatment within agreed protocols. Clear documentation, shared goals, and accountability are important.

7. Suggested Structured Pharmacist-Led Program

A practical program can be organized as a sequence of assessment, education, action planning, and reassessment. The following framework is illustrative and should be adapted to local scope of practice and resources.

Table 1. Suggested structured pharmacist-led diabetes education program.

Stage	Core activities	Potential measures
Initial assessment	Review diagnosis, medicines, HbA1c and available glucose records; assess adherence, health literacy, priorities, barriers, hypoglycemia risk, and learning needs.	Baseline HbA1c, medication list, adherence measure, knowledge/self-care assessment
Education encounter	Explain disease and treatment; demonstrate medication/device technique; discuss monitoring, nutrition, activity, risk reduction, and sick-day or hypoglycemia precautions where appropriate.	Teach-back, technique checklist, patient-defined goal
Action planning	Agree on one or more realistic behaviors, support needs, and communication/referral actions; provide written or accessible plan.	Goal documentation, referrals, resolved medication-related problems
Follow-up	Review progress, glucose patterns, adherence, adverse effects, barriers, and goal feasibility; reinforce or adapt education.	HbA1c at clinically appropriate interval, adherence, self-care behavior, safety events
Ongoing review	Coordinate with prescriber/team; reassess when goals are unmet, treatment changes, or life circumstances shift.	Clinical outcomes, patient experience, service utilization

Follow-up intervals should be individualized. HbA1c is generally reassessed at intervals appropriate to the clinical situation and treatment changes, often around three months when evaluating a recent intervention, rather than being measured at every educational contact. The program should prioritize safe, achievable behavior changes and avoid overburdening patients with excessive monitoring or multiple simultaneous goals.

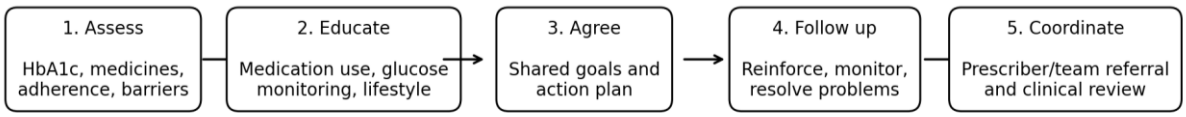

Figure 1. Integrated pharmacist-led diabetes education and self-management support framework (Person-centered, Iterative care, Tailor intensity and referrals to clinical needs).



Figure 2. Illustrative pharmacist counseling session demonstrating diabetes self-management education.



Figure 3. Illustrative visual aids for blood glucose monitoring, healthy eating, physical activity, and medication management.

8. Additional Outcomes Beyond HbA1c

Although glycemic control is a central endpoint, a comprehensive evaluation should include other domains. Medication adherence and persistence indicate whether prescribed treatment is being used as intended. Diabetes knowledge and self-efficacy can assess whether education has improved understanding and confidence. Self-care measures may capture dietary behaviors, activity, monitoring, and foot care. Blood pressure, lipid levels, body weight, and hypoglycemia may reflect broader metabolic and safety outcomes, though these are affected by many factors beyond education. Patient-reported outcomes are also important. Quality of life, diabetes distress, treatment burden, satisfaction, and confidence in managing the condition may reveal benefits or harms that HbA1c alone cannot capture. Healthcare utilization, including emergency visits and hospital admissions, may be relevant for service evaluation, but requires appropriate design and adequate follow-up. Outcomes should be selected before implementation and measured consistently [9-10].

9. Barriers and Challenges

9.1 Patient-level barriers

Limited health literacy, numeracy, language discordance, financial hardship, food insecurity, low access to monitoring supplies, competing responsibilities, and psychosocial distress may limit engagement. Education alone cannot resolve structural barriers. Pharmacists should identify these factors sensitively and connect patients with appropriate clinical, social, or community resources.

9.2 Practice and system barriers

Common challenges include limited consultation time, inadequate reimbursement, lack of private counseling space, insufficient training, restricted access to clinical records, unclear scope of practice, and weak communication between pharmacists and prescribers. Sustainable implementation requires leadership support, defined workflows, documentation standards, referral pathways, training, and a feasible payment or funding model.

9.3 Variability in evidence

Studies differ in intervention content, intensity, provider roles, patient characteristics, comparator care, follow-up duration, and outcome measurement. Some trials are relatively small or have limited follow-up; blinding is often impractical for educational interventions. Usual care also varies across settings. These limitations contribute to heterogeneity and make it difficult to identify a single optimal intervention. Positive average results do not guarantee improvement for every patient or service.

10. Implementation Considerations in Pharmacy Practice

Implementation should begin with a defined target population, such as adults with type 2 diabetes who have elevated HbA1c, adherence difficulties, recent medication changes, or unmet educational needs. Eligibility criteria should be transparent and equitable. Pharmacists delivering the service need competency in diabetes pharmacotherapy, counseling, behavior-change methods, glucose-monitoring devices, hypoglycemia prevention, and referral criteria. Structured templates can support consistent assessment while allowing individualized discussion. Documentation should include the patient's priorities, medicines reviewed, education provided, technique assessed, barriers identified, goals agreed, recommendations communicated, and follow-up plan. Medication-related recommendations should be conveyed to the prescriber when needed. Quality assurance may include periodic review of documentation, patient feedback, referral completion, and clinical outcomes. Programs should also protect confidentiality and use secure communication methods [9-10].

In India and other resource-constrained settings, community and hospital pharmacists may be accessible points for education and adherence support. Local adaptation is important: counseling may need to use regional languages, locally familiar foods and activity examples, low-cost strategies, and practical approaches for patients with limited access to glucose-monitoring devices. The role should be developed within applicable professional regulations and coordinated with the treating clinician.

11. Discussion

The evidence summarized in this review supports pharmacist-led diabetes education and self-management support as a meaningful adjunct to usual care. Across systematic reviews and meta-analyses, interventions are associated with reductions in HbA1c and improvements in medication adherence and selected self-care behaviors. The magnitude of HbA1c reduction reported in evidence syntheses is clinically relevant at a population level, although effects vary and cannot be assumed for every individual. A plausible explanation is that pharmacists address the practical medication-use and behavior-related issues that frequently arise between clinical appointments. An important distinction is that education is not equivalent to simply distributing information. Effective services involve assessment of what a patient already knows, demonstration and practice of skills, discussion of barriers, shared goal setting, and follow-up. The ADA's contemporary DSMES recommendations

emphasize personalized delivery and behavioral strategies. Pharmacists can contribute these approaches while respecting professional boundaries and involving other team members when nutritional, psychological, or medical complexity exceeds their role [1].

The evidence base also has limitations. Reviews include overlapping studies, intervention models are heterogeneous, and the long-term persistence of benefits is not always clear. HbA1c is important but does not capture the entire experience of diabetes management. Program evaluation should therefore incorporate safety, patient-reported outcomes, and implementation indicators. In addition, the pharmacist's contribution may be influenced by the quality of collaboration with prescribers and the ability to access relevant clinical information. Overall, the literature favors integrating pharmacists into multidisciplinary diabetes care rather than treating them as isolated educators. When supported by training, structured pathways, and communication systems, pharmacists can help patients use medicines safely, build self-management skills, and address modifiable barriers to glycemic control.

12. Future Directions

Future research should use adequately powered randomized or pragmatic trials with clearly described pharmacist competencies, intervention components, frequency, and fidelity. Standardized outcome sets would improve comparability across studies. Research should examine durability of HbA1c improvements, cost-effectiveness, patient-reported outcomes, equity, and effects among people with multimorbidity, insulin use, or limited access to care. Component analyses may help determine which combinations of education, medication review, adherence support, and collaborative treatment management are most effective. Digital and hybrid models deserve evaluation, but should be designed to complement rather than replace accessible human support. Implementation studies can assess uptake, workflow, staffing, reimbursement, and sustainability. Further work is also needed to define appropriate referral and escalation processes, and to determine how pharmacist services can be embedded into routine diabetes pathways without duplicating existing care.

Conclusion

Pharmacist-led diabetes education and self-management support can improve glycemic control and reinforce medication adherence, diabetes knowledge, and practical self-care behaviors. Evidence syntheses report average HbA1c improvements in favor of pharmacist interventions, while individual studies demonstrate benefits from home-based education and collaborative pharmacy care. The most promising services are person-centered, continuous, tailored to the patient's needs, and coordinated with the wider healthcare team. Pharmacists should be equipped to provide medication education, adherence support, monitoring instruction, lifestyle reinforcement, and timely referral within their scope of practice. Future studies should strengthen evidence on long-term outcomes, cost-effectiveness, and sustainable implementation. Pharmacist-led support should be considered a complementary component of comprehensive diabetes care, not a replacement for medical management or individualized professional assessment.

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Author contributions:

Data availability: Not applicable; no original dataset was generated.

Author contributions

The initial manuscript was drafted by the first author, who led the literature synthesis, methodology design, and core text development. Project supervision, structural direction, technical validation, and critical review were provided by the corresponding author. All co-authors contributed to identifying data sources, extracting and validating evidence, building comparison tables, and revising the manuscript. The final manuscript was reviewed and approved by all authors for publication.

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