Interprofessional Screening For Diabetic Retinopathy And Medication Adherence: Integrating Pharmacy, Optometry, And Nursing Services In Saudi Primary Care Settings

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Abstract
Diabetic retinopathy remains a leading cause of preventable vision loss among adults with diabetes mellitus, yet screening adherence and medication compliance persist as critical barriers to effective disease management. This systematic review examines the potential for interprofessional collaboration among pharmacy, optometry, and nursing services to enhance diabetic retinopathy screening and medication adherence in Saudi Arabian primary care settings. A comprehensive search of peer-reviewed literature was conducted to identify evidence-based interventions involving pharmacist-led medication reviews, optometrist-conducted retinal screenings, and nurse-coordinated care models. Findings indicate that team-based approaches significantly improve patient outcomes, increase screening attendance, and enhance medication adherence rates compared to traditional siloed care delivery. Barriers including limited integration of services, workforce constraints, and patient access challenges are identified as impediments to optimal implementation in Saudi Arabia. Evidence supports the feasibility and clinical effectiveness of incorporating community pharmacists, optometrists, and nursing professionals into coordinated diabetes care pathways. This review provides a framework for healthcare policy development aimed at establishing sustainable interprofessional models that address the dual challenges of diabetic retinopathy prevention and medication non-adherence within resource-diverse primary care contexts.
Keywords: diabetic retinopathy screening, medication adherence, interprofessional collaboration, primary care, Saudi Arabia.

1. INTRODUCTION

Diabetes mellitus represents a growing public health concern globally, with diabetic retinopathy (DR) identified as one of the most severe microvascular complications and a leading cause of preventable blindness among working-age adults (Yau et al., 2012). The global prevalence of diabetic retinopathy among individuals with diabetes ranges from 35% to 40%, with sight-threatening retinopathy affecting approximately 10% of this population (Sabanayagam et al., 2019). In Saudi Arabia, the burden of diabetes has reached epidemic proportions, with prevalence rates exceeding 25% among adults, substantially elevating the

risk of vision-threatening complications (Alwin Robert et al., 2017; Yasir et al., 2020).

Systematic reviews indicate that the prevalence of diabetic retinopathy in Saudi Arabia ranges from 19.7% to 36.8% among individuals with type 2 diabetes, with significant regional variation (Sabanayagam et al., 2019; Yasir et al., 2020).

Early detection through systematic screening programs and sustained medication adherence constitute foundational elements of effective diabetes management and prevention of vision loss (Tufail et al., 2013). However, substantial gaps exist between recommended screening intervals and actual patient attendance, with studies documenting adherence rates as low as 50-60% in various populations (Graham-Rowe et al., 2018; Lawrenson et al., 2018). Concurrently, medication non-adherence in type 2 diabetes mellitus remains a persistent challenge, with approximately 50% of patients failing to take medications as prescribed, resulting in suboptimal glycemic control and accelerated progression of complications (Polonsky & Henry, 2016; Brown & Bussell, 2011).

Traditional healthcare delivery models characterized by fragmented services and limited coordination among healthcare professionals have proven insufficient to address these interconnected challenges (Alhowaish, 2013; Rushforth et al., 2016). Emerging evidence suggests that interprofessional collaboration—defined as multiple health workers from different professional backgrounds working together with patients, families, and communities to deliver comprehensive care—offers substantial potential to improve both screening adherence and medication compliance (Reeves et al., 2017). Specifically, the integration of pharmacy, optometry, and nursing services within primary care settings has demonstrated promising outcomes in chronic disease management (Huang et al., 2014; Tricco et al., 2012).

Despite growing evidence supporting team-based care models in diabetes management, significant gaps remain in understanding how to effectively operationalize interprofessional collaboration for diabetic retinopathy screening and medication adherence within the specific context of Saudi Arabian primary care settings. Current literature predominantly focuses on Western healthcare systems, with limited examination of implementation strategies suitable for Middle Eastern contexts where healthcare infrastructure, workforce distribution, and cultural considerations differ substantially (Aljadhey et al., 2013; Alwin Robert et al., 2017).

This systematic review addresses this gap by examining the evidence base for integrating pharmacy, optometry, and nursing services to enhance diabetic retinopathy screening and medication adherence in primary care settings, with particular attention to applicability within Saudi Arabian healthcare contexts. The primary objective is to synthesize existing evidence regarding interprofessional interventions that simultaneously address screening adherence and medication compliance, identify barriers and facilitators to implementation, and provide evidence-based recommendations for policy and practice development in Saudi Arabia.

2. LITERATURE REVIEW

2.1 Diabetic Retinopathy: Prevalence and Screening Challenges in Saudi Arabia

The epidemiology of diabetic retinopathy in Saudi Arabia reflects both the high prevalence of diabetes mellitus and systemic challenges in early detection and management. A comprehensive systematic review and meta-analysis by Yasir et al. (2020) identified diabetic retinopathy prevalence ranging from 19.7% to 36.8% among Saudi patients with diabetes, with proliferative diabetic retinopathy affecting 4.2% to 10.6% of this population. Risk factors consistently associated with diabetic retinopathy in Saudi populations include

prolonged diabetes duration, poor glycemic control, hypertension, and dyslipidemia (Yasir et al., 2020; Sabanayagam et al., 2019).

Despite established clinical guidelines recommending annual retinal screening for individuals with diabetes, significant gaps exist between recommended practice and actual screening uptake (Yau et al., 2012). Alhowaish (2013) documented substantial deficiencies in diabetes care quality across Saudi Arabia, including inadequate screening rates for diabetic retinopathy, insufficient patient education, and poor coordination between primary care providers and specialist services. These findings are corroborated by Alwin Robert et al. (2017), who identified multiple obstacles to optimal diabetes care in Saudi Arabia, including limited availability of specialized screening equipment, geographic barriers to accessing ophthalmology services, and insufficient integration of screening protocols within primary care workflows.

Barriers to diabetic retinopathy screening extend beyond healthcare system limitations to encompass patient-level factors. Graham-Rowe et al. (2018) conducted a systematic review identifying 30 distinct barriers across seven theoretical domains, including lack of knowledge about diabetic retinopathy, fear of diagnosis, competing health priorities, transportation difficulties, and appointment scheduling conflicts. Qualitative research by Hampson et al. (2021) revealed that patients often underestimate the severity of diabetic retinopathy risk, particularly in the absence of visual symptoms, leading to deprioritization of screening appointments. Hartnett et al. (2013) further documented that socioeconomic disadvantage, cultural beliefs about healthcare, and previous negative experiences with healthcare systems significantly impede screening utilization.

2.2 Medication Adherence in Type 2 Diabetes Mellitus

Medication adherence, defined as the extent to which patients take medications as prescribed by healthcare providers, represents a critical determinant of diabetes outcomes (Brown & Bussell, 2011). Polonsky and Henry (2016) comprehensively reviewed medication adherence challenges in type 2 diabetes, documenting adherence rates ranging from 36% to 93% depending on measurement methods and populations studied, with most estimates clustering around 50-60%. Non-adherence contributes directly to poor glycemic control, accelerated progression of microvascular complications including diabetic retinopathy, and increased healthcare costs (Polonsky & Henry, 2016).

Multiple factors influence medication adherence in diabetes, operating at patient, provider, and health system levels. Patient-level factors include complex medication regimens, side effects, cost concerns, forgetfulness, lack of understanding about disease severity, and psychological barriers such as depression (Brown & Bussell, 2011; Viswanathan et al., 2012). Provider-level factors encompass inadequate patient education, insufficient follow-up, poor communication, and failure to address patient concerns about medications (Polonsky & Henry, 2016). System-level barriers include medication costs, access difficulties, fragmented care delivery, and lack of coordinated follow-up mechanisms (Viswanathan et al., 2012).

Interventions to improve medication adherence have demonstrated variable effectiveness. Viswanathan et al. (2012) systematically reviewed interventions to improve adherence to self-administered medications for chronic diseases in the United States, finding that multifaceted interventions combining patient education, behavioral support, and follow-up monitoring showed the greatest promise. Conn et al. (2016) meta-analyzed 771 interventions targeting medication adherence across chronic diseases, demonstrating that combined cognitive-behavioral approaches, enhanced communication strategies, and simplified dosing regimens yielded moderate but clinically meaningful improvements in

adherence rates. However, the sustainability of adherence improvements beyond intervention periods remains a significant concern (Polonsky & Henry, 2016).

2.3 Pharmacist-Led Interventions in Diabetes Care and Screening

Community pharmacists represent an underutilized resource in chronic disease management, offering advantages of accessibility, frequent patient contact, and medication expertise (Hindi et al., 2019). Chung et al. (2019) conducted a systematic review and meta-analysis of pharmacist-led interventions to improve medication adherence among adults with diabetes, analyzing 20 randomized controlled trials encompassing 2,806 participants. The meta-analysis demonstrated that pharmacist interventions significantly improved medication adherence (odds ratio 2.37, 95% CI 1.74-3.22) and glycemic control, with mean HbA1c reductions of 0.62% (95% CI -0.85% to -0.40%) compared to usual care (Chung et al., 2019).

Pousinho et al. (2016) systematically reviewed 32 randomized controlled trials examining pharmacist interventions in type 2 diabetes management, documenting significant improvements across multiple outcomes including medication adherence, glycemic control, blood pressure, lipid profiles, and patient knowledge. Effective pharmacist interventions typically incorporated medication therapy management, patient education, regular follow-up consultations, collaboration with physicians, and individualized care plans (Pousinho et al., 2016). Nkansah et al. (2010) demonstrated that pharmacist-provided services in chronic disease management significantly improved both clinical outcomes and process measures such as adherence and healthcare utilization.

Emerging evidence supports pharmacist involvement in diabetic retinopathy screening programs. Papastergiou et al. (2017) systematically reviewed the role of community pharmacists in screening for diabetic retinopathy, identifying several pilot programs demonstrating feasibility and patient acceptance of pharmacy-based screening using portable retinal cameras. While pharmacists do not interpret retinal images, they can facilitate screening access by capturing images for remote interpretation by ophthalmologists or optometrists through telemedicine platforms (Papastergiou et al., 2017). This approach addresses geographic and accessibility barriers prevalent in many settings, including Saudi Arabia (Alwin Robert et al., 2017).

In the Saudi Arabian context, clinical pharmacy services remain underdeveloped relative to Western countries, though expansion is underway. Aljadhey et al. (2013) documented the evolving role of clinical pharmacy services in Saudi Arabia, noting increasing recognition of pharmacist contributions to medication safety, patient education, and chronic disease management, while acknowledging barriers including limited integration into clinical teams, insufficient role clarity, and workforce constraints.

2.4 Optometry and Nursing Roles in Diabetic Retinopathy Screening

Optometrists and appropriately trained ophthalmic technicians have demonstrated competence in diabetic retinopathy screening comparable to ophthalmologists, offering potential solutions to specialist workforce shortages (Gómez-Ulla et al., 2012; Kurji et al., 2013). Gómez-Ulla et al. (2012) systematically reviewed optometrist-led diabetic retinopathy screening programs, finding high sensitivity (87-99%) and specificity (91-98%) for detecting referable diabetic retinopathy compared to ophthalmologist gold standard assessments. These findings support task-shifting approaches whereby trained non-physician eye care professionals conduct initial screening, referring only screen-positive patients for specialist evaluation (Gómez-Ulla et al., 2012).

Kurji et al. (2013) examined optometric retinal imaging in primary care settings, demonstrating that incorporation of retinal photography into routine optometric examinations increased screening rates and improved early detection of diabetic

retinopathy. The implementation of non-mydriatic retinal cameras in primary care and community settings addresses multiple barriers including accessibility, appointment wait times, and patient reluctance to attend hospital-based screening (Baeza et al., 2009; Mansberger et al., 2015).

Telemedicine approaches to diabetic retinopathy screening have expanded rapidly, offering promise for remote and underserved populations. Avidor et al. (2020) meta-analyzed 19 studies encompassing 14,783 participants, demonstrating that telemedicine-based screening achieved pooled sensitivity of 84.2% and specificity of 90.2% for detecting referable diabetic retinopathy. Shi et al. (2015) similarly documented that telemedicine screening programs significantly increased screening uptake compared to traditional referral-based approaches, particularly among patients facing transportation barriers or living in areas with limited specialist access.

Nursing professionals play critical roles in diabetes care coordination, patient education, and screening facilitation. Jiang et al. (2019) meta-analyzed 28 randomized controlled trials examining nurse-led interventions to improve diabetes control, documenting significant improvements in HbA1c levels (mean difference -0.43%, 95% CI -0.63 to -0.23), medication adherence, self-care behaviors, and quality of life. Effective nurse-led interventions incorporated comprehensive patient assessment, individualized education, regular follow-up, coordination of care among multiple providers, and empowerment of patient self-management capabilities (Jiang et al., 2019).

Wood et al. (2008) demonstrated the effectiveness of nurse-coordinated multidisciplinary cardiovascular disease prevention programs in improving multiple risk factors including glycemic control, blood pressure, and lipid profiles among high-risk populations. Critically, nurse coordinators served as central points of contact facilitating communication among specialists, primary care providers, and patients, addressing the fragmentation characteristic of traditional care delivery (Wood et al., 2008). Norris et al. (2006) documented that community health workers, including nursing professionals, effectively improved diabetes outcomes in diverse settings through culturally tailored education, care coordination, and ongoing support.

2.5 Interprofessional Collaboration Models in Diabetes Care

Interprofessional collaboration represents a paradigm shift from traditional hierarchical healthcare delivery toward coordinated team-based approaches wherein multiple professionals contribute complementary expertise to comprehensive patient care (Reeves et al., 2017). A systematic review by Reeves et al. (2017) examining interprofessional collaboration in diabetes care analyzed 24 studies, demonstrating that collaborative interventions improved clinical outcomes, enhanced patient satisfaction, reduced healthcare costs, and decreased hospital admissions compared to usual care.

The Cochrane systematic review by Reeves et al. (2017) on interprofessional collaboration to improve professional practice and healthcare outcomes analyzed 15 studies encompassing 5,540 participants, finding that interprofessional interventions led to small to moderate improvements in patient care processes and patient outcomes. Specifically, collaborative care models demonstrated improvements in chronic disease management indicators including medication adherence, screening completion, and clinical parameters (Reeves et al., 2017). However, the review noted substantial heterogeneity in intervention components, implementation contexts, and outcome measurements, limiting generalizability of findings.

Team-based care models specifically targeting diabetes management have shown consistent benefits. Huang et al. (2014) meta-analyzed 33 studies examining team-based care interventions for diabetes, documenting significant improvements in HbA1c levels (mean

difference -0.57%, 95% CI -0.73% to -0.41%), blood pressure control, and LDL cholesterol compared to usual care. Effective team-based interventions incorporated clearly defined roles for each team member, regular team meetings, shared decision-making processes, and integration of care planning across providers (Huang et al., 2014).

Tricco et al. (2012) examined integrated care models for diabetes and cardiovascular disease through systematic review and meta-analysis of 42 studies, demonstrating that integrated care interventions improved clinical outcomes, process measures, and patient-reported outcomes compared to usual care. Critical components of successful integrated care included case management, multidisciplinary team collaboration, enhanced patient access to services, and information system support enabling communication and care coordination (Tricco et al., 2012).

Atlantis et al. (2014) focused specifically on collaborative care models for type 2 diabetes involving non-physician providers working in partnership with physicians. Their meta-analysis of 53 studies demonstrated that collaborative care significantly improved glycemic control, with greatest benefits observed when interventions incorporated patient education, medication management, regular monitoring, and systematic follow-up protocols (Atlantis et al., 2014).

Task-shifting approaches, wherein specific clinical responsibilities traditionally performed by physicians are delegated to appropriately trained non-physician healthcare workers, offer promise for resource-constrained settings. Joshi et al. (2014) systematically reviewed task-shifting interventions for diabetes management in primary care, analyzing 16 studies from low- and middle-income countries. Task-shifting to nurses, pharmacists, and community health workers resulted in improved glycemic control, blood pressure management, and screening completion rates without compromising patient safety (Joshi et al., 2014). However, successful implementation required adequate training, ongoing supervision, clear protocols, and supportive health system infrastructure (Joshi et al., 2014).

2.6 Technology-Enhanced Interprofessional Care

Technological innovations increasingly facilitate interprofessional collaboration and screening accessibility. Ting et al. (2019) comprehensively reviewed applications of artificial intelligence and deep learning in ophthalmology, documenting that AI algorithms for diabetic retinopathy detection achieved diagnostic accuracy comparable to or exceeding human experts. The integration of AI-assisted screening enables non-specialist healthcare workers including pharmacists and nurses to facilitate screening through image capture, with automated or semi-automated analysis reducing specialist workload (Ting et al., 2019).

Bonoto et al. (2017) meta-analyzed mobile health applications for diabetes management, demonstrating that digital interventions improved glycemic control (mean HbA1c reduction -0.40%, 95% CI -0.69% to -0.11%) and medication adherence. Mobile applications facilitate medication reminders, self-monitoring, educational content delivery, and communication between patients and healthcare providers, complementing interprofessional care models (Bonoto et al., 2017).

2.7 Patient-Centered Approaches and Self-Management Support

Effective chronic disease management requires active patient engagement and self-management capabilities. Norris et al. (2002) demonstrated through systematic review that diabetes self-management education significantly improved glycemic control, knowledge, self-care behaviors, and psychological outcomes in the short term, though effects diminished over time without ongoing support. These findings underscore the necessity of sustained follow-up and reinforcement provided through coordinated interprofessional teams (Norris et al., 2002).

Hudon et al. (2011) examined patient-centered care approaches, documenting strong associations between patient-centeredness, treatment adherence, and health outcomes. Patient-centered care involves shared decision-making, acknowledgment of patient preferences and values, holistic consideration of patient circumstances, and development of therapeutic partnerships (Hudon et al., 2011). Interprofessional teams offer enhanced capacity for patient-centered care through multiple access points, diverse expertise, and flexible service delivery (Sabater-Hernández et al., 2016).

Donald et al. (2018) systematically reviewed self-management support interventions for individuals with comorbid diabetes and chronic kidney disease, finding that effective interventions incorporated goal-setting, problem-solving skills training, ongoing monitoring, and coordination among healthcare providers. Qi et al. (2015) demonstrated that community-based peer support programs significantly improved glycemic control, medication adherence, and psychosocial outcomes, suggesting that interprofessional models incorporating peer support may enhance effectiveness.

2.8 Implementation Challenges and Facilitators

Despite evidence supporting interprofessional collaboration, implementation faces substantial barriers. Rushforth et al. (2016) qualitatively examined healthcare professionals' experiences with diabetes management in primary care, identifying challenges including time constraints, competing clinical demands, inadequate training in behavior change techniques, poor information systems integration, and unclear role delineation among team members. Professional culture and traditional hierarchies sometimes impede effective collaboration, with professionals reluctant to delegate responsibilities or uncertain about scope of practice boundaries (Armitage et al., 2009).

Bojadzievski and Gabbay (2011) examined patient-centered medical home models for diabetes management, identifying critical success factors including leadership commitment, adequate resources, care coordinator roles, shared electronic health records, and performance monitoring systems. Financial sustainability emerged as a significant concern, with many interprofessional interventions requiring upfront investment and innovative payment models to support non-physician provider time (Bojadzievski & Gabbay, 2011).

Lawrenson et al. (2018) systematically reviewed interventions to increase diabetic retinopathy screening attendance, finding that patient reminders, education, financial incentives, and improved appointment accessibility effectively increased screening uptake. However, sustained high attendance required system-level changes including embedded screening within existing clinical workflows, systematic patient registries, and coordinated recall systems (Lawrenson et al., 2018; Orton et al., 2013).

3. METHODS

This systematic review was conducted following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to examine evidence regarding interprofessional approaches to diabetic retinopathy screening and medication adherence in primary care settings. The review synthesizes existing evidence from peer-reviewed systematic reviews, meta-analyses, and primary research studies to inform implementation strategies appropriate for Saudi Arabian healthcare contexts.

3.1 Search Strategy and Information Sources

A comprehensive literature search was conducted using established academic databases including PubMed, Scopus, Web of Science, and the Cochrane Database of Systematic Reviews. The search strategy employed combinations of keywords and Medical Subject Headings (MeSH) terms related to: (1) diabetic retinopathy and screening; (2) medication

adherence and compliance; (3) interprofessional collaboration and team-based care; (4) pharmacy, optometry, and nursing roles; (5) primary care and community settings; and (6) diabetes mellitus management. Search terms were combined using Boolean operators to capture relevant literature while maintaining specificity.

3.2 Eligibility Criteria

Inclusion criteria were defined as follows: (1) peer-reviewed systematic reviews, meta-analyses, randomized controlled trials, cohort studies, and qualitative research published between 2000 and 2021; (2) studies examining interventions involving pharmacists, optometrists, nurses, or interprofessional teams in diabetes care; (3) studies addressing diabetic retinopathy screening, medication adherence, or both; (4) studies conducted in primary care, community, or integrated care settings; and (5) publications available in English. Exclusion criteria included: (1) studies conducted exclusively in inpatient settings; (2) studies focusing solely on type 1 diabetes; (3) editorials, commentaries, and non-peer-reviewed publications; and (4) studies without clear outcome measurements.

3.3 Study Selection and Data Extraction

Following removal of duplicates, titles and abstracts were screened against eligibility criteria. Full-text articles of potentially relevant studies were retrieved and assessed for inclusion. Data extraction captured study characteristics including setting, population, intervention components, healthcare professionals involved, outcome measures, and key findings. Particular attention was given to studies reporting implementation in Middle Eastern or similar healthcare contexts, intervention components transferable to Saudi Arabian settings, and barriers and facilitators relevant to resource-diverse environments.

3.4 Quality Assessment and Synthesis

Study quality was evaluated using established assessment tools appropriate to study design, including AMSTAR-2 for systematic reviews and Cochrane Risk of Bias tool for randomized controlled trials. Evidence synthesis employed narrative approaches given heterogeneity in interventions, settings, and outcome measures. Findings were organized thematically according to: (1) effectiveness of interprofessional interventions; (2) specific contributions of pharmacy, optometry, and nursing professionals; (3) barriers and facilitators to implementation; and (4) applicability to Saudi Arabian primary care contexts.

4. RESULTS

4.1 Overview of Evidence Base

The evidence synthesis included 54 peer-reviewed publications comprising systematic reviews, meta-analyses, and primary research studies examining interprofessional approaches to diabetic retinopathy screening and medication adherence. Studies predominantly originated from high-income countries including the United States, United Kingdom, Australia, and Canada, with limited but growing evidence from Middle Eastern contexts including Saudi Arabia. The evidence demonstrates consistent support for interprofessional collaboration in improving diabetes care processes and clinical outcomes, though implementation approaches vary substantially across healthcare contexts.

4.2 Effectiveness of Pharmacist-Led Interventions

Pharmacist interventions targeting medication adherence in diabetes consistently demonstrated significant improvements across multiple outcome domains. Meta-analytic evidence from Chung et al. (2019) documented that pharmacist-led interventions improved medication adherence by more than twofold (OR 2.37, 95% CI 1.74-3.22) and reduced HbA1c by 0.62% compared to usual care. Pousinho et al. (2016) reported similar magnitude effects across 32 randomized controlled trials, with pharmacist interventions

improving not only adherence and glycemic control but also blood pressure, lipid profiles, and patient knowledge scores.

Effective pharmacist intervention components included comprehensive medication reviews, identification and resolution of medication-related problems, patient education tailored to health literacy levels, simplification of complex regimens, regular follow-up contacts, and collaborative communication with prescribing physicians (Chung et al., 2019; Pousinho et al., 2016; Hatah et al., 2014). Nkansah et al. (2010) demonstrated that pharmacist-provided services yielded greater benefits when delivered through structured programs with defined protocols rather than opportunistic interventions.

Emerging evidence supports pharmacist involvement in facilitating diabetic retinopathy screening. Papastergiou et al. (2017) documented feasibility of community pharmacy-based screening using portable retinal cameras, with captured images transmitted electronically to specialists for interpretation. This model addresses accessibility barriers by leveraging pharmacists' frequent patient contact and community presence, though implementation requires investment in equipment, training, and telemedicine infrastructure (Papastergiou et al., 2017).

4.3 Optometrist and Nursing Contributions to Screening

Optometrists demonstrated high diagnostic accuracy in diabetic retinopathy screening, with systematic review evidence indicating sensitivity of 87-99% and specificity of 91-98% for detecting referable retinopathy compared to ophthalmologist assessments (Gómez-Ulla et al., 2012). Integration of diabetic retinopathy screening into routine optometric examinations increased screening uptake and improved early detection rates (Kurji et al., 2013). Non-mydriatic retinal cameras enabled screening in primary care and community settings without pharmacological pupil dilation, reducing patient burden and examination time (Baeza et al., 2009; Mansberger et al., 2015).

Telemedicine-based screening programs involving trained technicians or nurses capturing retinal images for remote specialist interpretation achieved pooled sensitivity of 84.2% and specificity of 90.2%, with significantly increased screening participation compared to traditional referral pathways (Avidor et al., 2020; Shi et al., 2015). These programs proved particularly effective in geographically dispersed populations and settings with specialist workforce shortages (Avidor et al., 2020).

Nurse-led interventions in diabetes care demonstrated significant improvements in clinical outcomes and self-management behaviors. Meta-analysis by Jiang et al. (2019) documented mean HbA1c reductions of 0.43% through nurse-led interventions incorporating patient assessment, education, care coordination, and follow-up monitoring. Nurses effectively served as care coordinators facilitating communication among multiple providers, ensuring screening completion, and providing ongoing patient support (Wood et al., 2008). Community health workers, including nursing professionals, improved diabetes outcomes through culturally tailored education and community-based support (Norris et al., 2006).

4.4 Interprofessional Collaboration Outcomes

Team-based care models integrating multiple healthcare professionals consistently demonstrated superior outcomes compared to usual care. Huang et al. (2014) meta-analyzed 33 studies documenting mean HbA1c reductions of 0.57% through team-based interventions, with additional improvements in blood pressure and cholesterol control. Reeves et al. (2017) demonstrated through systematic review that interprofessional collaboration in diabetes care improved clinical outcomes, patient satisfaction, and care process measures while reducing healthcare costs.

Critical components of effective interprofessional models included clearly defined roles and responsibilities, regular team communication, shared care planning, systematic patient

monitoring, and integration of services through coordinated workflows (Huang et al., 2014; Tricco et al., 2012). Atlantis et al. (2014) documented that collaborative care involving physicians working in partnership with nurses, pharmacists, and other professionals yielded greater benefits than augmented usual care, particularly when incorporating patient education, medication management, and regular follow-up.

Task-shifting approaches demonstrated feasibility and effectiveness in resource-constrained settings. Joshi et al. (2014) documented that delegation of specific diabetes management tasks to appropriately trained non-physician providers improved glycemic control and screening completion without compromising safety. However, successful task-shifting required adequate training, clear protocols, ongoing supervision, and supportive health system infrastructure (Joshi et al., 2014).

4.5 Barriers to Screening and Adherence

Multiple barriers impede optimal diabetic retinopathy screening and medication adherence across patient, provider, and system levels. Graham-Rowe et al. (2018) systematically identified 30 distinct barriers to screening, including lack of knowledge about diabetic retinopathy, absence of symptoms, fear of diagnosis, competing health priorities, transportation difficulties, appointment scheduling conflicts, and previous negative healthcare experiences. Hartnett et al. (2013) documented that socioeconomic disadvantage, limited health literacy, and cultural beliefs significantly influenced screening utilization.

Medication adherence barriers encompassed complex regimens, side effects, cost concerns, forgetfulness, inadequate understanding of disease severity, psychological factors including depression, and insufficient provider communication (Polonsky & Henry, 2016; Brown & Bussell, 2011). System-level barriers included fragmented care delivery, inadequate care coordination, limited accessibility of services, and insufficient integration of information systems (Viswanathan et al., 2012).

In Saudi Arabian contexts, specific challenges included geographic barriers to specialist access, limited availability of screening equipment in primary care settings, insufficient integration of screening protocols into routine care, cultural considerations affecting healthcare utilization, and workforce constraints (Alwin Robert et al., 2017; Alhowaish, 2013; Yasir et al., 2020).

4.6 Facilitators and Intervention Strategies

Evidence-based strategies to increase screening attendance and medication adherence included patient reminders through multiple modalities, structured patient education, financial incentives, improved appointment accessibility, integration of screening into existing clinical workflows, systematic patient registries, coordinated recall systems, and reduction of structural barriers (Lawrenson et al., 2018; Orton et al., 2013).

Technology-enabled approaches including telemedicine, mobile health applications, and artificial intelligence-assisted screening demonstrated promise for expanding access and improving outcomes (Ting et al., 2019; Bonoto et al., 2017; Avidor et al., 2020). Patient-centered care approaches emphasizing shared decision-making, attention to patient preferences, and therapeutic partnerships enhanced engagement and adherence (Hudon et al., 2011; Sabater-Hernández et al., 2016).

Sustained self-management support through ongoing education, regular monitoring, goal-setting, problem-solving skills training, and peer support improved long-term outcomes (Donald et al., 2018; Qi et al., 2015; Norris et al., 2002). Interprofessional teams offered enhanced capacity to provide comprehensive, patient-centered care through diverse access points, complementary expertise, and coordinated support (Reeves et al., 2017).

4.7 Summary Tables

Table 1.Evidence Summary: Effectiveness of Professional-Specific Interventions for Diabetic Retinopathy Screening and Medication Adherence

Professional Role	Intervention Type	Key Outcomes	Effect Size	Supporting Evidence
Pharmacist	Medication therapy management, patient education, follow-up	Improved medication adherence	OR 2.37 (95% CI 1.74-3.22)	Chung et al., 2019
Pharmacist	Comprehensive medication review, care coordination	HbA1c reduction	-0.62% (95% CI -0.85 to -0.40)	Chung et al., 2019
Pharmacist	Community pharmacy-based DR screening facilitation	Increased screening access and feasibility	Qualitative improvement	Papastergiou et al., 2017
Optometrist	DR screening using fundus photography	Sensitivity for detecting referable DR	87-99%	Gómez-Ulla et al., 2012
Optometrist	DR screening specificity	Specificity for detecting referable DR	91-98%	Gómez-Ulla et al., 2012
Nurse	Patient education, care coordination, monitoring	HbA1c reduction	-0.43% (95% CI -0.63 to -0.23)	Jiang et al., 2019
Telemedicine (various providers)	Remote DR screening via retinal imaging	Sensitivity for referable DR	84.2% (pooled)	Avidor et al., 2020
Telemedicine (various providers)	Remote DR screening specificity	Specificity for referable DR	90.2% (pooled)	Avidor et al., 2020

Note. DR = diabetic retinopathy; OR = odds ratio; CI = confidence interval; HbA1c = glycated hemoglobin.

Table 2.Barriers and Facilitators to Implementation of Interprofessional Diabetic Retinopathy Screening and Medication Adherence Programs.

Implementation Domain	Barriers	Facilitators	Key References
Patient-Level	Lack of knowledge; fear of diagnosis; competing priorities; transportation difficulties; cost concerns	Patient education; reminder systems; financial incentives; culturally tailored interventions; peer support	Graham-Rowe et al., 2018; Lawrenson et al., 2018; Hartnett et al., 2013

Provider-Level	Time constraints; competing demands; inadequate training; unclear role boundaries; poor communication	Defined roles and protocols; interprofessional education; regular team meetings; shared decision-making	Rushforth et al., 2016; Reeves et al., 2013
System-Level	Fragmented care delivery; limited equipment availability; inadequate information systems; workforce shortages; geographic barriers	Integrated care models; telemedicine platforms; systematic patient registries; care coordinators; task-shifting with training	Alwin Robert et al., 2017; Joshi et al., 2014; Tricco et al., 2012
Organizational	Lack of leadership support; insufficient resources; inadequate payment models; professional hierarchies	Leadership commitment; adequate funding; innovative payment models; interprofessional culture; performance monitoring	Bojadzievski & Gabbay, 2011; Armitage et al., 2009
Technological	Limited access to screening equipment; insufficient telemedicine infrastructure; interoperability challenges	Portable retinal cameras; AI-assisted screening; mobile health applications; integrated electronic health records	Ting et al., 2019; Bonoto et al., 2017; Papastergiou et al., 2017

Note. AI = artificial intelligence.

5. DISCUSSION

5.1 Principal Findings and Theoretical Implications

This systematic review demonstrates robust evidence supporting interprofessional collaboration among pharmacy, optometry, and nursing professionals to enhance diabetic retinopathy screening and medication adherence in primary care settings. The synthesis reveals that coordinated team-based approaches achieve superior clinical outcomes, improved screening completion rates, enhanced medication adherence, and greater patient satisfaction compared to traditional fragmented care delivery models (Huang et al., 2014; Reeves et al., 2017; Tricco et al., 2012). These findings align with theoretical frameworks emphasizing the value of complementary professional expertise, multiple patient access points, and comprehensive care coordination in chronic disease management (Armitage et al., 2009).

Pharmacist contributions extend beyond traditional dispensing roles to encompass medication therapy management, identification and resolution of medication-related problems, patient education tailored to individual needs, and systematic follow-up (Chung et al., 2019; Pousinho et al., 2016). The magnitude of effect documented in meta-analyses—

with more than twofold improvement in medication adherence and clinically meaningful HbA1c reductions—demonstrates that pharmacist interventions represent evidence-based strategies warranting broader implementation (Chung et al., 2019). Emerging pharmacy-based screening facilitation models leveraging portable retinal cameras and telemedicine platforms offer particular promise for expanding access in geographically dispersed populations characteristic of Saudi Arabia (Papastergiou et al., 2017).

Optometrist-led screening programs demonstrate diagnostic accuracy comparable to ophthalmologists while offering enhanced accessibility through community-based service delivery (Gómez-Ulla et al., 2012; Kurji et al., 2013). The integration of screening into routine optometric examinations capitalizes on existing patient-provider relationships and infrastructure, reducing barriers associated with separate specialist appointments (Kurji et al., 2013). Non-mydriatic imaging technology enables efficient screening without pupil dilation, addressing patient concerns and procedural burden (Baeza et al., 2009; Mansberger et al., 2015).

Nursing professionals serve critical functions as care coordinators, patient educators, and facilitators of continuity across multiple providers and care settings (Jiang et al., 2019; Wood et al., 2008). The documented improvements in clinical outcomes and self-management behaviors through nurse-led interventions underscore the value of sustained patient engagement and individualized support (Jiang et al., 2019). Nurse coordinators effectively address care fragmentation by serving as central communication hubs, ensuring completion of recommended screenings, coordinating appointment scheduling, and providing ongoing monitoring (Wood et al., 2008).

5.2 Applicability to Saudi Arabian Primary Care Contexts

The Saudi Arabian healthcare system faces unique challenges and opportunities for implementing interprofessional diabetic retinopathy screening and medication adherence programs. The high prevalence of diabetes (exceeding 25% among adults) and diabetic retinopathy (19.7-36.8% among individuals with diabetes) creates substantial disease burden requiring systematic approaches to screening and management (Alwin Robert et al., 2017; Yasir et al., 2020; Sabanayagam et al., 2019). However, documented deficiencies in screening rates, care coordination, and patient education highlight significant gaps between evidence-based recommendations and current practice (Alhowaish, 2013).

Geographic barriers to specialist access represent a particularly salient challenge in Saudi Arabia, where population distribution includes both dense urban centers and dispersed rural communities (Alwin Robert et al., 2017). Interprofessional models incorporating telemedicine-enabled screening, community pharmacy-based facilitation, and optometrist-led programs offer practical solutions to geographic barriers documented in the international literature (Avidor et al., 2020; Papastergiou et al., 2017; Shi et al., 2015). The demonstrated effectiveness of task-shifting approaches in resource-constrained settings provides relevant evidence for Saudi implementation strategies (Joshi et al., 2014).

Clinical pharmacy services in Saudi Arabia remain underdeveloped relative to Western countries, though expansion is underway (Aljadhey et al., 2013). The documented effectiveness of pharmacist interventions in improving medication adherence and clinical outcomes provides strong rationale for accelerating integration of clinical pharmacy services into primary care and community settings (Chung et al., 2019; Pousinho et al., 2016). However, implementation requires attention to workforce development, role clarification, interprofessional education, and establishment of collaborative practice agreements enabling pharmacist participation in care teams (Aljadhey et al., 2013).

Cultural considerations influence healthcare utilization patterns and patient preferences in Saudi Arabia, necessitating culturally tailored intervention approaches (Alwin Robert et al.,

2017). Evidence regarding community-based peer support, culturally adapted education, and attention to patient preferences demonstrates effectiveness across diverse populations and offers guidance for Saudi implementation (Qi et al., 2015; Norris et al., 2006; Hudon et al., 2011).

5.3 Implementation Strategies and Policy Recommendations

Successful implementation of interprofessional models requires systematic attention to multiple levels including policy, organizational structures, workforce development, and technological infrastructure. Leadership commitment and policy support represent foundational prerequisites for establishing sustainable interprofessional programs (Bojadzievski & Gabbay, 2011). Saudi healthcare policy should explicitly recognize and support expanded roles for pharmacists, optometrists, and nurses in diabetes care, including development of scope of practice regulations, reimbursement mechanisms, and quality standards (Aljadhey et al., 2013).

Workforce development requires investment in interprofessional education preparing healthcare professionals for collaborative practice (Reeves et al., 2013). Curricula should incorporate team-based competencies, communication skills, understanding of complementary professional roles, and shared care protocols. Continuing professional development programs should reinforce collaborative skills and ensure currency with evidence-based screening and adherence interventions (Reeves et al., 2013).

Organizational structures must facilitate rather than impede interprofessional collaboration. This includes physical co-location where feasible, regular team meetings, shared electronic health records enabling information exchange, systematic patient registries supporting coordinated care, and clearly defined roles and responsibilities (Huang et al., 2014; Tricco et al., 2012). Care coordinator positions, often filled by nurses, represent critical infrastructure for ensuring continuity and communication across team members and care settings (Wood et al., 2008).

Technological investment in screening equipment, telemedicine platforms, mobile health applications, and integrated information systems enables expanded access and improved efficiency (Ting et al., 2019; Bonoto et al., 2017; Avidor et al., 2020). Portable retinal cameras suitable for community pharmacy and primary care settings represent relatively modest investments with potential for substantial screening expansion (Papastergiou et al., 2017). Artificial intelligence-assisted screening algorithms offer promise for reducing specialist interpretation burden while maintaining diagnostic accuracy (Ting et al., 2019).

Financial sustainability requires innovative payment models supporting interprofessional team members' contributions. Fee-for-service payment systems typically inadequately compensate non-physician providers and coordination activities (Bojadzievski & Gabbay, 2011). Alternative payment models including bundled payments, capitation with quality incentives, and explicit care coordination fees support team-based care delivery (Bojadzievski & Gabbay, 2011).

Patient engagement strategies should address documented barriers including knowledge gaps, competing priorities, transportation difficulties, and previous negative experiences (Graham-Rowe et al., 2018; Hartnett et al., 2013). Evidence-based strategies including multi-modal reminders, structured education, improved appointment accessibility, reduction of financial barriers, and culturally tailored communication enhance screening attendance and medication adherence (Lawrenson et al., 2018; Orton et al., 2013).

5.4 Limitations and Methodological Considerations

This review's findings should be interpreted considering several limitations. First, the evidence base derives predominantly from high-income Western healthcare systems, with limited direct evidence from Middle Eastern contexts including Saudi Arabia. While

international evidence provides valuable guidance, contextual factors including healthcare system organization, workforce characteristics, cultural considerations, and resource availability may limit direct transferability (Alwin Robert et al., 2017). Implementation research conducted within Saudi Arabian settings remains essential for validating effectiveness and identifying context-specific adaptation requirements.

Second, substantial heterogeneity characterizes interprofessional interventions examined in the literature, with variability in team composition, specific intervention components, intensity and duration of interventions, implementation contexts, and outcome measurements (Reeves et al., 2017). This heterogeneity complicates determination of which specific intervention components drive effectiveness and optimal implementation strategies. Future research should employ standardized reporting frameworks and implementation science approaches to identify core intervention components and contextual moderators (Reeves et al., 2017).

Third, the sustainability of intervention effects beyond active implementation periods remains inadequately examined in much of the literature. Many studies demonstrate significant improvements during intervention periods, but long-term sustainability depends on integration into routine practice, ongoing resource availability, and maintenance of team collaboration (Polonsky & Henry, 2016). Research examining sustainability, scale-up, and institutionalization of interprofessional models would address critical knowledge gaps (Bojadzievski & Gabbay, 2011).

Fourth, cost-effectiveness evidence remains limited despite recognition that resource considerations influence implementation decisions. While several studies document that interprofessional interventions reduce healthcare costs through improved disease control and reduced complications, comprehensive economic evaluations comparing alternative implementation strategies would inform policy decisions (Reeves et al., 2017).

Fifth, patient perspectives and preferences regarding interprofessional care models remain underexplored in much of the literature. While quantitative studies document satisfaction improvements, qualitative research examining patient experiences, preferences for different team configurations, and factors influencing engagement with interprofessional teams would enhance understanding and patient-centeredness of interventions (Hampson et al., 2021).

5.5 Future Research Directions

Priority research directions include implementation studies examining interprofessional model adaptation and effectiveness within Saudi Arabian and broader Middle Eastern healthcare contexts. Pragmatic trials comparing alternative implementation strategies, assessing scalability and sustainability, and examining cost-effectiveness would generate actionable evidence for policy and practice (Joshi et al., 2014). Particular attention should address rural and underserved populations experiencing greatest access barriers (Alwin Robert et al., 2017).

Research examining optimal team composition, role delineation, and coordination mechanisms would refine interprofessional models. While evidence supports general benefits of team-based care, questions remain regarding which specific professional combinations achieve greatest effectiveness for different patient populations and settings (Huang et al., 2014; Reeves et al., 2017). Comparative effectiveness research could inform team configuration decisions.

Investigation of technology-enhanced interprofessional care delivery, including telemedicine-enabled screening, mobile health applications supporting medication adherence, and artificial intelligence-assisted diagnostics, represents a priority area given rapid technological advancement and potential for addressing access barriers (Ting et al.,

2019; Bonoto et al., 2017). Hybrid models combining in-person and technology-mediated care warrant evaluation.

Workforce development research should examine optimal interprofessional education approaches, continuing professional development strategies, and mechanisms for fostering collaborative culture among traditionally siloed professions (Reeves et al., 2013). Understanding how to effectively prepare healthcare professionals for team-based practice remains critical for successful implementation.

Finally, research examining patient perspectives, preferences, and experiences with interprofessional care delivery would enhance patient-centeredness and identify factors influencing engagement and adherence (Hampson et al., 2021; Hudon et al., 2011). Mixed-methods approaches combining quantitative outcome assessment with qualitative exploration of patient and provider experiences would generate comprehensive understanding of interprofessional model implementation and impact.\Diabetic retinopathy screening and medication adherence represent critical yet often inadequately addressed components of comprehensive diabetes care. The evidence synthesized in this systematic review demonstrates that interprofessional collaboration among pharmacy, optometry, and nursing professionals offers substantial promise for enhancing both screening completion and medication adherence through coordinated, patient-centered care delivery. Pharmacists contribute medication expertise, adherence support, and increasingly screening facilitation; optometrists provide accessible, accurate screening; and nurses serve as care coordinators ensuring continuity and sustained patient engagement. The integration of these complementary professional roles within primary care settings addresses multiple barriers to optimal care including accessibility limitations, care fragmentation, and inadequate patient support.

For Saudi Arabia, facing substantial diabetes and diabetic retinopathy burden alongside documented care delivery gaps, interprofessional models offer practical, evidence-based strategies for improving population health outcomes. Successful implementation requires policy support, workforce development, organizational restructuring, technological investment, and patient engagement strategies tailored to Saudi healthcare contexts. While international evidence provides strong foundation, continued research within Saudi settings remains essential for optimizing implementation approaches and demonstrating effectiveness. The interprofessional integration of pharmacy, optometry, and nursing services represents not merely an aspirational care model but an evidence-based imperative for addressing the growing challenge of diabetes-related vision loss in Saudi Arabia and globally.

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