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Role of PCP in the Early Detection and Management of Vision Disorders in Primary Healthcare: A Systematic Review

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ABSTRACT

Vision disorders affect over 1.1 billion people globally, with preventable cases contributing significantly to the burden. Primary care physicians (PCPs) are uniquely positioned to address this gap, yet challenges in screening and management persist. This systematic review evaluated the role of PCPs in early detection and management of vision disorders, synthesizing evidence from 11 studies published between 2014 and 2024.

Key findings revealed that instrument-based screening in primary care improved completion rates (54% to 89%) and reduced unnecessary referrals by 15–33.8%. Training interventions enhanced PCP knowledge (70.2% adherence post-training), though systemic barriers like resource limitations hindered long-term impact. Telemedicine demonstrated high detection rates for glaucoma (30%) and diabetic retinopathy (6.8%), with 76.7% follow-up attendance. Shared care models between PCPs and specialists showed comparable outcomes to specialist care, reducing costs by 43–45% for conditions like glaucoma and diabetic retinopathy. However, challenges such as staff turnover, resource gaps, and inconsistent referrals persisted.

The included studies collectively illustrate the feasibility of integrating vision screening and management into primary care, though challenges persist. The review highlights the potential of scalable technologies, multimodal training, and telemedicine to strengthen primary care vision services. Policy recommendations include investing in validated screening tools, standardized shared care protocols, and workforce retention strategies. Future research should explore hybrid care models and task-shifting in low-resource settings. By integrating these strategies, PCPs' pivotal role in reducing preventable vision loss globally will be enhanced.

Keywords: *primary care physicians, vision disorders, early detection, telemedicine, shared care, systematic review..*

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1. INTRODUCTION

Vision disorders represent a significant global public health challenge, affecting over 1.1 billion people worldwide as of 2020,[1] with projections indicating this number could rise to 1.8 billion by 2050.[2] The substantial healthcare and economic burden associated with vision impairment is estimated at $411 billion annually in direct costs worldwide,[3] Despite the.

magnitude of this challenge, approximately 40% of blindness in developed countries remains either preventable or treatable with timely diagnosis and intervention.[4–6] This reality underscores a critical gap in healthcare delivery that primary care physicians (PCPs) are uniquely positioned to address.[6]

Primary care physicians (PCPs) serve as the first line of defense in healthcare systems, with eye-related complaints comprising 2-3% of primary care office visits.[7] However, despite their frequent encounters with patients experiencing visual symptoms, many PCPs face significant challenges in effectively screening for and managing vision disorders. Most adults aged 50-80 seeking regular checkups reported their doctors had not inquired about their vision.[8] This oversight represents a missed opportunity for early intervention, particularly given that conditions such as glaucoma, diabetic retinopathy, and age-related macular degeneration often progress asymptomatically until irreversible damage has occurred.

The role of PCPs in vision care extends beyond simple visual acuity testing. These healthcare professionals are strategically positioned to identify systemic diseases that impact eye health, including diabetes, hypertension, and cardiovascular conditions, which frequently manifest with observable changes in ocular structures.[7,9] Research demonstrates that patients are more likely to undergo eye examinations when their PCP recommends it,[10] highlighting the influential role PCPs play in patient compliance with preventive eye care. Furthermore, PCPs manage chronic conditions such as diabetes and hypertension that significantly increase the risk of vision-threatening complications, making their involvement in eye health surveillance particularly crucial.[9,10] However, traditional approaches to vision screening in primary care settings have been constrained by technological limitations and time pressures. The conventional direct ophthalmoscope, while historically important, presents significant practical challenges in busy primary care environments, including the need for pupil dilation and its narrow field of view. Recent technological advances, including digital fundus photography and optical coherence tomography, offer new opportunities to enhance the effectiveness of vision screening in primary healthcare settings.[11–13]

The integration of systematic approaches to vision screening within primary healthcare has shown promise in various global contexts. Rwanda's national primary eye care program successfully trained 2,707 nurses and conducted nearly one million eye examinations across all health centers, demonstrating the feasibility of task-shifting models in resource-constrained settings.[14] Similarly, evidence from a previous systematic review of global literature indicates that appropriateness of eye care delivery varies widely, across different conditions and healthcare settings,[15] suggesting substantial room for improvement through standardized protocols and enhanced training.

This systematic review aims to comprehensively evaluate the current evidence regarding the role of primary care physicians in the early detection and management of vision disorders within primary healthcare settings. By synthesizing existing research on screening methodologies, training interventions, technological innovations, and patient outcomes, this review seeks to provide evidence-based guidance for enhancing the integration of vision care into routine primary healthcare practice. The findings will inform healthcare policy makers, primary care practitioners, and public health officials working to address the growing global burden of preventable vision loss through improved early detection and intervention strategies.

2. RESEARCH QUESTION

What is the role of primary care physicians in the early detection and subsequent management of vision disorders, compared with standard ophthalmic referral or usual care within primary healthcare settings worldwide?

3. METHODS

Study Design

This systematic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines,[16] synthesizing evidence from diverse sources.

Search Strategy

The search was performed across multiple electronic databases, including PubMed/MEDLINE, Embase, Cochrane Library, Web of Science, Scopus, and CINAHL, to identify relevant peer-reviewed studies. Additionally, manual searches of reference lists from key articles were conducted to identify further relevant studies.

The search strategy utilized a combination of Medical Subject Headings (MeSH) and free-text terms related to primary care physicians, vision disorders, screening methods, and primary healthcare settings. Examples of MeSH and free-text terms used related to: Primary care physicians (*"primary care physician," "family physician," "general practitioner," "PCP"*); vision disorders (*"vision impairment," "eye diseases," "glaucoma," "diabetic retinopathy," "macular degeneration"*); screening and management (*"early detection," "screening," "diagnosis," "management," "telemedicine," "shared care"*); and primary healthcare settings: *"primary care," "community health," "family medicine"*). Boolean operators (AND, OR) were employed to refine the search and ensure comprehensive coverage of relevant literature.

Inclusion and Exclusion Criteria

The following criteria were followed for inclusion of the identified studies

Population: Studies involving PCPs or primary healthcare workers in vision disorder screening and management.

Intervention: Any vision screening tool, training program, telemedicine application, or shared care model implemented in primary care.

Comparison: Standard ophthalmic referral, usual care, or alternative screening methods.

Outcomes: Screening accuracy, referral rates, cost-effectiveness, patient satisfaction, and clinical outcomes.

Study Types: Randomized controlled trials (RCTs), observational studies, quasi-experimental studies.

Language: English-language publications.

Publication Date: To capture recent evidence, we included only English studies published in the last 10 years (2014–2024).

Non-primary research studies, reviews, case reports, editorials, and studies not involving primary care settings were excluded.

Screening Process

The selection process involved two independent reviewers who first screened titles and abstracts for relevance. Full-text articles of potentially eligible studies were then assessed for final inclusion based on the inclusion criteria. Any discrepancies between reviewers were resolved through discussion or consultation with a third reviewer. Figure 1 shows further details of this process.

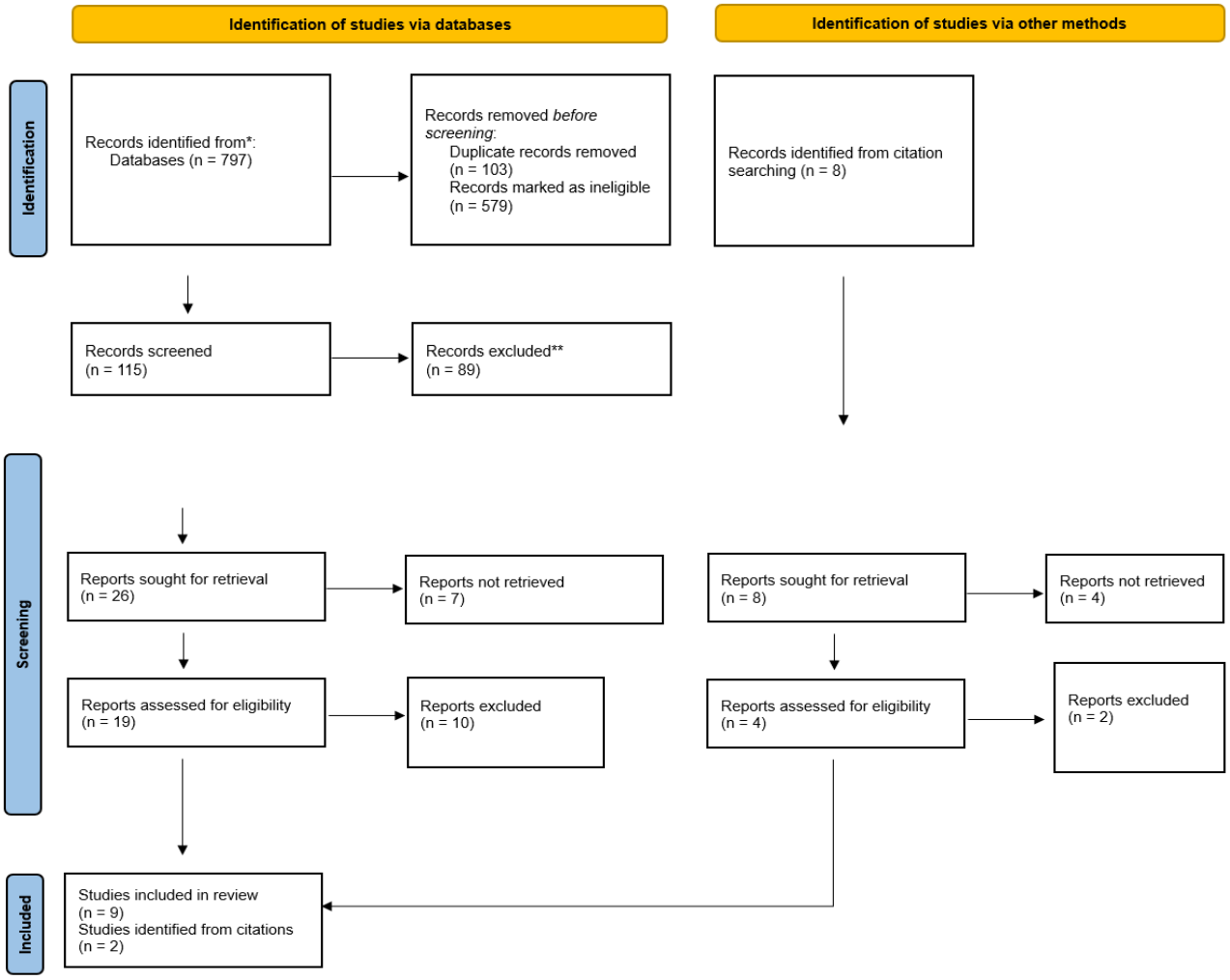

Figure 1. PRISMA Flow chart showing the study selection process

Data Extraction

Data extraction was performed using a standardized form to ensure consistency across studies. Extracted information included study characteristics such as author, year, country, study design, and sample size. Population details encompassed demographics and risk factors, such as diabetes and hypertension. Interventions were categorized by type, including screening tools like digital fundus photography and optical coherence tomography, training programs, and telemedicine applications. Outcomes of interest included screening completion rates, referral rates, diagnostic accuracy, cost savings, and patient satisfaction. Additionally, key findings from each study were documented, along with noted strengths, limitations, and implications for primary care.

Quality Assessment

The methodological quality of included studies was evaluated using appropriate tools based on study design. Randomized controlled trials (RCTs) were assessed with the Cochrane Risk of Bias Tool (RoB 2.0),[17] observational studies with the Newcastle-Ottawa Scale (NOS),[18] and quasi-experimental studies with the Joanna Briggs Institute (JBI) Critical Appraisal Checklist.[19] Studies were categorized as low, moderate, or high risk of bias to ensure the reliability of synthesized evidence.

Data Synthesis

The findings were synthesized, identifying key themes: effectiveness of different screening tools; the impact of training programs on PCP knowledge and practice; the role of telemedicine in improving access and detection rates; shared care models between PCPs and specialists; and systemic challenges such as resource constraints and staff turnover. Subgroup analyses were performed to examine variations by geographic setting (high-income versus low- and middle-income countries), type of vision disorder (such as glaucoma, diabetic retinopathy, or pediatric vision screening), and type of intervention (training, technology, or policy changes). Sensitivity analyses were conducted by excluding studies with a high risk of bias to assess the robustness of the results.

4. RESULTS

Characteristics of included studies

This review included eleven studies published between 2014 and 2024 (Table 1). Study designs varied, including three randomized controlled trials,[20–22] two observational and multi-site studies,[23,24] two randomized quality improvement studies,[25,26] one quasi-experimental and cluster randomized interventions,[27] one randomized non-controlled observational study,[28] one study with mixed methods design,[29] and one retrospective longitudinal analysis study,[30] Sample sizes ranged widely, from small cohorts, such as 39 to 500 participants.[24,28]

Participant groups included preschool children, adults at risk of eye disease, patients with chronic conditions like diabetes or glaucoma, and primary health workers from diverse healthcare settings across both high- and low-income countries.

Table 1. Characteristics of included studies

Authors, year*	Title	Study design	Sample
Modest et al.[26] 2017	Implementation of Instrument-Based Vision Screening for Preschool-Age Children in Primary Care	Cluster randomized quality improvement project	12 pediatric practices
Guven et al.[23] 2022	The effect of education seminars on pediatric vision screening in the primary care settings	Observational study	124
Owsley et al.[24] 2024	Alabama Screening and Intervention for Glaucoma and Eye Health through Telemedicine (AL-SIGHT): Baseline Results.	Observational study, multi-site (implied)	500
Mafwiri et al.[29] 2016	Mixed methods evaluation of a primary eye care training programme for primary health workers in Morogoro, Tanzania.	Mixed methods study; non-controlled; observational; quantitative data analyzed using paired t-test; qualitative data collected through in-depth interviews; purposeful sampling.	116
Anzelic et al.[28] 2019	Preschool Vision Screening Collaborative: Successful Uptake of Guidelines in Primary Care	Randomized non-controlled observational study	Total: 39 Cohort 1: 26 Cohort 2: 13
Kalua et al.[20] 2014	A randomised controlled trial to investigate the effects of enhanced supervision on primary eye care services at health centres in Kenya, Malawi and Tanzania	Randomized controlled trial, multi-site	343
Vernacchio et al.[25] 2019	Effect of Instrument-Based Vision Screening for 3- to 5-Year-Old Children on Referrals to Eye Care Specialists	Randomized quality improvement study	12 practices
Ly et al.[30] 2020	Glaucoma Community Care: Does Ongoing Shared Care Work?	Retrospective, longitudinal, stratified	Total: 266 Ophthalmology-led: 81 Optometry-led: 185
Mathur et al.[21] 2019	Shared Care for Patients with Diabetes at Risk of Retinopathy: A Feasibility Trial	Randomized equivalence trial	Total: 231 PEC: 115 SOC: 116

Goh et al.[22] 2018	Shared Cared for Stable Glaucoma Patients: Economic Benefits and Patient-centered Outcomes of a Feasibility Trial	Randomized equivalence feasibility trial	233
Okwen et al.[27] 2014	Primary eye care skills scores for health workers in routine and enhanced supervision settings.	quasi-experimental, cluster randomized intervention study	25 clinical officers and 35 nurses

Year of publication,* ***AL-SIGHT* *– Alabama Screening and Intervention for Glaucoma and Eye Health through Telemedicine,* ***PEC*** *– Primary Eye Care,* ***PHCWs*** *– Primary Health Care Workers,* ***QI*** *– Quality Improvement,* ***SOC*** *– Specialist Outpatient Clinic*

The findings highlight these key themes, including the impact of screening in primary care, training interventions, telemedicine, shared care models, and systemic challenges.

Effectiveness of screening tools in primary care

Included studies demonstrated that instrument-based vision screening in primary care settings significantly improved screening completion rates and reduced unnecessary referrals to eye care specialists. For instance, Modest et al.[26] found that instrument-based screening increased completed vision screenings among 3- to 5-year-old children from 54% to 89%, with a 15% reduction in referrals. Similarly, Vernacchio et al.[25] reported a 33.8% reduction in visits to eye care specialists and a 15.2% decrease in costs after implementing instrument-based screening. These findings suggest that adopting advanced screening tools in primary care can enhance efficiency and reduce the burden on specialist services.

Impact of training and education

Training programs for PCPs and primary health workers were shown to improve knowledge and screening practices, though systemic barriers often limited their long-term impact. Guven et al.[23] found that education seminars increased adherence to pediatric vision screening recommendations, with 70.2% of physicians performing screenings as advised. However, practice-related barriers, such as time constraints and resource limitations, persisted. Mafwiri et al.[29] reported similar outcomes in Tanzania, where a primary eye care training program improved health workers' knowledge but was hindered by challenges in clinical management and resource availability. Enhanced supervision, as studied by Okwen et al.,[27] led to better knowledge and skills among health workers compared to routine supervision, though high staff turnover remained a limiting factor.

Role of telemedicine in detecting treatable eye conditions in primary care

Telemedicine emerged as a promising approach for detecting treatable eye conditions in primary care. Owsley et al.[24] evaluated a telemedicine screening program in Alabama and found high detection rates for conditions like glaucoma (30%), diabetic retinopathy (6.8%), and cataracts (37.6%). The program also achieved a 76.7% follow-up attendance rate and high patient satisfaction, demonstrating its feasibility and scalability in resource-limited settings.

Shared care models

Shared care models between PCPs, optometrists, and ophthalmologists were effective in managing chronic eye conditions like glaucoma and diabetic retinopathy. Ly et al.[30] showed that optometry-led care for stable glaucoma patients resulted in a 21% re-referral rate to ophthalmologists, with minimal delays in follow-up. Mathur et al.[21] and Goh et al.[22] found that primary eye care clinics provided clinical outcomes comparable to specialist clinics for diabetic retinopathy and glaucoma, respectively, while reducing costs by 43-45%. These models not only improved patient access but also alleviated pressure on specialist services.

Systemic challenges and opportunities

Despite the successes, several studies identified systemic challenges, including high staff turnover, resource limitations, and inconsistent referral systems. Kalua et al.[20] noted that enhanced supervision improved basic eye care knowledge but had a limited clinical impact due to staff attrition. Anzeljc et al.[28] highlighted difficulties in rescreening processes, particularly for younger children, despite overall improvements in guideline adherence. These findings underscore the need for sustainable training, better resource allocation, and integrated referral pathways to maximize the role of PCPs in vision care.

Table 2. Populations, outcomes measured and main findings of included studies

Authors, year*	Population characteristics	Outcome measured	Main findings
Modest et al.[26] 2017	3- to 5-year-old children	completed vision screening at well-child visits, family satisfaction, referrals to eye care specialists	Instrument-based vision screening increased completed screening among 3- to 5-year-old children from 54% to 89% in the phase 1 group and from 65% to 92% in the phase 2 group. Improvement was most marked among 3-year-old children, with completed screening increasing from 39% with chart-based screening to 87% with instrument screening. Instrument screening was associated with a 15% reduction in referrals to eye care specialists and higher family satisfaction.
Guven et al.[23] 2021	Physicians working in primary care settings in Kayseri province of Turkey Group 1: significantly older and more experienced than Group 2	Performance of pediatric vision screening as recommended Frequency of performing the red reflex (RR) test Frequency of referrals to an ophthalmologist	A high rate of reported adherence to pediatric vision screening recommendations was found, with 70.2% of participants performing screening as recommended. Physicians with previous education on vision screening were more likely to perform the red reflex test and less likely to refer patients to an ophthalmologist. Practice-related barriers were identified as a common issue, despite reported high adherence, suggesting insufficient performance of vision screening.
Owsley et al.[24] 2024	At least 18 years of age Mean age: 58 years 45.6% African American and 51.6% White At risk for glaucoma-associated diseases with current diagnosis of GAD Family history of GAD, and diabetes Diabetic retinopathy (6.8%), cataract (37.6%), refractive error (68.4%), and other eye conditions (9.2%)	Rates of disease detection, referral for follow-up, follow-up attendance, and participant satisfaction	Remote diagnostic evaluation revealed a high prevalence of treatable eye conditions, including 30% GAD, 6.8% diabetic retinopathy, 37.6% cataract, 68.4% refractive error, and 9.2% other eye conditions. 47.2% of participants were referred for follow-up examination, with a high attendance rate of 76.7%. Participants were highly satisfied with the screening process and its convenience, supporting the effectiveness and scalability of telemedicine programs in FQHCs.
Mafwiri et al.[29] 2016	Primary Health Workers (Nurses and Clinical Officers) Average time in current position: 5 years	knowledge of eye diseases, clinical management practices, health education practices	The primary eye care training program improved health worker knowledge about eye care in the short term.
	Majority work in dispensaries (90%)		Despite improvements in management decisions, participants often struggled with correct diagnoses, indicating a need for enhanced clinical management skills. The training was well-received, increasing confidence and satisfaction among participants, but its effectiveness was limited by broader systemic issues such as resource availability and referral systems.
Anzelic et al.[28] 2019	Diverse patient population with approximately 45% Medicaid and 49% private insurance Practices located in urban (3 out of 11), rural (3 out of 11), and suburban (5 out of 11) areas Preschool-aged children (3-, 4-, and 5-year-olds)	Percentage of patients with a standardized vision screening attempted during a 3-, 4-, and 5-year well-child visit - Percentage of patients who complete the vision screening Percentage of patients with an abnormal screening result referred for a comprehensive eye examination Percentage of patients with incomplete screens scheduled for a rescreening examination Percentage of patients successfully rescreened	Practitioners improved evidence-based screening attempts for distance visual acuity and stereopsis from 18% to 87% over the first six months and sustained this improvement. Referral rates for abnormal vision screens improved by 59% during the first six months and were maintained throughout the collaborative. Rapid integration and maintenance of preschool vision screening guidelines are feasible in primary care settings, but challenges remain in rescreening processes, especially for 3-year-olds.
Kalua et al.[20] 2014	Primary health care workers (PHCWs) in Kenya, Malawi, and Tanzania High staff turnover (about 75% by the end of the study)	Change in test scores of basic knowledge and skills (points)	The improvements in facilities receiving enhanced supervision were very modest and of questionable clinical significance. The low impact of the intervention may be due to high staff turnover and absenteeism. There was a significant increase in test scores in intervention sites compared to non-intervention sites, but the clinical significance is questioned.
Vernacchio et al.[25] 2019	- 3- to 5-year-old children	Visit rates to eye care specialists (visits per 1000 children per year),	The implementation of instrument-based vision screening resulted in a 33.8% reduction in visits to eye care specialists.

		costs of eye care services (costs per 1000 children per year)	The cost of services by eye care specialists decreased by 15.2% after implementing instrument-based vision screening.
Ly et al.[30] 2020	Diagnosed or suspected of glaucoma Chronic stable glaucoma cases at low risk of vision loss	Re-referral rate to ophthalmology, median intraocular pressure reduction, median time delay between actual and recommended review period	Under half of all follow-up consultations were managed by optometry-led care with a 21% re-referral rate to ophthalmology. Treated patients experienced a median intraocular pressure reduction of 20% and minimal delays in follow-up reviews. Shared care is an effective option for managing chronic stable glaucoma cases at low risk of vision loss.
Mathur et al.[21] 2019	Patients with diabetes at risk of diabetic retinopathy 83.1% had no DR; 16.9% had stable mild non-proliferative DR Patients in PEC group were older compared to SOC group Lower rate of Type 2 diabetes in PEC group Lower monthly income in PEC group Less diabetes-related medication used in PEC group	Clinical management (Correct Clinical Assessment and Satisfactory Management)	Patients with diabetes at risk of diabetic retinopathy received similar clinical care and management at a primary eye care (PEC) setting compared to a specialist outpatient clinic (SOC). Patient satisfaction was equally high in both PEC and SOC settings. Direct costs per patient visit were 45% lower at PEC compared to SOC, indicating significant economic benefits.
Goh et al.[22] 2018	Stable glaucoma patients with no visual field progression or change in management for at least 3 years On a maximum of a single glaucoma medication No previous tube-shunt implant At least 3-year posttrabeculectomy surgery Comprised of glaucoma disc suspects, primary angle closure suspects, ocular hypertension, primary angle closure glaucoma, and primary open angle glaucoma	clinical assessment and management, economic benefits, and patient satisfaction	Glaucoma clinical care and management at primary eye care clinics were as good as those at tertiary specialist outpatient clinics. Patient satisfaction was equally high at both settings. Direct costs per patient visit were 43% lower at primary eye care clinics compared to tertiary specialist outpatient clinics.
Okwen et al.[27] 2014	Health workers based at government dispensaries in Mwanga District	PEC knowledge scores, ability to describe and demonstrate vision testing	Enhanced supervision significantly improved primary eye care knowledge and skills among health workers in Tanzania. The intervention group showed higher mean scores of knowledge and better ability to describe and demonstrate vision testing compared to the routine supervision group. Overall, enhanced supervision was more effective than routine supervision in improving PEC knowledge and skills.

Year of publication, **DR – Diabetic Retinopathy, **GAD** – Glaucoma-Associated Diseases, **FQHCs** – Federally Qualified Health Centers, **PEC** – Primary Eye Care, **PHCWs** – Primary Health Care Workers, **RR** – Red Reflex, **SOC** – Specialist Outpatient Clinic*

5. DISCUSSION

The findings of this systematic review highlight the pivotal role of PCPs in the early detection and management of vision disorders, offering a comprehensive synthesis of evidence that aligns with and expands upon existing literature. The review underscored key themes, including the effectiveness of instrument-based screening, the impact of training interventions, the promise of telemedicine, the viability of shared care models, and persistent systemic challenges.

The review demonstrates that instrument-based vision screening significantly improves screening completion rates and reduces unnecessary referrals to specialists up to 15% reduction in referrals and a 33.8% decline in specialist visits.[25,26] These findings are similar to what was reported by a systematic review by Jonas et al.,[31] which found that automated screening devices in primary care settings increased detection rates for amblyopia and refractive errors by 20–30% compared to traditional methods. However, Jonas et al.[31] also highlighted variability in outcomes based on device type, suggesting that not all technologies are equally effective. This aligns with our findings that the success of instrument-based screening depends on the specific tools used and the context of implementation. Contrastingly, a systematic review by Evans et al.[32] argued that while instrument-based screening is efficient, its cost-effectiveness in low-resource settings remains questionable due to high initial investment costs. This contrasts with our review's findings, which emphasize the long-term cost savings from reduced referrals. The discrepancy may stem from differences in study populations or healthcare systems, underscoring the need for context-specific evaluations.

Training programs for PCPs and primary health workers were shown to improve knowledge and screening adherence (70.2% of physicians adhered to screening guidelines after training), though persistent diagnostic challenges and systemic barriers often limited their long-term impact.[23,29] These results are consistent with those of a previous study, which concluded that short-term training interventions improve PCP confidence but rarely translate into sustained practice changes without ongoing support.[1] Studies further emphasized the importance of multimodal training, combining didactic education with hands-on practice and feedback.[33,34] This approach was not explored in several studies reviewed here, which

may explain the limited clinical impact observed. For instance, Kalua et al.[20] found that enhanced supervision improved test scores but had negligible clinical significance due to high staff turnover. This suggests that training programs must be coupled with systemic support, such as mentorship and resource allocation, to achieve meaningful outcomes.

Telemedicine emerged as a promising tool for detecting treatable eye conditions in primary care, which is supported by a systematic review by Bastawrous et al.,[35] which found that telemedicine programs in low- and middle-income countries (LMICs) increased screening coverage by 40% and reduced time-to-diagnosis for diabetic retinopathy. However, Bastawrous et al.[35] also noted challenges, such as poor internet connectivity and patient reluctance, which were not addressed in the current review. However, other studies found that telemedicine was less effective for conditions requiring immediate intervention, such as acute glaucoma.[36–38] Visual acuity testing, visual field testing, intraocular pressure (IOP) and pachymetry measurements, biomicroscopy examination, including gonioscopy, optic nerve assessment, and the imaging and photographic modalities that are standard of care for glaucoma management are among the many difficulties that virtual telemedicine presents for various aspects of eye care.[39] This highlights the need for hybrid models that combine telemedicine with in-person evaluations for complex cases. The current review's focus on chronic conditions may have overlooked this nuance, suggesting an area for future research.

Shared care models between PCPs, optometrists, and ophthalmologists were effective for managing chronic conditions like glaucoma and diabetic retinopathy, with Ly et al.[30] reporting a 21% re-referral rate and Mathur et al.[21] noting 45% cost savings. These results align with a previous systematic review, which concluded that shared care models for glaucoma reduced specialist workload by 30% without compromising outcomes.[40] However, caution should be present for such models that require rigorous governance to avoid fragmentation of care, a point not explicitly addressed in the current review. However, shared care models for diabetic retinopathy in LMICs have mixed success due to inconsistent referral pathways. This discrepancy underscores the importance of contextual factors, such as healthcare infrastructure and workforce capacity, in determining the viability of shared care.

The review identified systemic barriers, including high staff turnover, resource limitations, and inconsistent referral systems. These challenges are similar to those previously reported, which indicate that up to 60% of vision care programs in LMICs failed due to inadequate funding and workforce shortages.[41,42] Gordois et al.[43] proposed task-shifting as a solution, demonstrating that nurse-led screening programs could reduce costs by 25%. However, the current review's included studies did not explore this strategy in depth, suggesting a gap in the evidence.

Based on this review's findings, these key policy implications and future directions are recommended for improving the early detection and management of vision disorders in primary healthcare. Policymakers should invest in scalable technologies by prioritizing low-cost, portable screening devices that have been validated across diverse settings.[31] This approach can enhance accessibility, particularly in low-resource environments.

Equally important is the adoption of multimodal training strategies that combine education with ongoing mentorship and feedback loops to strengthen provider skills and ensure sustained quality of care.[33] Strengthening telemedicine infrastructure is also essential, with efforts directed toward closing connectivity gaps and improving patient literacy to ensure effective use of digital health services. In addition, the development and implementation of standardized shared care protocols will help establish clear referral pathways and robust quality metrics, facilitating better coordination between primary and specialist care providers.[40] Finally, addressing systemic barriers such as workforce shortages and high turnover requires dedicated funding for workforce retention strategies and task-shifting initiatives, ensuring that services remain available and effective over time

The review had some limitations to consider. Only studies published in English were included, potentially excluding relevant research in other languages. Variability in study designs, populations, interventions, and measured outcomes limits direct comparability and synthesis of findings. Finally, grey literature and unpublished studies were likely underrepresented, which may have skewed the results toward studies with positive findings.

In conclusion, this review underscores the critical role of PCPs in the early detection and management of vision disorders. Instrument-based screening, telemedicine, and shared care models are effective strategies that can be integrated into primary care to improve outcomes and reduce costs. Training interventions enhanced provider knowledge and adherence to screening protocols, although systemic barriers, such as limited resources and high staff turnover, often curtailed their long-term impact. Telemedicine demonstrated high detection rates for conditions like glaucoma and diabetic retinopathy, alongside strong patient satisfaction and follow-up adherence. Shared care models delivered outcomes comparable to specialist-led care while reducing costs and alleviating specialist workload. Across the studies, recurrent challenges included maintaining workforce capacity, ensuring consistent referral pathways, and sustaining improvements over time. Collectively, the evidence underscores that while PCPs can play a pivotal role in reducing preventable vision loss through targeted interventions, success depends on coupling these strategies with systemic support and infrastructure investment.

Addressing systemic barriers through enhanced training, supervision, and resource support is essential for long-term success. Policymakers and healthcare leaders should prioritize these interventions to bridge gaps in vision care delivery and reduce preventable vision loss globally. While the findings align with broader literature on screening, training, and

telemedicine, they also reveal gaps, such as the need for hybrid care models and task-shifting strategies. Future research should explore these areas while addressing contextual barriers to implementation.

REFERENCES

[1] Burton MJ, Ramke J, Marques AP, et al. The Lancet Global Health Commission on Global Eye Health: vision beyond 2020. The Lancet Global Health. 2021;9(4):e489-e551. doi:10.1016/S2214-109X(20)30488-5

[2] Stern J, Yasmin S, Qureshi MB, Bourne R. 2030 In Sight: the future of global eye health. Eye (Lond). 2024;38(11):1979-1980. doi:10.1038/s41433-023-02815-2

[3] WHO. Blindness and Vision Impairment.; 2023. Accessed August 9, 2025. https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment

[4] Lee SY, Gurnani B, Mesfin FB. Blindness. In: StatPearls. StatPearls Publishing; 2025. Accessed August 9, 2025. http://www.ncbi.nlm.nih.gov/books/NBK448182/

[5] Wittenborn JS, Gu Q, Erdem E, et al. The Prevalence of Diagnosis of Major Eye Diseases and their Associated Payments in the Medicare Fee-for-Service Program. Ophthalmic Epidemiology. 2023;30(2):129-141. doi:10.1080/09286586.2021.1968006

[6] Rowe S, MacLean CH, Shekelle PG. Preventing Visual Loss From Chronic Eye Disease in Primary Care: Scientific Review. JAMA. 2004;291(12):1487. doi:10.1001/jama.291.12.1487

[7] Bradford CA, Melson AT. Ocular Complaints, Disease, and Emergencies in the General Medical Setting. Medical Clinics of North America. 2021;105(3):409-423. doi:10.1016/j.mcna.2021.02.002

[8] Ehrlich JR, Ndukwe T, Solway E, et al. Self-reported Eye Care Use Among US Adults Aged 50 to 80 Years. JAMA Ophthalmol. 2019;137(9):1061-1066. doi:10.1001/jamaophthalmol.2019.1927

[9] Ammary-Risch NJ, Huang SuberS. The Primary Care Physician's Role in Preventing Vision Loss and Blindness in Patients With Diabetes. Journal of the National Medical Association. 2011;103(3):281-283. doi:10.1016/S0027-9684(15)30288-1

[10] Mwangi N, Macleod D, Gichuhi S, et al. Predictors of uptake of eye examination in people living with diabetes mellitus in three counties of Kenya. Trop Med Health. 2017;45(1):41. doi:10.1186/s41182-017-0080-7

[11] Grzybowski A, Jin K, Zhou J, et al. Retina Fundus Photograph-Based Artificial Intelligence Algorithms in Medicine: A Systematic Review. Ophthalmol Ther. 2024;13(8):2125-2149. doi:10.1007/s40123-024-00981-4

[12] Watanabe T, Hiratsuka Y, Kita Y, et al. Combining Optical Coherence Tomography and Fundus Photography to Improve Glaucoma Screening. Diagnostics. 2022;12(5):1100. doi:10.3390/diagnostics12051100

[13] Weng CY, Maguire MG, Flaxel CJ, et al. Effectiveness of Conventional Digital Fundus Photography-Based Teleretinal Screening for Diabetic Retinopathy and Diabetic Macular Edema. Ophthalmology. 2024;131(8):927-942. doi:10.1016/j.ophtha.2024.02.017

[14] Yip JLY, Bright T, Ford S, Mathenge W, Faal H. Process evaluation of a National Primary Eye Care Programme in Rwanda. BMC Health Serv Res. 2018;18(1):950. doi:10.1186/s12913-018-3718-1

[15] Ho KC, Stapleton F, Wiles L, et al. Systematic review of the appropriateness of eye care delivery in eye care practice. BMC Health Serv Res. 2019;19(1):646. doi:10.1186/s12913-019-4493-3

[16] Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. Published online March 29, 2021:n71. doi:10.1136/bmj.n71

[17] Nejadghaderi SA, Balibegloo M, Rezaei N. The Cochrane risk of bias assessment tool 2 (RoB 2) versus the original RoB: A perspective on the pros and cons. Health Science Reports. 2024;7(6):e2165. doi:10.1002/hsr2.2165

[18] Lo CKL, Mertz D, Loeb M. Newcastle-Ottawa Scale: comparing reviewers' to authors' assessments. BMC Med Res Methodol. 2014;14(1):45. doi:10.1186/1471-2288-14-45

[19] JBI. Critical Appraisal Tools. Accessed June 7, 2023. https://jbi.global/critical-appraisal-tools

[20] Kalua K, Gichangi M, Barassa E, Eliah E, Lewallen S, Courtright P. A randomised controlled trial to investigate effects of enhanced supervision on primary eye care services at health centres in Kenya, Malawi and Tanzania. BMC Health Serv Res. 2014;14(S1):S6. doi:10.1186/1472-6963-14-S1-S6

[21] Mathur R, De Korne DF, Wong TY, et al. Shared Care for Patients with Diabetes at Risk of Retinopathy: A Feasibility Trial. Int J Integr Care. 2019;19(3):18. doi:10.5334/ijic.4208

[22] Goh D, De Korne DF, Ho H, et al. Shared Cared for Stable Glaucoma Patients: Economic Benefits and Patient-centered Outcomes of a Feasibility Trial. Journal of Glaucoma. 2018;27(2):170-175.

doi:10.1097/IJG.0000000000000852

[23] Guven S. The effect of education seminars on pediatric vision screening in the primary care settings. Int Ophthalmol. 2022;42(2):635-644. doi:10.1007/s10792-021-02037-z

[24] Owsley C, Swain TA, McGwin G, et al. Alabama Screening and Intervention for Glaucoma and Eye Health through Telemedicine (AL-SIGHT): Baseline Results. American Journal of Ophthalmology. 2024;257:66-75. doi:10.1016/j.ajo.2023.09.001

[25] Vernacchio L, Trudell EK, McLaughlin SR, Bhambhani V. Effect of Instrument-Based Vision Screening for 3- to 5-Year-Old Children on Referrals to Eye Care Specialists. Clin Pediatr (Phila). 2019;58(5):541-546. doi:10.1177/0009922819832020

[26] Modest JR, Majzoub KM, Moore B, Bhambhani V, McLaughlin SR, Vernacchio L. Implementation of Instrument-Based Vision Screening for Preschool-Age Children in Primary Care. Pediatrics. 2017;140(1):e20163745. doi:10.1542/peds.2016-3745

[27] Okwen M, Lewallen S, Courtright P. Primary eye care skills scores for health workers in routine and enhanced supervision settings. Public Health. 2014;128(1):96-100. doi:10.1016/j.puhe.2013.10.007

[28] Anzeljc S, Ziemnik L, Koscher S, Klein W, Bridge C, Van Horn A. Preschool Vision Screening Collaborative: Successful Uptake of Guidelines in Primary Care. Pediatric Quality & Safety. 2019;4(6):e241. doi:10.1097/pq9.0000000000000241

[29] Mafwiri MM, Jolley E, Hunter J, Gilbert CE, Schmidt E. Mixed methods evaluation of a primary eye care training programme for primary health workers in Morogoro Tanzania. BMC Nurs. 2016;15(1):41. doi:10.1186/s12912-016-0163-5

[30] Ly A, Wong E, Huang J, et al. Glaucoma Community Care: Does Ongoing Shared Care Work? Int J Integr Care. 2020;20(3):5. doi:10.5334/ijic.5470

[31] Jonas DE, Amick HR, Wallace IF, et al. Vision Screening in Children Ages 6 Months to 5 Years: A Systematic Review for the U.S. Preventive Services Task Force. Agency for Healthcare Research and Quality (US); 2017. Accessed August 10, 2025. http://www.ncbi.nlm.nih.gov/books/NBK487841/

[32] Evans JR, Morjaria P, Powell C. Vision screening for correctable visual acuity deficits in school-age children and adolescents. Cochrane Eyes and Vision Group, ed. Cochrane Database of Systematic Reviews. 2018;2018(2). doi:10.1002/14651858.CD005023.pub3

[33] Sharma A. Strategies to Improve the Accuracy of Vision Measurement by Teachers in Rural Chinese Secondary Schoolchildren. Arch Ophthalmol. 2008;126(10):1434. doi:10.1001/archopht.126.10.1434

[34] Deshmukh ND, Thakur SA, Ret. S K Somaya Vinay Mandir Junior College, India. Integrating multimodal teaching strategies into stem education: reflections from pre-service and in-service teacher workshop experiences. In: SCIENCE AND TECHNOLOGY EDUCATION: EXPECTATIONS AND EXPERIENCES. Scientia Socialis Press; 2025:71-85. doi:10.33225/BalticSTE/2025.71

[35] Bastawrous A, Giardini ME, Bolster NM, et al. Clinical Validation of a Smartphone-Based Adapter for Optic Disc Imaging in Kenya. JAMA Ophthalmol. 2016;134(2):151. doi:10.1001/jamaophthalmol.2015.4625

[36] Liu H, Ying S, Kamat S, et al. The Role of Telemedicine in Glaucoma Care Triggered by the SARS-CoV-2 Pandemic: A Qualitative Study. OPTH. 2023;Volume 17:2251-2266. doi:10.2147/OPTH.S418502

[37] Meshkin RS, Armstrong GW, Hall NE, Rossin EJ, Hymowitz MB, Lorch AC. Effectiveness of a telemedicine program for triage and diagnosis of emergent ophthalmic conditions. Eye. 2023;37(2):325-331. doi:10.1038/s41433-022-01940-8

[38] Lam PY, Chow SC, Lai JSM, Choy BNK. A review on the use of telemedicine in glaucoma and possible roles in COVID-19 outbreak. Survey of Ophthalmology. 2021;66(6):999-1008. doi:10.1016/j.survophthal.2021.03.008

[39] Thomas SM, Jeyaraman M, Hodge WG, Hutnik C, Costella J, Malvankar-Mehta MS. The Effectiveness of Teleglaucoma versus In-Patient Examination for Glaucoma Screening: A Systematic Review and Meta-Analysis. Acott TS, ed. PLoS ONE. 2014;9(12):e113779. doi:10.1371/journal.pone.0113779

[40] Azuara-Blanco A, Banister K, Boachie C, et al. Automated imaging technologies for the diagnosis of glaucoma: a comparative diagnostic study for the evaluation of the diagnostic accuracy, performance as triage tests and cost-effectiveness (GATE study). Health Technol Assess. 2016;20(8):1-168. doi:10.3310/hta20080

[41] Resnikoff S, Felch W, Gauthier TM, Spivey B. The number of ophthalmologists in practice and training worldwide: a growing gap despite more than 200 000 practitioners. Br J Ophthalmol. 2012;96(6):783-787. doi:10.1136/bjophthalmol-2011-301378

[42] Resnikoff S, Lansingh VC, Washburn L, et al. Estimated number of ophthalmologists worldwide (International Council of Ophthalmology update): will we meet the needs? Br J Ophthalmol. 2020;104(4):588-592. doi:10.1136/bjophthalmol-2019-314336

[43] Gordois A, Cutler H, Pezzullo L, et al. An estimation of the worldwide economic and health burden of visual impairment. Global Public Health. 2012;7(5):465-481. doi:10.1080/17441692.2011.634815