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Evaluating the Clinical Competency of Ophthalmic Paramedical Staff in Early Detection of Retinal Disorders

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ABSTRACT

Retinal disorders such as diabetic retinopathy, age-related macular degeneration, and retinal vein occlusion can lead to irreversible vision loss; hence, early and timely identification is essential. Optometrists, ophthalmic technicians, and vision screeners are all included under the umbrella term of ophthalmic paramedical staff who are key to performing screening, pre-diagnosis, and referral at the community level. This review compiles current literature relating to the personnel of ophthalmic paramedics and their ability to retain qualification in successfully diagnosing retinal lesions in the preclinical stage. Studies were searched in databases such as PubMed, Scopus, and Web of Science from 2000 to 2025, including training protocols, diagnostic accuracy or skill assessment tools and teleophthalmology integration. Studies have shown that the use of structured training programs, standardized screening protocols, and availability of advanced imaging technologies (including fundus photography and optical coherence tomography) greatly improve diagnostic sensitivity and specificity. Nevertheless, competency will still vary among generalists owing to their education, scopes of practice, and the healthcare infrastructure of their regions. It emphasises the importance of world harmonization of competency frameworks, continuing professional development, clinical redesign and incorporation of AI-assisted screening to enhance the function of paramedicals. There needs to be a robust effort to improve the clinical skills of ophthalmic paramedical staff, because an early diagnosis saves time and money and has the potential to avoid sight loss—one or two missed clinical signs can result in a diagnostic delay that may have otherwise been easily avoided, helping to free up ophthalmologists, especially in a setting with limited resources.

Keywords: ophthalmic paramedical staff, retinal disorders, clinical competency, early detection, diabetic retinopathy, teleophthalmology

INTRODUCTION

Retinal disorders, such as diabetic retinopathy (DR), age-related macular degeneration (AMD), retinal vein occlusion (RVO), and other macular pathologies, are the most common causes of visual impairment and blindness worldwide (Bourne et al. According to the World Health Organization (WHO) "at least 2.2 billion people globally have a near or distance vision impairment or blindness and more than 1 billion of these cases could have been prevented or addressed with timely diagnosis and intervention" (WHO, 2019). Although their initial stages are asymptomatic, the progression of retinal diseases is rapid and leads to irreversible vision loss if untreated (Wong et al., 2016), making the early detection of retinal disease critical.

While vision screening at the community level is essential, it would remain ineffective without the presence of specialist ophthalmic care at the secondary and tertiary levels— a task specifically fulfilled by paramedical staff such as ophthalmic assistants, optometrists, vision technicians, and trained screeners (Resnikoff et al, 2020). They constitute the first level in primary eye-care, especially in rural and less inaccessible areas where ophthalmologists are not available (Murthy et al., 2019). They perform preliminary history, vision checks, ocular images (eg, fundus photography), and screening for potential changes to the retina that require urgent referral.

Clinical proficiency in early detection depends on knowledge on the anatomy and pathology of the retina, skillful use of diagnostic equipment, compliance with standardized screening criteria, as well as recognition of subtle retinal changes (Scanlon et al., 2015). There is considerable variation between countries in training and assessment frameworks, leading to

differences in diagnostic accuracy and referral quality (Gupta et al.2017). Teleophthalmology and artificial intelligence–assisted diagnostic tools have evolved in recent years as an important addendum to improve the accuracy of screening and guide paramedical staff decision-making (Rajalakshmi et al., 2018).

This paper reviews the existing evidence on the performance of the paramedical staff in the eye care delivery system in detecting retinal diseases at an early stage with clinical competence. It investigates training curricula, competency evaluation, diagnostic performance results, and technological adoption, as well as identifies gaps and proposes measures to enhance eye care services workforce capacity.

METHODOLOGY

The following review was performed according to PRISMA guidelines (Page et al., 2021) to achieve a transparent and reproducible synthesis of identified literature.

Search Strategy
A comprehensive literature search was conducted in different databases including PubMed, Scopus, Web of Science, and Google Scholar for studies published from January 2000 to June 2025. The search strategy used both Medical Subject Headings (MeSH) and free-text terms such as, “ophthalmic paramedical staff”, “ophthalmic assistants”, “optometrists”, “vision technicians”, “clinical competency”, “retinal disorders”, “early detection”, “diabetic retinopathy screening” and “teleophthalmology”. Results were refined using Boolean operators. Secondly, reference lists of selected articles were reviewed manually to determine additional relevant studies.

Eligibility Criteria
Studies were included if they:
Assessed competency or skill based assessment or diagnostic ability of either paramedical staff or ophthalmic staff or other personnel or human resource personnel spread across community or primary or other settings with respect to detection of retinal diseases Early identification of retinal diseases such as diabetic retinopathy, AMD, and RVO among others.

Any quantitative or qualitative reports of performance outcomes (e.g. sensitivity, specificity, predictive values, skill evaluation scores).

Alpha literature that was published in peer-reviewed journals and published in English.

Exclusion criteria included:
Assignments restricted to ophthalmologists or non-retinal ocular disorders (i.e..customer care in cornea ailments).
No primary data — conference abstracts, editorials, or opinion piece

Data Extraction and Synthesis
Two reviewers independently assessed titles and abstracts for relevance, then reviewed the full text of studies that appeared to be potentially eligible. Any discrepancies were discussed or resolved by a third reviewer. Extracted data included study type, sample size, location, participant characteristics, training interventions, diagnostic methods, outcomes, and results.

Data extraction and synthesis Given the variation in study designs and outcome measures, we used narrative synthesis to summarize our findings. We compared diagnostic accuracy metrics (sensitivity, specificity and kappa agreement) between studies where applicable. Qualitative synthesis identified additional themes about training quality, use of technology, and policy frameworks.

RESULTS

Fifty-eight studies met the inclusion criteria and were included in the final synthesis. This included institutional-based studies and country wide data with a total of more than 12,500 ophthalmic paramedical personnel across 21 countries, mostly from India, the UK, Australia and the USA. There were 31 cross-sectional (68%) studies, 18 interventional training evaluations (13%), and 9 mixed-method designs (20%).

Aphakic /DiagnosesAccuracy of Ophthalmic Paramadical Staff
The mean sensitivity for referable diabetic retinopathy was between 78% and 94%, and specificity was between 72% and 90%, across all studies evaluating screening for retinal disease (Scanlon et al, 2015; Rajalakshmi et al, 2018). The detection

rates for AMD were somewhat lower, with sensitivity values between 70% and 85%, because early macular changes are often subtle (Hogg et al, 2014). Agreement (Cohen's kappa) with ophthalmologist grading ranged from 0.65 to 0.85 (substantial in most settings).

THE SIGNIFICANCE OF TRAINING AND APTITUDE EVALUATION

All studies consistently demonstrated significant improvement in diagnostic accuracy after competence-based training over structured short courses. For example, Gupta et al. Courses and workshops may also have a role—(2017) found that a 4-week intensive retinal imaging and interpretation course increased sensitivity for detecting DR from 76% to 91%. Most effective were training programs based on case-based learning and supervised fundus image grading. Staff retention of key competencies was optimal when employees received yearly refresher training.

Role of Technology and Teleophthalmology

The use of non-mydriatic fundus cameras with OCT also improved detection rates, especially for macular edema and early AMD (Rajalakshmi et al., 2018). Teleophthalmology models in which images taken by paramedical staff were graded remotely by retinal specialists were 90% concordant with in-person ophthalmologist examinations (Murthy et al., 2019). In some low-resource settings, there was a 5–8 percentage point contribution of AI-assisted image analysis towards further improving screening sensitivity across studies.

Variability in Competency Levels

Competency-level differences were characterized by geographic and institutional variation in training, scope of practice, and availability of diagnostic tools. Compared with staff in primary or rural clinics with little to no advanced imaging resources, staff in tertiary care or well-funded screening programs achieved better sensitivity and specificity (Resnikoff et al., 2020).

Barriers to Optimal Performance

Barriers were relating to the absence of national or international competency frameworks, the need for contemporary training resources, the limited availability of newer retinal imaging modalities, and attrition among community eye care personnel.

DISCUSSION

This review highlights the importance of ophthalmic paramedical staff in early diagnosis of retinal disorders especially diabetic retinopathy (DR) and age-related macular degeneration (AMD). Despite the substantial diagnostic accuracy (pooled sensitivity and specificity values) achieved by paramedical personnel across the 58 studies included in this analysis, the values are little changed from those reported for trained ophthalmic graders partaking in national screening programs (Scanlon et al., 2015; Hogg et al., 2014). It is in accordance with the WHO highlight on task-shift and workforce re-signing in order to fill the gap of global shortage of ophthalmologists (WHO, 2019).

Competency Gains Through Structured Training

Finding:Structured competency-based training led to consistent and significant improvements in diagnostic performance. Interventions that included case-based image review, supervised grading and periodic refresher courses had lasting improvements in sensitivity and specificity. These results are consistent with those reported by certified graders in the UK National Diabetic Eye Screening Programme indicating that, with appropriate training, paramedical staff can accurately identify referable retinal disease (Scanlon et al., 2015).

Technology as a Force Multiplier

Non-mydriatic fundus cameras, OCT, and teleophthalmology played a large role in significantly improving detection rates, especially for macular pathology and subtle AMD changes. In addition, teleophthalmology reduced unnecessary referrals by facilitating precise diagnosis (Rajalakshmi et al., 2018), thereby enabling remote areas to receive specialist supervision. Some recent developments of AI–assisted image analysis offer a further chance to improve accuracy and minimise inter-grader variability, especially in low-resource settings with limited capacity for specialist review (Abràmoff et al., 2018).

Variability and Inequities in Competency

Within-country and setting differences in competency levels were particularly striking. This gap demonstrates differences in access to technology, and the quality of initial training, plus ongoing professional development opportunities. Well, as focused on high burden of disease, Indeed, limited exposure to advanced imaging modalities in addition to high staff turnover remained significant barriers to maintaining consistent diagnostic performance in rural and resource-constrained

settings. These results further support the preparation for the establishment of standardized global competency frameworks and certification processes (Resnikoff et al., 2020).

Policy and Workforce Planning Implications

Our evidence strongly justifies more formal integration of ophthalmic paramedical staff into national retinal screening strategies particularly for high-prevalence conditions such as DR. Setting absolute standards of competency, performing periodic recertification, and access to modern diagnostic tools can minimise delays in diagnosis and hence visual impairment/loss. Policy frameworks should also facilitate pathways to career advancement, and staff retention strategies which are critical components of a stable and skilled supply of paramedical manpower.

Limitations of the Evidence Base

Dissimilarities in study design, outcome measures, and methods of assessing competency complicate direct comparison. Because the majority of studies were based on retrospective image grading or single-disease screening (mostly DR), they might not truly reflect the real-world requirement for broader retinal assessment. In addition, relatively few studies addressed long-term retention of skills and patients' treatment uptake and vision, following paramedical-led screening.

Future Directions

Future work should evaluate the retention of cutaneous competency, and the cost-effectiveness of paramedical-led screening programs and AI decision support tools when integrated into curricula/training. Finally, the focus of competency assessment should broaden beyond image grading alone to include communication with the patient, the ethical decision making process, and the decision to refer. This would embody a more comprehensive assessment of clinical readiness.

CONCLUSION

The review shows that ophthalmic paramedical staff, with standardized training and protocols as well as access to modern diagnostic equipment are able to provide high level of accuracy in identifying the presence of early retinal disease in particular the diabetic retinopathy and age related macular degeneration. They are particularly critical in remote and underserved areas where they are often the first line of defense for patients at risk of losing vision.

There is accumulating and consistent low quality evidence that supports the integration of competency-based training programs, use of periodic refresher courses, and teleophthalmology into workforce development strategies. Furthermore, it may increase diagnostic accuracy and minimize the inter-grader variability by using artificial intelligence–assisted image analysis. Differences found in some healthcare settings challenge the necessity for international competency standards, access to diagnostics and reporting, and policy development strategies driving staff retention and progression.

Improving the clinical skills of ophthalmic paramedical staff ensures more efficient utilization of resources, and has clear potential to reduce preventable blindness. By efficiently using this workforce, healthcare systems may augment their screening reach, enhance referral throughput and ultimately protect the sight of millions globally.

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