Enhancing Glaucoma Detection in Primary Care: A Systematic Review of Global Challenges, Advances and the Pakistan Perspective

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Supplementary Table 1: Global burden and epidemiology of glaucoma.

Citation	Setting	Study Design	Population	Outcomes	Key Findings
Pascolini D, 2012	Global	Meta-analysis	Global population	Visual impairment prevalence	285M visually impaired; glaucoma major cause
Flaxman SR, 2017	Global	Meta-analysis	Global population	Causes of visual impairment	Glaucoma among top causes of irreversible blindness
Tham Y-C, 2014	Global	Meta-analysis	Global population	Glaucoma prevalence projections	111.8M glaucoma cases expected by 2040
Varma R, 2011	USA	Review	US population	Economic burden of glaucoma	Major health and cost impact of glaucoma
IAPB, 2020	Global	Report	Global population	Economic burden of vision loss	Significant cost burden globally

Supplementary Table 2: Role of primary care providers in early detection and screening.

Citation	Setting	Study Design	Population	Outcomes	Key Findings
Gupta D, 2016	USA	Clinical review	Primary care providers	PCP education tools for glaucoma	Tools for early glaucoma recognition
Salikhova KM, 2020	Russia	Observational	Family doctors	PCP role in early detection	PCPs crucial in early glaucoma detection
Stein JD, 2021	USA	Clinical review	Primary care settings	Screening strategies	Primary care-based screening strategies
Gedde SJ, 2021	USA	Guideline	POAG patients	Diagnosis and treatment	AAO diagnosis/treatment guidelines
McMonnies CW, 2017	Australia	Review	General population	Glaucoma risk factors	Systemic factors linked to glaucoma
Lee SS, 2022	Australia	Review	At-risk population	Early detection challenges	Underdiagnosis and late presentation
Crabb D, 2016	UK	Commentary	Glaucoma patients	Awareness of vision loss	Patients often unaware of gradual loss
Schettler AJ, 2019	USA	Cohort	Community screening participants	Screening impact	Community screening improved outcomes
Shukla AG, 2024	USA	Review	PCP clinics	Novel screening strategies	Novel in-clinic screening strategies
Gonzalez A, 2023	USA	Implementation study	PCP workflow	Workflow integration	Streamlined glaucoma detection integration

Supplementary Table 3: Situation in Pakistan (Awareness, access, and local research).

Citation	Setting	Study Design	Population	Outcomes	Key Findings
Nawab A, 2024	Pakistan	Cross-sectional	General population	Awareness, prevalence	Low awareness and high unmet need
Kazmi S, 2022	Pakistan	Editorial	Health policy	Screening advocacy	Calls for national screening programs
Hassan B, 2019	Pakistan	Epidemiological	National population	GBD data	Glaucoma is 2nd leading cause of blindness
Farooq U, 2018	Pakistan	Observational	Rural and urban populations	Access disparities	Rural-urban disparities in access
Malik TG, 2024	Pakistan	Descriptive	Family medicine trainees	Fellowship training model	Family medicine glaucoma training initiative
Ali MA, 2021	Pakistan	KAP study	Patients	Knowledge and attitudes	Major knowledge deficits
Khan MA, 2019	Pakistan	Cross-sectional	Karachi population	Awareness	Low awareness in Karachi
Khan A, 2020	Pakistan	Mixed-methods	Patients and providers	Access barriers	Travel, cost, awareness major obstacles

Supplementary Table 4: Importance of early diagnosis and risk-based screening.

Citation	Setting	Study Design	Population	Outcomes	Key Findings
Lee SS, 2022	Australia	Review	At-risk population	Early detection	Underdiagnosis and late presentation
Crabb D, 2016	UK	Commentary	Glaucoma patients	Vision loss awareness	Patients unaware of gradual vision loss
Cate H, 2014	UK	Clinical study	Glaucoma patients	Treatment adherence	Improved detection leads to better compliance
Lawrenson J, 2013	UK	Review	General population	Case detection	Gaps in early diagnosis
Allison K, 2021	USA	Review	High-risk adults	Risk-based screening	Supports targeted screening
AAO, 2015	USA	Guideline	At-risk adults	Eye exam frequency	Frequency based on age/risk
USPSTF, 2022	USA	Guideline	General population	Screening recommendation	Insufficient evidence for routine screening

Supplementary Table 5: Barriers to detection and management.

Citation	Setting	Study Design	Population	Outcomes	Key Findings
Lee JH, 2022	Korea	Observational	Glaucoma patients	Socioeconomic barriers	Income disparities affect care access
Lee JW, 2023	Global	Review	Global population	SES impact on diagnosis/ treatment	SES strongly affects outcomes
Khan A, 2020	Pakistan	Mixed-methods	Patients/providers	Access barriers	Travel, cost, awareness major obstacles
Hu VH, 2021	Global	Commentary	LMIC settings	Infrastructure and awareness barriers	LMICs face infrastructure and cost issues
Meethal NSK, 2024	Global	Review	Developing countries	Screening barriers	Identifies barriers in developing countries
IAPB (2015)	Global	Report	Global population	Prevention and detection	Advocacy for earlier detection
Ichhpujani P, 2012	India	Survey	Eye care providers	Provider knowledge gaps	Significant knowledge gaps
Rotshtein A, 2015	Israel	Survey	PCPs	Awareness and confidence	Low awareness and confidence among PCPs
Alwazae M, 2020	Saudi Arabia	Cross-sectional	Physicians	Awareness and misconceptions	Misconceptions about glaucoma risks

Supplementary Table 6: Advances in screening technologies (AI & telemedicine).

Citation	Setting	Study Design	Population	Outcomes	Key Findings
Ting DSJ, 2024	Singapore	Editorial	AI technology users	AI algorithms for detection	Discusses LLM/AI for glaucoma detection
Zhang L, 2023	China	Review	General population	AI prediction models	Promising early risk models
Jammal AA, 2020	USA	Diagnostic study	Patients	AI vs human grading accuracy	AI matches expert performance
Hogarty DT, 2019	Australia	Review	Eye care providers	AI integration trends	Trends in clinical AI use
Yousefi S, 2023	Iran	Review	Eye care systems	AI diagnostic potential	Highlights Aiâ€™s diagnostic potential
Jan C, 2024	Australia	Review	Primary care	AI for rural screening	AI supports rural triage and screening
Gupta P, 2023	India	Systematic review	Telemedicine users	Tele-glaucoma access and accuracy	Telemedicine improves access/ accuracy
Qureshi MA, 2024	Global	Systematic review	Low-resource settings	Telemedicine effectiveness	Effective in low-resource settings

Supplementary Table 7: Best practices and global recommendations.

Citation	Setting	Study Design	Population	Outcomes	Key Findings
Gedde SJ, 2021	USA	Guideline	POAG patients	Diagnosis and management	AAO diagnosis/treatment guidelines
USPSTF, 2022	USA	Guideline	General population	Screening recommendation	Insufficient evidence for routine screening
AAO, 2015	USA	Guideline	At-risk adults	Eye exam frequency	Frequency based on age/risk
AAFP, 2022	USA	Clinical guideline	Primary care patients	PCP referral role	Recommend referral for high-risk patients