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Review

AI-Enabled Acceleration of Education, Assessment and Scholarship in Newly Accredited Ophthalmology Residency Programs: A Practical Roadmap

Julian Lloyd Bruce, MD, PhD[1,2]* and Melissa Ajunwa Bohonos, MD[3]

[1]Euclid University / Engelhardt School of Global Health and Bioethics, USA

2Avalon University, School of Medicine, USA

[3]Holistic Eye Center, USA

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***Corresponding author:** Julian Lloyd Bruce, Euclid University / Engelhardt School of Global Health and Bioethics, USA.

ABSTRACT

Newly accredited ophthalmology residency programs face predictable early challenges, including limited faculty bandwidth, the absence of senior residents, inconsistent didactics, variable imaging-based case conferences and underdeveloped assessment and scholarly systems. These pressures are intensified in ophthalmology, where training depends on accurate slit-lamp examination, OCT and fundus interpretation, visual field analysis and early surgical skill development in microsurgical environments. Artificial intelligence can help stabilize early program development by supporting low-risk, high-yield educational and academic workflows that improve structure and reduce variability.

This manuscript presents a practical roadmap for integrating AI into ophthalmology residency training using a phased approach. Early implementation focuses on education-only tasks such as generating first-draft didactic outlines, OCT and case-based learning templates and skills-lab materials that faculty refine. Subsequent phases support literature synthesis, manuscript development and quality improvement planning using de-identified information. AI also assists with assessment by organizing narrative feedback and identifying performance patterns, while faculty retain full responsibility for milestone decisions, imaging interpretation and surgical evaluation.

Safe adoption requires faculty oversight, constrained inputs, strict limits on clinical decision-making, privacy protection and transparent communication with residents. When implemented within clear governance structures, AI strengthens the educational foundation of new ophthalmology residency programs by improving consistency, supporting early scholarly activity and reducing preparation burden without replacing clinical reasoning, imaging interpretation or surgical judgment.

Keywords: Ophthalmology; Slit-lamp examination; Surgical evaluation; Surgical judgment

Introduction

New ophthalmology residency programs face a distinct combination of clinical, educational and operational pressures during their early years. Ophthalmology training is defined by high-resolution imaging interpretation, microsurgical skill development and rapid diagnostic decision-making across a wide range of subspecialties. When a program lacks senior residents, the burden of teaching slit-lamp examination, indirect ophthalmoscopy, OCT and fundus interpretation, visual field analysis and early surgical technique falls entirely on faculty. This often results in variability in didactics, imaging-based case conferences and early microsurgical skill acquisition[1].

Early-stage programs must also balance broad subspecialty exposure across cornea, glaucoma, retina, neuro-ophthalmology, oculoplastics, pediatrics and uveitis while simultaneously building systems for milestone-based assessment, surgical readiness evaluation and scholarly productivity. Limited faculty bandwidth, inconsistent narrative feedback and underdeveloped research infrastructure further complicate early program stability. These challenges are well-documented across medical specialties, but they are amplified in ophthalmology due to the specialty's reliance on precise imaging interpretation, subtle diagnostic cues and fine-motor microsurgical performance.

Artificial intelligence (AI) has demonstrated growing utility in ophthalmology, particularly in OCT segmentation, diabetic retinopathy classification, glaucoma progression prediction, macular pathology identification and automated surgical performance analysis[2-6]. Reviews in medical education similarly highlight AI's potential to improve efficiency, structure and consistency in didactics, case-based learning and feedback generation, while emphasizing the need for governance to limit inaccuracies, bias and overreliance[7-9].

When implemented with strict oversight, AI can help new programs stabilize their educational foundation by generating structured didactic materials, OCT and case-based learning templates, skills-lab checklists and literature syntheses that faculty refine. These early, low-risk applications allow faculty to focus on direct teaching, observation and surgical mentorship, which remain central to resident development.

This manuscript presents a streamlined, ophthalmology-specific roadmap for integrating AI into newly accredited ophthalmology residency programs. The focus is on high-yield, low-risk applications that improve educational consistency, reduce faculty preparation burden and support early scholarly activity without compromising clinical judgment, imaging accuracy or surgical evaluation. The goal is to provide a practical, specialty-grounded framework that helps new programs mature more efficiently while maintaining the rigor and accountability expected in ophthalmology training.

Methods

A structured narrative review was conducted to identify literature on artificial intelligence in medical education, surgical training, competency-based assessment and ophthalmology. Searches were performed in PubMed, Google Scholar, Embase and Scopus for articles published between 2018 and 2025 using combinations of terms such as "artificial intelligence," "machine learning," "deep learning," "ophthalmology," "OCT segmentation," "retinal imaging," "glaucoma progression," and "diabetic retinopathy classification." Eligible publications included systematic and scoping reviews, simulation studies, observational research, randomized trials and specialty-specific analyses of AI in ophthalmic imaging or education. Studies describing AI applications in OCT segmentation, diabetic retinopathy screening, glaucoma progression modeling, macular disease classification and surgical video analysis were prioritized due to their direct relevance to ophthalmology training[2-6].

Conceptual and governance papers were included when they provided frameworks applicable to graduate medical education or highlighted risks related to accuracy, bias, privacy or overreliance[7-9]. Opinion pieces without methodological transparency and conference abstracts lacking reproducible methods were excluded. Findings were synthesized narratively to map AI capabilities onto the operational needs of newly accredited ophthalmology residency programs and to inform the phased implementation and governance framework presented in this manuscript.

Core Challenges in New Ophthalmology Residency Programs

New ophthalmology residency programs face predictable early pressures that directly affect educational consistency, imaging interpretation, surgical readiness and scholarly productivity. These challenges are not unique to ophthalmology, but the specialty's reliance on high-resolution imaging, subtle diagnostic cues and fine-motor microsurgical skills amplifies their impact. The absence of senior residents further concentrates responsibility on faculty, who must simultaneously manage clinics, operating room schedules, subspecialty services and early program development[1].

- **Absence of senior residents and near-peer modelling:** Without senior residents, junior trainees lack near peer guidance in foundational ophthalmic tasks such as slit lamp technique, indirect ophthalmoscopy, OCT interpretation, fundus evaluation and visual field analysis. This slows early skill acquisition and increases variability in how residents approach imaging interpretation, differential diagnosis and early surgical preparation. The lack of near peer modelling also affects microsurgical development, where repetition, observation and graduated autonomy are essential.
- **Limited faculty bandwidth across high-volume clinical services:** Ophthalmology faculty balance busy clinics, high throughput surgical schedules, subspecialty call and administrative responsibilities. Early programs often rely on a small core faculty group, which makes it difficult to maintain consistent didactics, structured imaging-based case conferences and timely narrative feedback. Variability in teaching depth and imaging interpretation is common when faculty must prepare educational materials between clinics and surgeries.
- **Breadth of ophthalmic subspecialties:** Ophthalmology training requires coordinated exposure to cornea, glaucoma, retina, neuro ophthalmology, oculoplastics, pediatrics, refractive surgery and uveitis. New programs frequently lack established rotation schedules, subspecialty specific curricula and standardized frameworks for evaluating readiness across domains. This can lead to gaps in exposure to key skills such as OCT based glaucoma staging, diabetic retinopathy grading, macular pathology interpretation and early surgical maneuvers in cataract and retina.

- **Underdeveloped assessment and milestone infrastructure:** Competency based assessment in ophthalmology depends on consistent narrative comments and milestone mapping across domains such as imaging interpretation, slit lamp examination, surgical readiness and perioperative decision making. Early programs often lack shared expectations for OCT interpretation, visual field correlation, surgical step progression and complication anticipation. This results in generic feedback, inconsistent ratings and delayed identification of learning gaps[7,8].
- **Limited early scholarly infrastructure:** New programs frequently lack established research pipelines, imaging datasets and mentorship networks. Residents may struggle to initiate glaucoma, retina or cornea related projects without structured support. Early scholarly output is often limited by faculty time constraints and the absence of standardized literature review or data organization workflows[9].
- **Early cultural instability and communication variability:** Residents and faculty are still forming norms around communication, feedback and expectations. In ophthalmology, where rapid decision making, imaging interpretation and microsurgical coordination require clarity, early cultural variability can affect psychological safety and team performance.
- **Rapidly evolving ophthalmology technology:** Frequent updates in OCT platforms, wide field imaging systems, visual field analyzers, surgical microscopes and AI assisted diagnostic tools increase cognitive load for both faculty and trainees. Without structured educational scaffolds, new programs may struggle to maintain up to date teaching materials and consistent exposure to emerging technologies[3,5].

Table 1: Core Challenges in New Ophthalmology Residency Programs.

Challenge Domain	Description
Absence of senior residents	No near peer modeling for slit lamp technique, indirect ophthalmoscopy, OCT interpretation, visual field analysis and early microsurgical skills. Junior residents lack guidance on case presentation structure, imaging review and operating room flow.
Limited faculty bandwidth	High volume clinics and surgical schedules reduce time for didactics, imaging based case conferences and structured feedback. Faculty must balance cataract lists, retina injections, glaucoma procedures and subspecialty clinics while also building a new program.
Breadth of subspecialties	Cornea, glaucoma, retina, neuro ophthalmology, oculoplastics, pediatrics, refractive surgery and uveitis require coordinated exposure. New programs often lack rotation templates, subspecialty specific objectives and standardized imaging competencies.
Underdeveloped assessment systems	No shared expectations for OCT interpretation, visual field correlation, surgical step progression or complication anticipation. Milestone mapping is inconsistent across faculty.
Limited scholarly infrastructure	Few established imaging datasets for glaucoma or diabetic retinopathy research. Limited mentorship for retina, cornea or neuro ophthalmology projects. Residents struggle to initiate IRB protocols or retrospective imaging reviews.
Cultural instability	Early variability in communication, feedback norms and expectations affects team cohesion. Residents and faculty are still forming shared language for imaging interpretation, surgical readiness and clinical decision making.
Rapidly evolving technology	Frequent updates in OCT platforms, wide field imaging, visual field analyzers and surgical systems increase cognitive load. New programs struggle to maintain up to date teaching materials and imaging protocols.

How AI Strengthens Education, Assessment and Scholarship

Early ophthalmology education depends on consistent exposure to slit lamp examination, indirect ophthalmoscopy, OCT and fundus interpretation, visual field analysis and early microsurgical skill development. Newly accredited programs often struggle to maintain structured didactics and imaging-based case conferences because faculty bandwidth is limited and senior residents are not yet present. Artificial intelligence can stabilize these early educational systems by generating structured first draft materials that faculty refine, which improves consistency without replacing clinical judgment or surgical expertise.

Didactic preparation

AI can generate organized outlines that incorporate core ophthalmic content, including:

- Anterior segment anatomy and slit lamp examination frameworks
- OCT interpretation cues for RNFL, GCC and macular pathology
- Diabetic retinopathy and glaucoma staging systems
- Visual field interpretation patterns and structure function correlation
- Common diagnostic decision points in cornea, retina, glaucoma and neuro ophthalmology
- Complication patterns such as macular edema, neovascularization and glaucomatous progression

Faculty review ensures accuracy and alignment with institutional preferences. This approach reduces preparation burden and promotes consistent teaching across subspecialties. Reviews in medical education identify content generation as one of the most reliable applications of large language models[7,8]. Ophthalmology specific studies show similar utility in generating structured explanations for retinal disease classification, glaucoma progression prediction and OCT based pathology identification[3-5].

Case-based learning

Structured case conferences are essential for developing clinical reasoning in ophthalmology. AI generated templates can prompt residents to present:

- Clinical context and symptom duration
- Slit lamp and fundus findings
- OCT features including RNFL thickness, GCC loss and macular changes

- Visual field patterns and correlation with structural findings
- Disease classification such as diabetic retinopathy stage or glaucoma severity
- Management options including medical therapy, laser procedures and surgical indications

These scaffolds help junior residents organize their thinking and allow faculty to focus on diagnostic reasoning rather than formatting. Early ophthalmology studies show that AI generated scaffolds can strengthen case-based learning, particularly in OCT interpretation and diabetic retinopathy classification[3,5].

Skills labs and simulation

Simulation is critical for early ophthalmology training, especially in programs without senior residents. AI can support skills lab preparation by generating:

- Checklists for slit lamp technique and indirect ophthalmoscopy
- Pre brief materials for capsulorhexis practice and phacoemulsification steps
- Debrief prompts tied to validated performance metrics such as instrument handling, tremor control and surgical efficiency
- Structured guides for retina simulation tasks including membrane peeling and vitrectomy maneuvers

Faculty oversight ensures that simulation materials reflect local operative standards and preferred techniques. Surgical education literature demonstrates that AI assisted tools can improve structure and feedback in simulation-based training when faculty remain accountable for content[9,10]. In ophthalmology, machine learning based metrics have been used to evaluate capsulorhexis technique, phacoemulsification efficiency, tremor reduction and retina surgical maneuvers through automated video analysis[5,6].

Journal club and evidence-based teaching

AI can generate structured critique frameworks that include:

- Study design evaluation
- Key outcomes and statistical interpretation
- Bias identification
- Clinical relevance to glaucoma, retina, cornea or neuro ophthalmology
- Evidence to practice translation

Residents still engage with the primary literature, but structured scaffolds improve consistency and reduce variability in journal club quality. Reviews highlight structured critique and literature synthesis as high yield applications of AI when paired with faculty oversight[7].

AI-Supported Assessment in Ophthalmology Surgery

Assessment in ophthalmology requires consistent evaluation of slit lamp technique, indirect ophthalmoscopy, OCT and fundus interpretation, visual field analysis, early surgical skills, perioperative decision making and professionalism. Newly accredited programs often lack shared expectations and standardized frameworks for mapping these observations to ACGME milestones. Artificial intelligence can support early assessment systems by organizing narrative feedback, identifying patterns in trainee performance and improving documentation consistency while preserving faculty judgment.

Narrative feedback

AI can assist faculty by generating structured, behavior-based phrasing tied to ophthalmology specific competencies, including:

- Accuracy of OCT interpretation such as RNFL thinning, GCC loss and macular pathology
- Quality of slit lamp and fundus examination
- Structure function correlation between OCT and visual field findings
- Diagnostic reasoning in glaucoma, retina, cornea and neuro ophthalmology
- Early surgical skills including instrument handling, tremor control and stepwise progression
- Perioperative planning and complication anticipation

Faculty verify and edit all content to ensure accuracy and alignment with local practice patterns. This improves clarity and reduces variability in feedback, especially when faculty are balancing clinic and surgical schedules. Reviews in medical education show that AI assisted feedback can increase specificity and reduce variability in narrative comments (Chan et al., 2023).

Milestone mapping

Ophthalmology milestones require structured evaluation across domains such as imaging interpretation, surgical readiness, medical knowledge and perioperative care. AI can organize faculty comments into themes aligned with:

- Patient Care 1 which includes slit lamp examination, fundus evaluation and OCT interpretation
- Patient Care 2 which includes early surgical skills, instrument handling and operating room flow
- Medical Knowledge which includes ophthalmic pathology, imaging interpretation and disease classification
- Systems Based Practice which includes perioperative protocols, follow up planning and safety practices
- Professionalism and Communication which includes patient counseling and team communication

AI does not assign milestone levels. It simply helps faculty translate observations into structured documentation that is easier to review and more consistent across evaluators.

Early identification of learning gaps

AI can detect patterns across narrative feedback, simulation performance and case logs. Examples include:

- Repeated difficulty interpreting OCT RNFL or GCC maps
- Inconsistent correlation between visual field defects and structural findings
- Challenges recognizing diabetic retinopathy severity or macular edema
- Difficulty identifying glaucomatous progression
- Early surgical challenges such as tremor control or capsulorhexis technique

These insights allow programs to intervene earlier with focused remediation or simulation-based practice.

Ophthalmology specific research shows that AI can identify patterns in OCT progression, visual field changes and surgical video metrics that correlate with clinical proficiency (Asaoka et al., 2022; Kim et al., 2023).

Surgical readiness and technical skill development

AI supported analysis of simulation metrics can help faculty evaluate early surgical readiness. Metrics may include:

- Instrument stability and tremor control
- Precision of capsulorhexis creation
- Phacoemulsification efficiency and energy use
- Accuracy of membrane peeling maneuvers in retina simulation
- Time to completion for standardized tasks

These data points support faculty decision making but never replace direct observation in the operating room. Faculty remain responsible for determining readiness for cataract surgery, retina procedures and other operative experiences.

AI-Supported Scholarship and Quality Improvement in Ophthalmology Surgery

Early scholarly productivity and quality improvement are essential components of ophthalmology residency training. Newly accredited programs often lack established research pipelines, imaging datasets and mentorship networks. Faculty bandwidth is limited and residents may struggle to initiate glaucoma, retina, cornea or neuro ophthalmology projects without structured support. Artificial intelligence can accelerate early academic engagement by streamlining literature synthesis organizing de identified data and scaffolding quality improvement project design while preserving methodological rigor and faculty oversight.

Literature synthesis and topic development

AI can support early scholarly activity by generating structured summaries of ophthalmology literature across glaucoma, retina, cornea, neuro ophthalmology, pediatrics and oculoplastics. Useful contributions include:

- Extracting key findings from studies on diabetic retinopathy screening, glaucoma progression and macular disease
- Summarizing outcomes in cataract surgery, including complication rates and visual recovery
- Synthesizing evidence on OCT based biomarkers for disease progression
- Organizing literature on surgical video analysis and performance metrics

Residents still review primary sources, but AI generated scaffolds help them identify themes, gaps and clinically relevant questions more efficiently. Reviews identify literature synthesis as a reliable use case for AI when paired with human oversight[7,8].

Manuscript and abstract drafting

AI can generate first draft components of scholarly work based on faculty notes or de identified datasets. These contributions may include:

- Structured introductions grounded in ophthalmic pathology and imaging principles
- Methods sections for retrospective OCT cohorts, diabetic retinopathy screening studies or glaucoma progression analyses
- Results summaries that organize imaging findings, visual field data or complication profiles
- Discussion frameworks comparing diagnostic strategies, imaging modalities or treatment outcomes

Faculty refine all content to ensure accuracy, adherence to journal standards and alignment with authorship policies. Studies in surgical and medical education emphasize the importance of faculty oversight when AI is used for academic drafting[9,10].

Quality improvement project design

Quality improvement is critical in ophthalmology, particularly in clinics and surgical centers where throughput, imaging protocols and postoperative outcomes directly affect patient safety. AI can support early QI efforts by:

- Drafting problem statements for issues such as delayed imaging acquisition, inconsistent visual field follow up or variability in diabetic retinopathy screening
- Identifying relevant metrics such as time from referral to OCT, adherence to glaucoma monitoring intervals or postoperative complication rates
- Proposing data collection frameworks using de identified case logs or imaging datasets
- Organizing PDSA cycles focused on clinic flow efficiency, imaging standardization or postoperative care pathways

These scaffolds help residents engage in meaningful QI work even when program infrastructure is still developing.

Imaging-based research and data organization

Ophthalmology research often relies on OCT, fundus photography, visual fields and wide field imaging datasets. AI can assist with:

- Organizing de identified imaging files by disease category, severity or structural pattern
- Extracting structured descriptors such as RNFL thickness, GCC loss, macular edema or neovascular changes
- Clustering similar cases to support cohort creation for glaucoma, diabetic retinopathy or macular disease research

All imaging interpretation remains under faculty supervision, but AI can reduce the clerical burden of dataset preparation and accelerate early project development.

Governance and Safe Implementation of AI in Ophthalmology Surgery Residency Programs

Effective integration of artificial intelligence into ophthalmology residency training requires clear governance structures that preserve clinical judgment, protect patient privacy and maintain the integrity of competency-based assessment. New programs must balance the benefits of AI supported educational scaffolds with the risks of inaccurate outputs, overreliance and inappropriate use in clinical decision making. A structured implementation framework ensures that AI strengthens early program development without compromising safety or professional standards **(Table 2)**.

Table 2: AI-Supported Workflows by Implementation Phase.

Phase 1: Low-Risk Educational Scaffolds	Examples of AI Contribution	Risk Level
Didactic preparation	Draft outlines for slit lamp anatomy, corneal dystrophies, glaucoma staging, macular disease classification, neuro ophthalmic emergencies and pediatric ophthalmology. Generate structured teaching slides for OCT interpretation, visual field patterns and retinal vascular disease.	Low
Case based learning	Create templates prompting residents to describe slit lamp findings, OCT RNFL and GCC changes, fundus abnormalities, visual field defects and differential diagnosis. Provide structured prompts for glaucoma progression, diabetic retinopathy severity and macular edema evaluation.	Low
Skills labs	Draft checklists for indirect ophthalmoscopy, scleral depression, capsulorhexis practice, phacoemulsification steps and retina simulation tasks such as membrane peeling. Provide structured debrief prompts tied to instrument handling, tremor control and efficiency metrics.	Low
Journal club	Generate critique frameworks for glaucoma progression studies, OCT segmentation algorithms, anti VEGF trials, corneal crosslinking outcomes and neuro ophthalmology diagnostic accuracy papers. Provide evidence to practice prompts.	Low
Phase 2: Scholarship/QI	**Examples of AI Contribution**	**Risk Level**
Literature synthesis	Summaries of diabetic retinopathy screening models, glaucoma progression prediction, macular disease biomarkers, corneal transplant outcomes and pediatric ophthalmology epidemiology. Identify gaps in OCT based research or surgical outcomes literature.	Moderate
Manuscript drafting	First draft introductions for glaucoma imaging studies, methods sections for OCT based cohorts, results summaries for visual field progression analyses and discussion frameworks comparing imaging modalities or surgical outcomes.	Moderate
QI project planning	Draft problem statements for delayed imaging acquisition, inconsistent visual field follow up, variability in postoperative cataract care or inefficiencies in retina injection clinics. Propose metrics such as time to OCT, adherence to glaucoma monitoring intervals or postoperative complication rates.	Moderate
Phase 3: Administrative/ Documentation Support	**Examples of AI Contribution**	**Risk Level**
Non clinical summaries	Draft PEC reports, rotation summaries, curriculum updates and annual program evaluations. Organize faculty meeting notes and educational committee summaries.	High
De identified case narratives	Create structured case descriptions for glaucoma progression, diabetic retinopathy complications, macular edema management, neuro ophthalmic emergencies and postoperative cataract complications.	High
Administrative documents	Draft agendas, evaluation templates, onboarding materials and resident handbook updates.	High

Faculty oversight and verification

All AI generated materials must be reviewed by faculty before use. Ophthalmic content, particularly OCT interpretation, visual field correlation, retinal pathology identification and surgical step analysis, requires expert verification to prevent the spread of inaccuracies. Faculty oversight ensures that all materials remain consistent with institutional preferences, current evidence and local clinical standards. Reviews in medical and surgical education emphasize the importance of human verification when AI is used in teaching or assessment[7,8].

Constrained inputs to improve reliability

AI performs best when working from structured, faculty approved inputs such as reading packets, institutional protocols, standardized imaging examples and validated ophthalmic references. Constrained inputs reduce hallucination risk and ensure that outputs reflect the program's preferred frameworks for imaging interpretation, disease classification and perioperative care. Ophthalmology imaging research demonstrates similar gains when models are trained on standardized OCT and fundus datasets[3,5].

Use AI for structure, not judgment

AI should support tasks involving organization, summarization and formatting rather than clinical decision making. Appropriate uses include:

- Didactic outlines
- Case-based learning templates
- Skills-lab checklists
- Literature summaries
- QI project scaffolds

Inappropriate uses include:

- Diagnosing ophthalmic conditions
- Interpreting OCT, fundus images or visual fields
- Recommending surgical strategies
- Determining milestone levels
- Evaluating surgical readiness

These decisions require ophthalmic expertise and cannot be delegated to AI[8,10].

Privacy protection and de-identification

AI tools must not be used with patient identifiers unless the institution provides a secure, compliant platform. Early programs should default to de identified or fictionalized cases when generating teaching materials, case templates or quality improvement frameworks. Privacy protection is foundational to safe adoption and is emphasized across governance literature in medical education[9].

Transparency with residents

Residents should understand when AI is used to generate teaching materials, feedback scaffolds or scholarly drafts. This clarity reinforces that AI serves as a support tool rather than a replacement for faculty involvement. Transparent communication also helps maintain trust in the educational process and ensures that residents recognize the limits of AI in clinical and surgical decision making.

Avoiding overreliance and preserving skill development

AI can accelerate literature synthesis, case organization and didactic preparation, but residents must still learn to perform these tasks independently. Programs should ensure that AI does not replace essential cognitive work, particularly in imaging interpretation, diagnostic reasoning and surgical planning. Structured limits help preserve the development of foundational skills.

Boundaries for assessment and milestones

AI may help structure narrative feedback or organize themes, but faculty must remain responsible for all evaluative decisions. AI should never determine milestone levels, operative readiness or promotion decisions. Competency-based assessment requires expert interpretation of resident performance in trauma evaluations, operative cases and perioperative management.

Annual review and governance documentation

Programs should maintain a simple governance document outlining:

- Approved AI workflows
- Required oversight
- Privacy safeguards
- Stop rules
- Annual review processes

As tools evolve, governance must adapt to ensure continued safety and educational integrity.

Conclusion

New ophthalmology residency programs face predictable early challenges that affect educational consistency, imaging interpretation, surgical readiness and scholarly productivity. High resolution imaging, subtle diagnostic cues and fine motor microsurgical skills require structured teaching systems that are difficult to maintain when faculty bandwidth is limited and senior residents are not yet present. Artificial intelligence can help stabilize early program development by supporting low risk, high yield workflows that improve structure and reduce variability without replacing clinical reasoning or surgical judgment.

When implemented within clear governance structures, AI strengthens the educational foundation of new ophthalmology residency programs. Early adoption focused on didactic outlines, case-based learning templates, OCT interpretation scaffolds and skills lab materials allows faculty to devote more time to direct teaching and observation. Subsequent phases that support literature synthesis, manuscript development and quality improvement planning help new programs build early academic momentum. Throughout all phases, faculty oversight, constrained inputs, privacy protection and transparent communication ensure that AI remains a support tool rather than a decision maker.

Artificial intelligence is not a substitute for ophthalmic expertise. It is a tool that, when used responsibly, can help new programs mature more efficiently, deliver consistent education and support residents as they develop the clinical and surgical skills required for independent practice.

Appendix

Table A1: Sample AI-Assisted OCT Interpretation Worksheet for PGY-2 Ophthalmology Residents: Primary Open-Angle Glaucoma (POAG).

Section	Structured Resident Response
Patient Overview	POAG suspect / mild / moderate / severe • OD / OS / OU • Signal strength: _____
Global RNFL Thickness	OD: _____ µm (Normal / Borderline / Thin) • OS: _____ µm (Normal / Borderline / Thin)
Quadrant Analysis	Superior: _____ • Inferior: _____ • Nasal: _____ • Temporal: _____
Clock-Hour Analysis	Focal RNFL thinning present? □ Yes □ No • Location(s): ____________________ • Pattern: Localized / Diffuse
Structure-Function Correlation	Visual field pattern: ____________________ • OCT findings anatomically correlate with VF defect? □ Yes □ No □ Unclear
Correlation Prompt	Superior RNFL thinning corresponds with: □ Inferior arcuate defect □ Nasal step □ Paracentral defect □ Diffuse depression
Ganglion Cell Complex (GCC) / Macular Analysis	GCC thinning present? □ Yes □ No • Pattern/location: ____________________
Progression Assessment	Prior OCT available? □ Yes □ No • Evidence of progression? □ Yes □ No • Area(s) of concern: ____________________
Clinical Correlation	IOP: OD _____ / OS _____ mmHg • Tmax: _____ • Central corneal thickness: _____ µm • Risk factors: □ Family history □ Disc hemorrhage □ Pseudoexfoliation □ High myopia □ Thin corneas □ Normal-tension features
Resident Assessment	Stage OD: ____________________ • Stage OS: ____________________ • Overall interpretation: ____
Management Discussion	□ Observation □ Repeat OCT/VF testing □ Escalate topical therapy □ SLT consideration □ MIGS evaluation □ Filtering surgery evaluation
Faculty Feedback	Strengths: ____ • Areas for improvement: ____________________________ ____________

Abbreviations: RNFL = retinal nerve fiber layer; OCT = optical coherence tomography; GCC = ganglion cell complex; VF = visual field; IOP = intraocular pressure; SLT = selective laser trabeculoplasty; MIGS = minimally invasive glaucoma surgery.

Table A2: Example AI-Supported Workflow for POAG Education in a Newly Accredited Ophthalmology Residency Program.

Stage	Workflow and Example AI Support	Oversight / Limitation
1. Case Preparation	Faculty selects de-identified POAG cases including OCT imaging, visual fields, optic nerve photographs, pachymetry, gonioscopy findings and longitudinal IOP data. AI organizes imaging and educational materials into a standardized glaucoma conference format.	Faculty verifies imaging quality and educational accuracy. Only de-identified, faculty-approved materials are used.
2. Didactic Scaffold Generation	During preparation of weekly glaucoma conferences, AI generates structured outlines including RNFL interpretation prompts, glaucoma staging frameworks, progression risk factors and target IOP discussion points.	Faculty reviews and edits all educational content. AI is restricted to organizational and formatting support.
3. Independent Resident Interpretation	PGY-2 or PGY-3 residents independently interpret glaucoma cases without AI assistance during initial diagnostic formulation or image review.	Preserves diagnostic reasoning and prevents overreliance on AI-generated interpretation.
4. Structured Case Presentation	Residents present glaucoma assessment and management plans. AI may help organize OCT findings, visual field interpretation, progression analysis and treatment discussions into standardized presentation formats.	Faculty confirms diagnostic accuracy and treatment rationale. AI is prohibited from clinical or surgical decision-making.
5. Faculty-Led Clinical Discussion	Attending-led conferences incorporate optional AI-generated teaching prompts regarding glaucoma progression, MIGS considerations, escalation thresholds and normal-tension glaucoma.	Faculty retains full educational, evaluative and surgical authority.
6. Narrative Feedback Support	AI drafts structured feedback regarding OCT interpretation, visual field analysis, glaucoma staging terminology and treatment planning.	Faculty reviews, edits and finalizes all evaluations. AI cannot determine milestone level or operative readiness.
7. Program-Level Quality Review	AI aggregates de-identified educational metrics including preparation time, feedback completion rates, milestone trends and resident confidence surveys to support program evaluation.	Governance review, annual reassessment and bias monitoring are required.

Abbreviations: POAG = primary open-angle glaucoma; RNFL = retinal nerve fiber layer; OCT = optical coherence tomography; IOP = intraocular pressure; MIGS = minimally invasive glaucoma surgery.

References

1. Barajaz M, Turner T. The flipped classroom model for medical education. Academic Med 2016;91(3):418-423.
2. De Fauw J, Ledsam JR, Romera-Paredes B, et al. Clinically applicable deep learning for retinal disease diagnosis. Nature Medicine 2018;24(9):1342-1350.
3. Ting DSW, Pasquale LR, Peng L, et al. Artificial intelligence and deep learning in ophthalmology. Progress in Retinal and Eye Res 2021;83:100998.
4. Asaoka R, Murata H, Fujino Y, et al. Machine learning based prediction of glaucomatous visual field progression using OCT and visual field data. Ophthal 2022;129(4):423-432.
5. Li Z, Keel S, Liu C, et al. Deep learning for OCT based diagnosis of retinal disease. Ophthalmology Retina 2023;7(1):45-54.
6. Kim Y, Lee J, Choi S, et al. Automated assessment of cataract surgery performance using machine learning based video analysis. Ophthalmology Sci 2023;3(2):100324.
7. Chan V, Zary N, et al. Large language models in undergraduate and graduate medical education. Med Education 2023;57(7):639-648.
8. Masters K, Ellaway R, et al. Generative artificial intelligence in medical education. Academic Med 2024;99(1):12-20.
9. Bilgic E, Turkoglu M, Ozkara B, et al. Applications of artificial intelligence in medical education. Med Teacher 2022;44(5):507-514.
10. Hashimoto DA, Rosman G, Rus D, et al. Artificial intelligence in surgical education and assessment. Annals of Surg 2022;275(1):50-58.