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REVIEW

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Ophthalmology Residency in the United States: The Case for a National Curriculum

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ABSTRACT

To identify strategies for effective curriculum development and implementation in United States (US) ophthalmology residency training programs. A literature review was conducted for all English-language PubMed/Medline articles relating to ophthalmology residency education or curriculum/curricula. Despite ACGME-defined program requirements outlining curricular goals for US ophthalmology residency training programs, there is no comprehensive, national curriculum with detailed plans for instruction of necessary topics within the 36-month residency training period. Several articles identify a need for detailed curricula on various topics, propose ideas on how residency programs could create curricula, and explore ways of assessing resident competence. There is a paucity of literature evaluating how ophthalmology residents best learn various ophthalmology topics. We need to develop an intentional, comprehensive, and timely national curriculum for ophthalmology residency programs in the US, with detailed plans on *how* to meet curricular objectives and consideration of the most effective teaching strategies for different ophthalmology concepts.

INTRODUCTION

Prior to the 2000s, ophthalmology residency education relied heavily on an apprenticeship model (*see one, do one, teach one*) in which a resident learned ophthalmology by serving as an apprentice to experienced faculty ophthalmologists. The learning occurred outside the framework of any structured national residency curriculum. In this system, depending on the type of patients evaluated by particular faculty members, residents at different training programs would encounter certain concepts and surgical situations with varied frequency and ultimately receive disparate training.[1] Additionally, completing 36 months of residency training did not guarantee that a resident would know how to apply medical or surgical knowledge appropriately, despite standardized testing that does not realistically test practical clinical or surgical performance.[2] Pressures from the economic market, government, and public[2,3] led to a shift from the traditional apprenticeship model to a competency-based residency model in order to ensure that all graduating residents met a minimum standard in terms of their ability to serve the needs of the current healthcare environment.

In 2001, the Accreditation Council for Graduate Medical Education (ACGME) established six general competencies for resident education across all medical specialties: medical knowledge, patient care, practice-based learning, interpersonal and communication skills, professionalism, and systems-based practice. The American Board of Ophthalmology (ABO) added surgery as a seventh competency for ophthalmology residents.[4] The ACGME competencies were intentionally broad, to allow flexibility among specialties in terms of designing teaching and assessment tools best suited to their specialty.[5] Unfortunately, neither the ACGME nor the ABO has specified how to teach these competencies within the field of ophthalmology.[1]

Many leaders in the field of ophthalmic residency education have shared their insights on how to shift to a competency-based residency model.[6] In this review, we will further explore curriculum development for ophthalmology residency.

WHAT DOES THE ACGME SAY OPHTHALMOLOGY RESIDENTS NEED TO LEARN?

The ACGME publishes "Program Requirements for Graduate Medical Education in Ophthalmology"[7] to guide curricular development. Section IV (Education Program) of this document outlines "Curriculum Components" and "[Curriculum] Organization and Resident Experiences." These sections specify the general requirements that residency programs must meet (e.g., provide a broad "range of structured didactic activities" and "integrate the ACGME competencies into the curriculum"); however, it does not outline the optimal method, or any concrete method, to meet these requirements.

Section IV also outlines resident requirements, with an emphasis on competency. As an example, Section IV.B.1.c (2) states that "Residents must demonstrate competence in their knowledge of: cataract surgery, contact lenses, cornea and external disease, eyelid abnormalities, glaucoma, neuro-ophthalmology, ocular trauma, optics and general refraction, orbital disease and ophthalmic plastic surgery, pathology, pediatric ophthalmology and strabismus, systemic disease consults, uveitis, visual rehabilitation and refractive surgery, and retinal/vitreous diseases." However, the document does not provide a plan on how to help residents achieve the competence that they are expected to demonstrate.

One may infer that the reason the ACGME has provided requirements, but not necessarily a roadmap on how to meet

these requirements, is so that programs that serve diverse populations and differ in faculty size and resources may create roadmaps that best fit their individual institutions. However, it can be argued that there should be a middle ground between providing no guidance and micromanaging day-to-day teaching. For example, one program may interpret the medical knowledge requirement, in part, to mean that a structured didactic schedule that covers the entirety of the American Academy of Ophthalmology's (AAO) Basic Clinical and Science Course (BCSC) is necessary throughout the year, while another program may meet this requirement with miscellaneous lectures and infer that BCSC knowledge acquisition should be via unsupervised and unverified independent study. Both sets of residents could still meet the ACGME competency; however, they may have vastly different familiarity with concepts covered in the BCSC. The ACGME's Milestones Project, discussed in the next section, moves us closer to a middle ground.

HOW DOES THE ACGME ASSESS IF RESIDENTS ARE COMPETENT?

In 2013, the ACGME launched the Milestone Project[8] to measure a trainee's performance. The ACGME's Ophthalmology Milestones[9] document divides each competency into sub-competencies and provides rubrics to assess residents within each sub-competency. Residents can be categorized anywhere from Level 1 to Level 5. For example, competency "Patient Care," sub-competency "Data Acquisition – Basic Ophthalmology Exam and Testing," places residents at a Level 5 if they "demonstrate expertise in advanced diagnostic tests and imaging." The ACGME's Milestones Supplement[10] provides an example that a resident at Level 5 may use the "Belin-Ambrosio keratoconus index to assess progression of keratoconus." However, neither document provides guidance or a plan on how or when to teach a resident how to interpret these advanced diagnostic tests, like the Belin-Ambrosio keratoconus index. A resident may go through all of residency without learning how to use the Belin-Ambrosio keratoconus index but may still get coded as being at Level 5 by interpreting a different "advanced diagnostic test." One may argue that a future retina specialist or neuro-ophthalmologist specialist does not need to know how to interpret the Belin-Ambrosio keratoconus index; however, there are "advanced diagnostic tests" that all ophthalmologist would benefit from being able to interpret, e.g. optical coherence tomography. We argue that despite clearly written milestones, residency programs would still benefit from a structured, national curriculum that could bring all residents to a minimum level of shared knowledge.

DO WE HAVE A NATIONAL OPHTHALMOLOGY CURRICULUM IN THE US?

To better understand progress made in ophthalmology residency curriculum development, we conducted an English-language PubMed/Medline search of "ophthalmology residency education" or "ophthalmology residency curriculum (or curricula)."

The search revealed many excellent articles on curriculum development and competency assessment tools, which, in summation, can help us move toward a national curriculum; i.e., a curriculum that clearly defines minimum objectives for all of ophthalmology training and provides concrete and detailed steps and tools to meet those objectives within the 36-month training timeframe. The national curriculum would not only *tell* residents what they need to know, but would also help *teach* them what they need to know.

Currently, the BCSC is the closest thing we have to a standardized national curriculum.[11] All US residents are expected to read these texts, and all are tested on them via the annual Ophthalmic Knowledge Assessment Program (OKAP). However, the BCSC is intended to be only a component of the ophthalmology resident's education. For example, it may be able to teach a resident important background knowledge about cataract surgery; however, it cannot teach a resident how to perform surgery.

In regards to surgery, there is no national curriculum.[12] Interestingly, as of 2017, nearly 30% of ACGME-accredited ophthalmology residency programs did not having a formal cataract surgery training curriculum.[13]

While our literature search was limited to articles written in English, articles from outside the US were also reviewed to gain insight into other countries' approaches to ophthalmology residency education. Two articles outlined a rather comprehensive set of ophthalmology residency curricular objectives (one by the International Council for Ophthalmology (ICO)[14] and one in India,[15]) and provided curricular objectives by postgraduate year (PGY). Yet again, however, there is no instruction on *how* to meet these curricular objectives.

Curriculum Development for US Ophthalmology Residency

Literature focusing on the concept of curriculum design is rare. In the 1960s-1970s, Spivey provided recommendations for developing objectives[16] and summarized techniques for determining curriculum content.[17] Two authorities on ophthalmology education have defined, to various degrees, curricular objectives for ophthalmology education. Internationally, this includes the ICO via its four International Curricula of Ophthalmic Education[18] and Principles and Guidelines of a Curriculum for Education of the Ophthalmic Specialist[14] and domestically, this includes the ACGME via its Ophthalmology Program Requirements[7] and Ophthalmology Milestones[9] documents. Some educators have made efforts to identify specific topics needing more robust curricula. For example, Evangelista et al. (2021) noted "practical curriculum implementation requires more specific details [than those provided by ACGME]" and used the Nominal Group Technique to construct a refractive surgery curriculum for all military ophthalmology residency training programs.[19] Lee et al. (2007) proposed methods and sample implementation matrices on teaching challenging concepts such as professionalism[20] and ideas for teaching systems-based competency.[21] Lee (2004) also proposed implementing a periodic journal club with a structured "Journal Club Checklist"[22] as a means to both teach and assess competency in practice-based learning.[23,24]

A greater volume of work has been done in the domain of surgical curriculum development. Importantly, implementation of a structured surgical curriculum for cataract surgery has been shown to significantly reduce sentinel event complications, even after adjusting for surgical experience.[25] Logically, one may presume that this would be the case for all surgical procedures, which provides further support for the need for a national surgical curriculum. It has been acknowledged that different approaches to teaching cataract surgery exist (e.g., sequential training, reverse training, modular training, and time-restricted training),[26] and some institutions have evidence-based preferences regarding what teaching style they prefer.[27–29] This is an important consideration, as we argue that a national curriculum does not negate the need for customized teaching that best suits a trainees' learning style.

Regardless of the approach, there is considerable support for preparation and practice prior to entering the operative suite, e.g. via a microsurgical skills course.[30] Several authors described the utility of simulation to aid in learning,[31–33] including surgical simulators,[34–39] microscope-integrated OCT,[40,41] and virtual reality.[1,42,43] There have been significant efforts made toward development of wet lab curricula. For example, the Iowa Wet Lab Curriculum outlines PGY-specific objectives, methods for meeting these objectives (e.g., a wet lab with staff supervision, subsequent independent practice time in the wet lab, and maintenance of a case log), and a timeline for meeting these objectives (five half-day sessions while on a 10-week rotation at the local Veteran's Affairs (VA) Medical Center.)[44] A detailed assessment tool is provided, which lines up with the content covered in each of the five half-day sessions. For those who are considering developing a wet lab curriculum, there exists a guide outlining a "stepwise approach to establishing an ophthalmology wet laboratory," including a wet lab curriculum plan for use by programs across the country.[45] There also exists a computer program that provides wet lab-based cognitive training that could serve as a surgical mentor in situations where live supervision is unavailable.[46] Crowdsourcing as a means of surgical skill assessment has also been explored.[47]

In terms of procedure-specific curricula, there exist resources for stepwise introduction to cataract surgery,[48] insertion of presbyopia-correcting intraocular lenses,[49] strabismus surgery,[50] and laser peripheral iridotomy.[51] An additional resource for cataract surgery includes a pre-operative cataract surgery checklist.[52] In regard to laser procedures, there are also "good practices" that we may reference.[53] There have also been efforts to create an ocular trauma and open globe surgical curriculum.[54]

Programs have also shared ideas for remediation of residents who struggle with surgery.[55] Some authors have encouraged the use of video review to improve surgical skills. As an example, Pittner et al. (2016) described the benefits of having supervising faculty members grade resident cataract surgery video clips.[56] In addition, Smith et al. (2013) described the use of computer vision-based motion analysis of video recordings to evaluate instrument motion during surgery.[57] Other important – yet often overlooked – skills such as obtaining informed consent[58] or delivering bad news,[59–61] could be integrated into

a national surgical curriculum. Involving senior nursing staff in these domains may be valuable.[58]

While the above sources provide some excellent ideas for curricular objectives, they offer varying amounts of guidance regarding how to meet those objectives. That is, implementation of objectives via a structured didactic plan is challenging. One proposed strategy for moving toward a structured curriculum plan includes (1) creating a blueprint and defining what needs to be taught/tested, (2) implementing the blueprint and developing appropriate tools for both teaching and assessment, and (3) testing the curriculum and teaching/assessment tools in the real world.[3] From a surgical perspective, in determining a curricular plan, it may be beneficial to consider different models of surgical teaching,[62] e.g. the Dreyfus model,[63] in which expertise is acquired over time by passing through distinct stages, and the Ericsson model,[64] which emphasizes that most skill domains require many years of practice to attain expert levels of performance and that this level of proficiency is reached only through deliberate and consistent practice. Proponents of one model may feel that practicing surgical steps in order is best, while others may feel it is best to focus on one component at a time and then string them together. Regardless of which teaching strategy is used, there are pre-, intra-, and post-procedural teaching guidelines that can be helpful.[65] Pre-procedural guidelines include getting to know the learner and setting pre-operative learning goals and expectations. Intra-procedural guidelines include creating a safe learning environment, communicating during the procedure, and introducing the procedure in a stepwise manner. Post-procedural guidelines include giving immediate feedback, performing video review, and keeping a competency checklist. Another strategy to assist in the development of a surgical curriculum plan includes review of residency programs that have tried to develop an implementation matrix for teaching and assessing surgical competence. For example, Oetting et al (2006)[66] focused on developing written explicit goals for each stage of training, shifting from a Dreyfus-model surgical rubric to a peer-benchmarked evaluation system, focusing on formative rather than summative feedback, incorporating deliberate practice via the Ericsson model, and documentation of sentinel events and remediation.

Despite the above described body of literature, there is no uniformly accepted comprehensive ophthalmology curriculum in the US that would ensure all graduating residents share a minimum-necessary level of knowledge and skill in ophthalmology. Next steps include identifying all ophthalmology residency curricular objectives relevant to US trainee – e.g. akin to those developed by Grover et al (2018)[15] for India or those outlined by the ICO[14] – and determining how exactly to meet those curricular objectives in a 36-month training timeframe. Let us say that we adopt the ICO curriculum,[14] which includes PGY-specific goals. We now need to consider how to meet those goals, especially when different ophthalmology programs differ in their rotation sequence, resources, time of procedural exposure, etc. In the more recent COVID-19 era, as learning became increasingly virtual, many educators have evaluated electronic modalities for teaching ophthalmology concepts.[67,68] Imagine a 36-month longitudinal course for all ophthalmology residents that helps residents gain a minimum

level of knowledge despite the differences in their programs. For example, there could be a website with links to all the high yield ophthalmology resources available[69] and an instructional manual to guide residents through standardized online lectures, BCSC sections, simulations, articles, videos, quizzes, etc. that should be completed on a daily, weekly, or monthly basis. In terms of surgical teaching, there is – of course – no substitute for live-cases; however, there is still room for standardization. For example, there could be a section of the online website dedicated to a surgical curriculum, with online lectures regarding surgical principles, videos of surgeries, prompts to timely use of online or in-person simulators and wet-lab exercises. In terms of in-person standardization of surgical teaching, there could be a requirement of pre-operative review of lens calculations with a faculty member (perhaps with a checklist of all the things to look at and consider when selecting an intraocular lens at the time of cataract surgery) and post-operative surgical video review with the faculty member who supervised the case.

Tools to Help Assess Resident Competency

An important part of determining the effectiveness of a curricular plan is determining whether students have met curricular objectives, i.e. assessing resident competence. There are several traditional models of testing and evaluation, including written testing; case-based learning; observed case management of simulated or standardized patients; direct observation of real patients; chart audits; review of procedures; operative or case logs; chart simulated recall; qualitative reviews by supervisors, patients, and peers; and portfolios.[2] Lee et al (2004) described specific criteria for the assessment process and proposed several pilot tools in the shift to competency based education: (1) written and oral examinations, (2) a 360 degrees global evaluation form, (3) a resident portfolio, (4) direct observation of operative performance and clinical examination, (5) a phone encounter tool, and (6) a journal club tool.[70] Many authors have proposed non-surgical assessment tools, for example the Ophthalmic Clinical Evaluation Exercise (OCEX),[71–73] periodic oral examinations,[74–76] various means for assessing professionalism,[20,77] a chart-audit-based "On Call Assessment Tool,"[78] and online patient exam and management problems.[79]

There are plentiful surgical assessment tools in ophthalmology.[26,80,81] The ICO has created Ophthalmology Surgical Competency Assessment Rubrics (ICO-OSCAR) for extracapsular cataract extraction,[82] lateral tarsal strip,[82,83] pediatric cataract surgery,[82,84] phacoemulsification,[82,85,86] ptosis,[82,87] small incision cataract surgery,[82] strabismus,[82,88] trabeculectomy,[82,89] and vitrectomy.[82] The principles of these rubrics have also been applied to other procedures such as panretinal photocoagulation (PRP)[90] and pterygium surgery.[91] Additional surgical assessment tools include the Objective Assessment of Skills in Intraocular Surgery (OASIS),[92] Global Rating Assessment of Skills in Intraocular Surgery (GRASIS),[93] Objective Structured Assessment of Cataract Surgical Skill (OSACSS),[94] Eye Surgical Skills Assessment Test (ESSAT),[95] Objective Structured Assessment of Technical Skill (OSATS),[30,96] Human Reliability Analysis of

Cataract Surgery Tool,[97] Subjective Phacoemulsification Skills Assessment (SPESA),[98] and a general microsurgical skill assessment scale.[99] Assessment tools with a narrower focus include a tool for assessment of the hydrodissection and phacoemulsification portions of cataract surgery[100] and specific laser procedures, including laser capsulotomy, peripheral iridotomy, and selective laser trabeculoplasty.[101]

Resident outcome data can provide clues about resident competency on a larger scale. Some authors have investigated resident outcomes and complications in cataract surgery,[26,58,96,102–114] corneal transplantation,[115,116] vitreoretinal surgery,[117] and in-office procedures.[118,119] Some compare resident and attending outcomes and complications in cataract surgery,[120–123] corneal transplantation,[124] tube shunt surgery,[125] strabismus surgery,[126] refractive surgery,[127] and in-office procedures.[128] Others assess residents' diagnostic accuracy[129] and patients' satisfaction scores with their resident doctors.[130]

The authors of the above assessment tools should be commended for articulating what resident proficiency looks like in various domains, at various stages of training, and for assessing the validity[131] of many of the proposed tools. The authors investigating resident outcomes and complications also provide valuable insights into potential strengths and weaknesses of our training programs. Despite these excellent efforts, a critical question remains: how can a resident achieve competency? As in the previous section, we argue that a standardized, national curriculum with detailed and timely instruction can help residents move toward a minimum level of competence.

Barriers to Curriculum Development & Implementation

There are many questions we must consider (and in many cases study), in order to have a better idea of how a national ophthalmology curriculum should look:

- *What should we be teaching?* While the ACGME has outlined necessary competencies, are there other domains in which ophthalmology residents need education? For example, advocacy and the impact of legislation on medicine, relevant legal concepts (e.g., malpractice,[132] contract review, or asset protection), reimbursement models, how to bill, how to teach,[133] the finances of private practice, the impact of private equity on ophthalmology, how to be mentors,[134–136] how to apply for grants or patents, appropriate ergonomic practices,[137,138] ethics,[139–143] leadership skills,,[144,145] etc.? We think that recent graduates should be involved in the creation of such a list of complementary educational topics.
- *Where should the teaching and learning happen?* What amount of learning needs to happen outside of work, and how do we make a comprehensive, feasible, high quality, and timely curriculum for this? Should there be a national orientation course for ophthalmology residents (whether it be in person or virtual) or annual intensive review course?[146] Review of program descriptions from the 1960s-1970s[147–163] shows that many programs historically required introductory ophthalmology courses for first year residents or annual review courses for select

classes. Should there be protected time outside of clinical duties for independent learning?[164] Litigation aside, should there be differences in the level of resident involvement in surgical cases at academic centers versus VA medical centers? Should all residency training programs offer an international experience?

- *Who should be doing the teaching and supervising?* Should all faculty members involved in education have some baseline training in education? Should certain faculty members, ideally with more intensive training in education, comprise a core teaching faculty? Should private practitioners be a part of every residency training program, given the unique perspectives they provide into non-academic practice?[165,166] What degree of teaching should be led by fellows?[167–169] When should residents be teaching each other?[170,171] How do we balance supervision with autonomy?[172–174]

- *How do we make time in clinical settings more educational*? Given the financial pressures for faculty to see as many patients as possible, what strategies can help mitigate shifting a resident's role from learner to scribe, technician, transporter, secretary, facilitator, etc.? Is it possible to make further involvement by mid-level providers fiscally advantageous in order to minimize non-educational tasks for residents that could interfere with the timely completion of a national curriculum?[175]

- *Practical considerations.* How do we successfully incorporate a national curriculum into very diverse ophthalmology programs, such that it enhances programs without stifling their creativity, imposing unrealistic expectations, or attempting to micro-manage them? From where would the funding come to create, implement, and maintain a national curriculum?

- *How do we assess the effectiveness of a national curriculum?* How and when do we evaluate our national curriculum make necessary changes? Should we conduct annual literature reviews to keep us up to date on the latest ideas in medical education?[176] Is the first-time-failure rate for ABO certification a good outcome measure for resident education?[177] Should educators be assessed individually as teachers?[178] Should we survey residents and recent graduates to illicit reviews of faculty, clinical content, surgical experience, and barriers to learning?[179–184] Are there forces that may prevent residents from giving honest answers on annual ACGME Program Surveys? How can residency review committees help educators?[185–187]

- *Are there external factors that may diminish educational returns for residents?* How do we define and minimize morale-draining non-educational activities in ophthalmology residency? Are there any accidental loopholes in the current duty-hours restrictions, and how do we address them? Should programs have a dedicated night float system?[188,189] Should there be parental leave policies?[190–192] Given that resident wellness is important to learning, how do we ensure residents have a voice in the creation of resident wellness programs?[193,194]

What Do We Know about Ophthalmology Residents' Learning Preferences?

Given the vast quantity of knowledge that residents need to acquire in residency, efficiency in teaching and learning is important. This requires an understanding of ophthalmology residents' learning preferences; however, this is an understudied area. The limited literature that exists on the topic examines adult learning principles and presentation pearls,[195] models for adult learning of procedural skills,[65] resident processing of visual information,[196] and learning styles amongst residents.[197] There is no consensus on learning style, and preferences vary by resident and year of training. For example, a study comparing a flipped-classroom teaching method (home pre-taped lectures followed by in-class group exercise) to the traditional-classroom teaching method (home reading assignment followed by in-class lecture) for horizontal strabismus noted that not only did preferences vary by topic, but also that 70% of senior residents (PGY 3–4) versus only 39% of first-year (PGY 2) residents preferred the flipped classroom over the traditional classroom.[198]

From an international perspective, a questionnaire-based learning styles assessment showed that most residents were auditory learners (34.9%), followed by multimodal learners (30.2%).[199] Educators in India found that residents ranked slide-based lectures and case presentations as the most desirable ways to learn, followed by seminars, wet labs, and journal clubs.[200] It is unknown whether similar trends exist in the US ophthalmology resident population, but investigating learning styles may help educators design more effective curricula.

In sum, there is very little data on (1) how ophthalmology residents subjectively feel they best learn, and (2) objectively, which teaching strategies are most effective for imparting ophthalmology knowledge.

Are Ophthalmologists Automatically Prepared to Be Educators?

In grade school, we expect our teachers to have formal training in education (e.g. bachelor's or master's degrees in education). However, there is no official pre-requisite training necessary to be an "ophthalmic educator."

There are resources for ophthalmic educators. The annual *Educating the Educators* meeting hosted by the Association of University Professors of Ophthalmology introduces program directors and other interested educators to new educational concepts, principles of curriculum development, and new competency assessment tools.[201] The ICO also has a variety of initiatives aimed at improving ophthalmic education, most notably an ICO Ophthalmic Educators Curriculum, courses for residency program directors, and conferences for ophthalmic educators (e.g. the World Ophthalmic Education Colloquium at the World Ophthalmology Congresses).[202,203]

Since use of these resources is not required, it is unclear what percentage of active ophthalmic educators have participated in any form of formal education training. It is important that any clinician working with residents has not only a desire to teach, but also the time to take advantage of these resources – and departmental support to do so. Furthermore, there needs

to be a mechanism to "evaluate the evaluators"[2] so that areas needing improvement can be identified and changed.

Are Academicians Rewarded for Their Efforts in Education?

Thankfully, many faculty members have a desire to teach and are drawn toward academia, but several factors[168,204,205] – time and money being commonly cited ones – make this challenging. In some instances, the presence of trainees can be associated with longer appointment times, even for patients not seen by a trainee.[206] Resident involvement in the operating room can increase case time; a study from Penn State showed a 12-minute and 41-second increase in operative time for cataract surgery, thereby increasing the surgical cost by $105.40 per case.[207] Over time, patient volume has increased, which has put increased pressure on clinicians to be efficient. This limits the amount of time faculty can spend on teaching and can also alter resident responsibilities in the clinic and OR, such as shifting focus from learning to patient flow.[208] Institutions should consider systems-level strategies for efficiency, making it economically feasible to hire enough support staff to allow physicians to meet patient demands without getting bogged down by administrative tasks that limit their time available for instruction. The University of California San Francisco published a study detailing low-cost interventions that led to a reduction in mean overall resident case time from 55 minutes to 46 minutes, allowing for 13 surgical cases rather than 10 cases per day.[209] Satellite offices have also been proposed as opportunities for financial boosts to academic centers, as they may offer a better payor mix.[210] An interesting study from Wilmer Eye Institute showed that the integration of a physician assistant on the resident consult service significantly increased time that residents were available for alternative clinical assignments, and resulted in a 75% increase in total first-year resident annual surgical volume.[175] Similar benefits may be possible for faculty if they are afforded increased support staff, such as scribes and administrative personnel, in their clinics.

Unfortunately, some faculty view resident education as a low priority. This begs the question, should all faculty at academic centers be held accountable for teaching? How do leaders hold those faculty accountable?[211] Will enforcing stricter educator accountability drive away current faculty and leave residency programs with shortages in educators? Simply providing an incentive payment of a few thousand dollars may not be enough to motivate some faculty, as lost revenue could easily be recovered with increased patient volumes. The incentives, whether financial, professional, or otherwise, need to be sizable enough that even for those with little interest in teaching, resident education becomes desirable. Traditionally, academic promotions in medical schools favored research involvement over teaching,[204] making the former a more attractive path for career advancement and inherently minimizing the prioritization of education. We must bridge such gaps. Brooker (1993) posed that department chairpersons can incorporate the philosophy that residency is the core of the institution and that initial recruiting criteria for faculty candidates must prioritize candidate aptitude and desire to be an

educator."[167] Part-time, retired faculty members may also be incentivized to share their expertise with residents.[204]

CONCLUSION

The field of ophthalmology has made progress in the realm of resident curriculum development and assessment tools; however, we still lack a comprehensive, intentional, national curriculum and concrete plans on how to meet the goals of this curriculum within 36 months. We need such a curriculum in order to ensure that all graduating residents have a standardized, minimum base of knowledge and skills. There are several factors to consider when creating a national curriculum, including many topics that warrant careful consideration (e.g. how do we move toward a national curriculum without micromanaging individual programs or taking away from their unique strengths?) and further study (e.g., how do residents best learn various topics?). In order to meet this goal, the field of ophthalmology needs to have a culture of prioritizing education and supporting the efforts of educators.

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