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## Academic Ophthalmology during and after the COVID-19 Pandemic

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Ophthalmology departments in academic medical centers (AMCs) have a triple mission of clinical care, teaching, and research. The coronavirus 2019 (COVID-19) pandemic has had a major impact on how the AMCs operate. In addition to ophthalmologists and other subspecialists being called to the front lines (e.g., to cover general wards), COVID-19 has required strategic and operational changes in each of the AMCs' triple missions.<sup>1</sup> Herein, we outline common practices and possible long-term impacts.

### Didactic Teaching Programs

Lectures have been converted rapidly from group meetings in conference rooms to online video conferences (e.g., Cisco WebEx, Zoom). This practice is convenient for faculty and residents, who may be dispersed in satellite clinics or segregated teams, allowing lectures to start at more convenient times (e.g., 7:00 AM rather than 6:30 AM because travel is eliminated). The long-term impact is that online video lectures are likely to continue after the pandemic.

Grand rounds are conducted via online platforms because of restricted movements, that is, complete or partial lockdowns. This approach also is easily adopted and increases the availability of invited national or international speakers (no need for travel), with reduced costs. A disadvantage is that online grand rounds reduce the opportunity for residents to network with senior ophthalmologists, some of whom may become fellowship preceptors. The long-term impact is that online grand rounds are likely to continue, but only as a component of the curriculum, because physical interaction and networking remain important.

International conferences (e.g., the Association for Research in Vision and Ophthalmology, World Ophthalmology Congress) also have moved online. This approach allows dissemination of scientific findings by international speakers without the need for travel. The long-term impact is that online large conferences may not continue, because conferences play key roles for interaction and networking. However, a virtual option likely will be a regular feature of all major international conferences.

### Patient Care

Outpatient volume has decreased (some >75%) and is restricted to urgent care. Personal protective equipment is required in clinics to prevent possible infection of patients and staff. A consequence of the decreased volume is that many patients are losing sight irreversibly. Before COVID-19, many

AMCs previously had developed virtual clinics and telemedicine programs.<sup>2,3</sup> Now patient acceptance has increased, including coding and billing for telemedicine services by insurers, which may hasten the adoption of such telemedicine programs.<sup>4</sup> For patients with mobile phones or computers, some AMCs can conduct face-to-face interviews. Others have adopted new technologies for visual acuity and visual field tests via telemedicine. Home monitoring equipment such as OCT may be possible for patients who can afford it.<sup>5</sup> To reassure patients who fear contagion at the AMC and to re-establish follow-up, some AMCs are scheduling appointments in safe environments outside the hospital. The long-term impact is that digital and telehealth initiatives are likely to be sustained, because virtual clinics and telemedicine will be established clinical practice for screening and monitoring of stable patients.<sup>6</sup> This approach may address some important problems in patient management, such as the failure of patients to receive the degree of clinical care in practice environments (e.g., rigorous follow-up for management of age-related macular degeneration) that they are required to receive in registration clinical trials.

Surgical volume has decreased (some >75%) during the pandemic and also is restricted to urgent or emergent conditions. However, because many AMCs are level 1 trauma units, complex cases (e.g., orbital cellulitis with abscess, intraocular foreign bodies) continue to receive surgery. In many AMCs, ambulatory surgery centers are closed, and ophthalmology cases are performed in the main operating rooms. The need for appropriate equipment for eye surgery in the main operating rooms thus has been demonstrated. Academic medical centers also have increased the rigor of protocols to ensure health and safety of operating room personnel during anesthesia induction, particularly for general anesthesia cases (with aerosol generation), before, during, and after surgery. The long-term impact is that routine elective surgeries will increase after the pandemic. Heightened safety standards are likely to persist indefinitely.

### Clinical Teaching Programs

Because of changes in outpatient practice, residents will become experts in telemedicine and remote monitoring. This will accelerate incorporation of artificial intelligence into clinical practice.<sup>7</sup> The pandemic also has had significant impact on surgical training for residents (e.g., 4–6 months of reduced surgical volume). Given the travel restrictions, no alternative surgical sites exist for residents. Training may need to rely more heavily on virtual reality surgical simulators.<sup>8</sup> During this pandemic, medical students likely

will not have exposure to ophthalmology. The long-term impact on clinical standards resulting from a reduction in clinical and surgical exposure on this cohort of graduating ophthalmology trainees is unclear. A cohort of graduating general physicians will have little to no ophthalmology exposure. Academic medical centers will need to modify residency curriculum to include data science, informatics, virtual reality training, and telemedicine.

## Clinical Research

Only essential clinical research has been permitted in most AMCs (e.g., clinical trials for sight-threatening conditions). A decrease in patient follow-up and treatment because of fear of acquiring COVID-19 in the clinic may impact clinical trial outcomes. Telemedicine has been used to contact patients, but remote diagnostics (e.g., vision, OCT), although useful for routine clinical care, may not be suitable for clinical trials. Regulatory agencies (e.g., the Food and Drug Administration) may have to accept novel data acquisition strategies. Some AMCs are establishing mobile vans for clinical trial patients for assessment and treatment. The long-term impact is that clinical research protocols likely will need to adapt to account for future pandemics, including novel data acquisition, telemedicine, online questionnaires, and remote monitoring. Regulatory agencies may modify their requirements regarding data capture.

## Basic Research

Similarly, only essential basic laboratory research activities are permitted in most AMCs. Experiments have stopped at reasonable pause points in their protocols. Automated support systems (e.g., power, temperature control) need to operate reliably, but a need exists to maintain core activities (e.g., cell culture, animal care). The long-term impact is that some changes to basic research protocols are likely.

## Academic Management and Working from Home

All nonessential nonclinical personnel have started to work from home. Most academic work can be carried out

remotely, including conducting meetings, telephone management, scheduling, grant administration, and budget preparation. New electronic and secure means for working from home are being implemented. Nonessential meetings have been cancelled without impact on operations, suggesting that many nonessential meetings could be cancelled permanently. The long-term impact is that acceptance of working from home will increase. Many staff members have children and elderly family members at home, and society value and impetus to maintain work from home programs may increase in the future.

Over the century, AMCs have evolved and adapted to changes to meet their triple mission of clinical care, teaching, and research. Many changes in practices during this pandemic will be accelerated and sustained and will become part of the new normal after the COVID-19 pandemic.

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