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Retina in the Age of COVID-19

Samuel Gelnick, MD\textsuperscript{a}, Marib Akanda, MD\textsuperscript{a},
Ronni Lieberman, MD\textsuperscript{b,*}

\textsuperscript{a}Department of Ophthalmology, Northwell Health, Great Neck, NY, USA; \textsuperscript{b}Department of Ophthalmology, Mt Sinai Medical Center, Ichan School of Medicine, New York, NY, USA

**BACKGROUND**

The novel coronavirus SARS-CoV-2 (COVID-19) pandemic presented numerous challenges for ophthalmology practices with regard to safely operating and providing care to patients, especially those at risk of vision loss. These obstacles were significant especially for retina practices in which patients may be due for intravitreal injections or need urgent workup for vision loss. Similarly, many glaucoma patients have treatment plans with time constraints preventing extended delays in care. Numerous adaptations were implemented, including the use of personal protective equipment (PPE), rescheduling strategies, and precautionary measures to allow for safely performing procedures both in the office and operating room.

\*Corresponding author. \textit{E-mail address:} liebermr@nychhc.org

https://doi.org/10.1016/j.yaoo.2021.04.013
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INTRODUCTION
Patients with sight-threatening disease faced the risk of vision loss because of their disease, which was then compounded by the risks posed by exposure to COVID-19 when seeking care. To curb the spread of illness, local, regional, and federal governments placed restrictions that also limited the ability of clinics to provide care for these patients. In order to adapt and safely protect patients from the risks of the virus while adhering to rapidly changing regulations, providers adopted many new practices. These included using improved infection control principles, triaging and screening patients to better settings, adjusting clinic patient flow to decrease exposure, and taking additional precautions with more efficient protocols for operating room cases. Although the recommended precautions and practices described later in this article changed the typical office flow and protocol for staff and physicians, they allowed crucial medical care to continue during an unprecedented crisis.

GENERAL CLEANING AND HYGIENE
All staff should be educated on COVID-19 precautions including appropriate use of PPE. Masks should be worn at all times by both staff and patients. Staff should clean hands often, including immediately after removing gloves and after contact with a patient by washing hands with soap and water for 20 seconds. If soap and water are not available and hands are not visibly dirty, an alcohol-based hand sanitizer may be used. A new pair of gloves should be worn for each patient encounter. Cleaning and disinfecting should be done before each patient being seen in an examination room and before the use of any imaging or testing [1]. The Centers for Disease Control and Prevention (CDC) recommends using bleach containing 5.25% to 8.25% sodium hypochlorite [1]. Alcohol solutions with at least 70% alcohol also may be used [1].

All slit lamps, imaging or testing equipment, and other patient contact surfaces including examination chairs should be cleaned and disinfected before each use. When cleaning any lenses, including those of imaging equipment, indirect lenses, or laser lenses, the manufacturer’s manual should be consulted before cleaning to avoid damage to the lens surface or coating [2]. Alternatively, clear cling wrap can be used to surround the lenses, and then wiped down between patients and changed when soiled [3]. All slit lamps and imaging modalities should be equipped with commercial barriers or breath shields in order to maximize protection for the patient and physician [4,5]. Disposal covers or equipment should be used where appropriate, including tonometers, ultrasound probes, and applanator tips [2]. Care should be taken to avoid contaminating eye drop bottles during each encounter by avoiding direct contact with patients.

PERSONAL PROTECTIVE EQUIPMENT
Appropriate PPE is a necessity in order to provide care during a pandemic such as COVID-19. Although 95% of vitreoretinal fellows in one study believed that surgical masks were available, only 65% of those fellows believed they had an
adequate supply of N-95 respirators available, and for 75% of those with respirators, a reuse policy was in place [6]. Extended use and reuse policies, although not recommended if avoidable, can be implemented when N-95 masks are in short supply [7]. Prior studies demonstrated that extended use of N-95 respirators can provide adequate protection for several hours before needing to be changed [8]. Appropriate measures must be taken to prevent the mask from becoming contaminated, such as wearing a surgical mask over the N-95 respirator and proper donning and doffing performed [9]. A face shield is also recommended to be used during close encounters with patients, which can even be used during indirect ophthalmoscopy examination [3]. Commercially manufactured breath shields also are recommended for slit lamp examinations [5]. Although both the patient and physician should be wearing masks, during the examination the patients’ mask may slip, and because of the close proximity, a breath shield can protect from unexpected sneezing or coughing.

PANDEMIC RESTRICTIONS
Under the guidance of local, state, and federal authorities, the COVID-19 required varying levels of restriction in order to safely protect the public and control disease outbreaks and hospital burden. When restrictions required lockdown of all nonessential businesses, stay-at-home orders, and other significant restrictions, disease activity was typically high or at risk of increasing, and these situations are described here as an “active pandemic.” As spread and incidence rates decrease, restrictions may slowly loosen and allow businesses to open in stages and social activities to resume gradually. As the course of the pandemic changes fluidly, so too do the restrictions on outpatient care providers fluctuate. Thus, rules and regulation for office visits of patients will differ between these disease activity levels, and the precautions under the most significant restrictions are described first.

CARE IN AN ACTIVE PANDEMIC
Scheduling visits
Office visits should be limited to only urgent matters when under lockdown or regional stay-at-home orders. All nonurgent office appointments should be canceled or rescheduled into telehealth visits. Although there is a significant amount of pressure to use telehealth measures both during a pandemic and in the future, ophthalmology is poorly suited at present to use telehealth to any reasonable extent. Patients should be notified of the cancellations in a timely manner to avoid any unnecessary travel and exposure. All patients should be called on an individual basis to confirm knowledge of the closure and need to reschedule when it is safe, and the office is reopened. At this time, an over-the-phone symptom screening and chart review should be conducted by a physician to ensure that red flag symptoms are not overlooked. In addition, patients should be given appropriate instructions regarding signs and symptoms they need to be aware of that would necessitate a more urgent
appointment or intervention. Finally, the appropriate information on how to contact the office in the event of any changes, questions, or concerns that the patients may have regarding their condition, appointments, or office functioning status should be communicated clearly.

Note that although the authors are limiting the discussion to retina practices, these guidelines can be extrapolated to other ophthalmic specialties, using their published guidelines.

Patients who are considered urgent or emergent and need to be seen during an active pandemic will need to be treated appropriately in order to ensure safety for the patient as well as the staff. Scheduling patients will need to be based on an appropriate risk assessment scale that takes into consideration patient characteristics, procedure factors, and disease factors. Patient characteristics consider the ability of a patient to attend the appointment and have appropriate follow-up. Procedural factors in a retina practice can be split up into procedures that can be performed in the office and those that require an operating room. Operating room procedures include pars plana vitrectomy, scleral buckle, membrane peeling, enucleation, and brachytherapy for example. Office procedures include laser therapy, intravitreal injection, pneumatic retinopexy, and cryotherapy [10]. Disease factors play a major role in the stratification process for patients in a retina practice.

Patients can be divided into urgent, semiurgent, and delayed appointments [3,11]. Note that other factors (social, age, comorbidities, monocular status) must be taken into account, with each patient being considered individually.

Urgent visits include the following:

- Symptoms such as sudden painful or painless vision loss or metamorphopsia, new onset, flashes, and floaters
- New cases of retinoblastoma, other ocular tumors, or retinopathy of prematurity
- Conditions needing urgent surgery, including open globes, recent rhegmatogenous, tractional or combined retinal detachments, endophthalmitis, retained lens material with secondary glaucoma, and bilateral vitreous hemorrhage
- Any nonurgent condition in the functioning eye of a monocular patient
- Significant pain

Semiurgent appointments include the following:

- Patient receiving injections for macular degeneration, choroidal neovascularization, diabetic macular edema, retinal vein occlusion, or other retinal condition, especially if there is perceived vision loss
- Patients with ongoing laser therapy (pneumopexy)
- Patients operated on in the last 3 months who have silicone oil or gas
- A referred retina case by another ophthalmologist also may be considered semiurgent

Delayed appointments include the following:

- Patients receiving injections with stable clinical status
Routine follow-up for macular degeneration, diabetic retinopathy, and retinal vein occlusions
- Stable postretinal detachment surgery
- Inherited retinal dystrophies
- Medication-induced retinal screening

Appointments scheduled during a pandemic require strict adherence to appropriate guidelines to ensure the safety of patients and staff. Staff and medical doctors alike must be cognizant of the fear that patients have coming into an office or hospital setting and must be able to reassure them as to the steps taken to assure their safety. Before the day of the visit, a travel history and symptom screen should be taken [6,12–14]. If the screening questions are negative, the patient may enter for the appointment according to the strict guidelines on distancing. Companions will be strongly discouraged in order to prevent spread of the virus. If a companion is necessary, only one companion may be allowed, undergoing the same testing and screening as the patient. The patient should be encouraged to wait in another location (home, car, outside, hospital, or medical center lobby) until there is room in the office to maintain social distancing. At that time the patient may be called in to the office for the appointment. At the door there should be another symptom screen and temperature test. All patients and companions would be required to wear a mask, and masks should be provided if the patient arrives without one. The patient should sit in a clearly marked, socially distanced location. When the office is ready for the patient to come in, they should be escorted to the appropriate room. If imaging is required, they should be brought to the appropriate imaging modalities at this time. It is important to maintain appropriate distancing, and no other patients should be in the halls or around the imaging locations. Some practices are using directionality (every hallway is one way) in order to decrease contact. After this is complete, they should be escorted to the room where they will be examined by the physician. Patients should not leave the examination room from this point until they are finished. Although in some practices patients were shuffled from room to room for different aspects of the examination, such as vision testing, dilation, and examination, now, in order to limit the exposure of each patient and ease adherence to disinfecting protocols, the entire examination should take place in one room.

During the various parts of the examination, it is important that the nurse, technician, provider, and patient all wear the appropriate PPE for the given situation and that the surfaces are disinfected as described earlier. Use of the slit lamp only when medically necessary may be appropriate due to the close nature of the examination. If examination at the slit lamp would not change the management of the retinal disease, a 20D examination of the patient may be substituted. If required, a 78D or 60D lens examinations may be preferred to increase the working distance necessary for an examination at the slit lamp, decreasing exposure and helping prevent fogging of the lens from the patient’s redirected exhalation from the mask. Although talking should be held to a
minimum, appropriate discussion regarding patient care should be had at a comfortable distance where all the information can be understood clearly and safely. Masks should be worn through the entirety of the examination.

Precautions for procedures
When it is determined that a procedure is medically necessary, the appropriate safety protocols need to be followed to ensure safety of staff and patients. Although most of the procedure will be the same as any other procedure, there are certain aspects of the procedure that should be considered in light of COVID-19 and the necessary changes to practice.

Intravitreal injections
Because of their role in vision-threatening retinal disease and dosing interval, intravitreal injections have been one of the more common procedures done during an active pandemic. Appropriate anesthetic should be applied according to regular practice. Topical betadine should be applied in the usual manner. It is important to properly visualize the area of injection. If a practitioner finds that due to the face shield, he or she is unable to maintain proper visualization, the face shield should be removed before preparation for the injection. Alternatively, or if the practitioner needs glasses during the injection, it may be useful to tape the superior portion of the mask to the side of the face preventing exhaled breath from exiting the superior aspect of the mask and fogging the view. Similarly, the patient should have the superior portion of the mask taped as well. Although there has been much debate about the need for practitioners to wear masks during injections, during the COVID-19 era this a foregone necessity. Because patients must wear masks as well, there is a theoretic increased risk in infection due to their own redirected airflow superiorly from the mask. Given the concern, it, therefore, is recommended to tape the superior portion of the mask to the side of the face during the procedure to limit this exposure. Although masks will be worn, no talking during the injection is advised to avoid any possible increased risk of infection as well as movement from the patient. The rest of the procedure should be done in the usual manner.

Several international studies prioritized patients for intravitreal injections and split patients into 3 priorities [3,11,15]. Following is a summarization of these lists:

High priority—0 to 7 days from their original appointment or from referral.
• Monocular patients with macular disease
• Wet macular degeneration, choroidal neovascularization, and active proliferative diabetic retinopathy with recent vitreous hemorrhage and no prior laser
• New-onset central retinal vein occlusion
• Retinopathy of prematurity
• Any patient from moderate priority that was already deferred 10 to 15 days

Moderate priority—10 to 15 days from their original appointment or from referral.
Other macular neovascularization patients such as those with proliferative diabetic retinopathy, retinal vein occlusion, and central serous chorioretinopathy with worsening vision

Severe nonproliferative diabetic retinopathy, no prior laser with macular edema and worsening vision

Any patient from low priority that was already deferred 30 to 40 days

Low priority—30 to 40 days from their original appointment or from referral.

Diabetic macular edema, retinal vein occlusions, and choroidal neovascularization that are stable since their last injection

When deciding on modes of treatment, due to the nature of unknown follow-up time in the event of an active pandemic, it is recommended to attempt to use modalities that will require less frequent follow-up time when appropriate, for example, using photodynamic therapy for chronic central serous chorioretinopathy with macular neovascularization as well as using intravitreal corticosteroids or using treat and extend protocols with antivascular endothelial growth factor agents for eligible patients [16].

Precautions for laser procedures

Laser procedures pose a unique procedural problem that require prolonged time of exposure at a very close distance. Appropriate protocols should be maintained when such procedures are necessary to prevent vision loss. Both patient and physician should wear N-95 respirators if possible due to the close proximity. As stated before, breath shields and face shields should also be used during this procedure as long as it does not interfere with patient care and effectiveness of the procedure. When possible, indirect laser should be used to increase the patient to physician distance. If not possible, contact-lens laser therapy can be carried out with adjustments to decrease exposure and risk. Multispot therapy should be preferred to decrease procedural time. The risk and benefit of splitting the treatment to minimize exposure time should be weighed against the possible difficulty with follow-ups. If the patient and provider can remain in the masks or respirators for an extended period of time, applying more treatment in one session to prevent the need for follow-up in the near future would be preferred. If, however, the burden of the masks for an extended period of time would be too difficult, the appropriate treatment should be done in part and finished at a later date. If the office does not have other emergent procedures waiting, they can take a break and finish in the same session. Although disposable lenses are preferable, if not available, lenses must be cleaned, following manufactures guidelines, with soap and water, or dipped in to 0.5% hypochlorite solution. One international society has recommended for the use of cling wrap surrounding the lenses during laser treatment without apparent decrease in effectiveness [3].

Scheduling follow-up visits

Careful consideration and planning of follow-up visits is required. When clinically possible, patients should have extended time between intravitreal
injections either by treat and extend measures or by changing to intravitreal corticosteroid injections. Televisits may be facilitated through the use of video to assess symptoms, in addition to obtaining objective data with applications on computers or smart phones where patients can perform tests for visual acuity, color vision, amsler grid, and possibly even fundus photos to assess for retinal pathology [17].

Patients with positive screening or testing for COVID-19

If a patient has a positive screening for any of the Covid-19 symptoms or a positive test the appropriate guidelines should be in place to prevent any possibility of spread of the virus [18]. First, consider the medical necessity of the appointment if it can wait until symptoms resolve and the patient is out of the window of spreading the disease [13]. If this is possible, rescheduling of the appointment should be done and close follow-up with the patient should be had to make sure the condition is not deteriorating and sooner management is required [13,18]. Appropriate communication to the patient and documentation of discussions including risks, benefits, and alternatives is important when dealing with possible visually threatening conditions.

When the patient who screens or tests positive must be seen or undergo a procedure, the decision has to be made whether or not the patient can be cared for safely in the office setting, rather than a nearby hospital or medical facility that can accommodate a patient with positive illness [6]. In order to safely treat a patient with possible COVID-19, ideally a negative pressure room will prevent further exposure to other staff or patients [6]. If a practice has the ability to do this, an examination or procedure can be done safely in such a room. If possible, any equipment necessary, including laser equipment, should temporarily be moved into this room for the procedure. If not possible, there needs to be appropriate referral or arrangement with a local facility that has the capability of managing patients with COVID-19.

When the patient is in the appropriate setting, the physician can begin the encounter. As much that can be taken care of over the phone without entering the room should be done to minimize time of exposure, including any additional pieces of information regarding the condition; explaining the risks, benefits, and alternatives of the procedure; and obtaining consent for the procedure. When this is complete and the physician is ready for the examination, he or she should enter the room in full PPE. In addition to transmission from aerosolized or contacted respiratory droplets, 24% of patients with moderate-to-severe disease have been shown to test positive for the virus in samples of their tears, presenting another concerning vector for the treating ophthalmologist [19]. These risk factors necessitate the use of full PPE including gloves, N-95 respirator and face shield, as well as full body impermeable gown for the physician. The patient should be wearing an N-95, with minimal talking during the examination to prevent transmission. The examination should otherwise be a normal examination without compromising the care of the patient including appropriate visualization as needed.
CARE AFTER IMMEDIATE PANDEMIC RESTRICTIONS ARE LIFTED

During this time, it is important to recognize that although the office will be opened, adhering to strict protocol is important to ensure appropriate patient care without risking increasing spread of the disease. Scheduling appointments will not result in the same volume as pre-COVID-19 numbers, but routine visits will be welcome at this point in addition to the urgent emergent cases that will continue from during the time when the pandemic is active.

Continued screening and scheduling precautions
Patients should be kept updated regularly on the functioning status of the clinic, which includes the office hours, contact modalities, and any scheduling changes. Providers should use modalities such as letters, voice messages, e-mails, and social media to ensure the availability of important information regarding their eye care is being populated appropriately and reaching everyone it needs to. Patients should be able to contact the providing office if they have questions in regard to scheduling, walk in procedures, testing requirements before office visits, as well as questions about symptoms they are having and the request for medical care over the phone and the ability to set up appointments if deemed necessary. Providing physicians should take extra care with patients who have retinal disease to be aware of signs and symptoms that may indicate grave prognosis such as flashing lights, numerous new floaters, and loss of partial or complete vision in one or both eyes. As part of a retina practice, patients should be properly educated on these signs and symptoms that may indicate the need for prompt medical treatment.

Every patient will be given a COVID-19 symptom questionnaire either by telephone or email 2 days before the office visit. Anyone with a positive screen should be offered to reschedule for a later time period when the symptoms resolve. If this is an urgent or emergent situation as described earlier, the same protocols should be followed as described earlier, and COVID-19 testing should be done before entering the office. If the screen is negative, there is less risk, and the COVID-19 test may be omitted.

Day of appointment precautions
The patient should arrive at the office and, if necessary, with a maximum of one companion. Patients and companions should be screened regarding symptoms [20]. As per the CDC symptoms such as fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, new loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting, and diarrhea may represent infection [20]. Although transmission through ocular surface and tears has been shown to be low, especially in patients who are asymptomatic, owing to the nature of the eye examination, including symptoms of conjunctivitis would be recommended to be included in the screening questionnaire [19,21].

If the screening test is negative, it should be documented as such in the medical record. If the screening test is positive the decision needs to be made whether this is an urgent or nonurgent visit as described earlier. In either
case the primary care provider of the patient should be contacted in order for the patient to obtain the appropriate testing. If this is a nonurgent matter, the appointment should be rescheduled for a later date. Regular reminders are encouraged with nonurgent patients in order to prevent being lost to follow-up when the symptoms have resolved. If the decision is made that the patient has an urgent matter that needs to be dealt with, an appropriate protocol needs to be in place to facilitate appropriate care of these patients as documented earlier.

Because of the prevalence of false-negative tests, patients with documented negative testing are not excluded from screening [22].

Patients who have negative screening and temperature tests should be given the option to wait outside the office until there is a room ready and should not be allowed in the waiting room until the waiting room can fit the patients properly socially distanced. When they are ready to be seen, similar guidelines will follow as if there was a pandemic. Patients should have any necessary imaging done before entering the examination room. Once they are in the examination room, ideally they should remain there for the duration of the examination and procedure. Having patients move in and out of examination rooms for several parts of the examination increases exposure from patient to patient and should be avoided. PPE should be worn by staff at all times, which includes a mask such as surgical 3-ply or cloth mask, gloves when handling instruments or touching patients, and a face shield or glasses. The examination should be done in the usual manner, taking care to be efficient, without compromising patient care or unnecessarily increasing exposure. Using techniques such as 20D anterior examination and minimizing close contact at the slit lamp when able would still be appropriate in this setting. At the end of the visit, the patient and any companion should leave the office. Follow-up visits will be scheduled over the phone to avoid increased exposure time in the office.

Performing elective surgery
Preoperative testing may be performed for patients with no history of the disease. When there is regional presence of the disease, every patient needs to undergo screening and testing for the disease [23]. If negative, a patient can undergo the procedure as normal with appropriate precautions in place.

If a patient tests positive the procedure should be postponed as follows. Elective surgeries requiring anesthesia for patients with symptoms or positive test: all positive patients with nonurgent elective procedures should be rescheduled for when they are out of the isolation and COVID-19 precaution phase [24]. CDC recommends a symptoms-based approach when discontinuing isolation precautions [25]. Patients with mild-moderate disease should fulfill all 3 criteria: at least 10 days since symptoms first appeared, at least 24 hours since last fever without the use of fever-reducing medications, and any symptoms (eg, cough, shortness of breath) have improved. Patients with severe disease or who are immunocompromised may follow these guidelines as well,
with the exception that up to 20 days should be considered since symptom onset to make sure the virus has cleared. Repeat testing can be considered in the setting of suspicion for persistent infection with the knowledge that the patient can test positive for a prolonged period of time after the virus has cleared. Patients who were asymptomatic with a positive COVID-19 test need to be symptom free for 10 days from their positive test. Recommended wait times from disease until surgical procedures are as follows [24]:

- Four weeks for an asymptomatic patient or recovery from only mild, non-respiratory symptoms
- Six weeks for a symptomatic patient (eg, cough, dyspnea) who did not require hospitalization
- Eight to ten weeks for a symptomatic patient who is diabetic, immunocompromised, or hospitalized
- Twelve weeks for a patient who was admitted to an intensive care unit due to COVID-19 infection. This is based on various studies showing the effect of Covid-19 and other respiratory illness on the postoperative recovery period [26–30]. There is no role for repeat testing in these patients at this time, unless new symptoms arise and/or 90 days have passed since the last test.

Operating room precautions
If there is a need for general anesthesia, only staff who are required to be present in the room for the intubation and extubation should be present and wearing N-95 respirators, face shield, and gown to prevent spread of infection through aerosolization.

For monitored anesthesia care with conscious sedation, if supplies permit, it is still recommended for the surgeon to wear an N-95 respirator and patient to wear a surgical mask, due to the prolonged exposure and close proximity of the surgeon to the respiratory system of the patient [2]. Air conditioning can still be used during operating room cases. Although negative pressure systems are recommended, if this is not possible a positive pressure system can still be used. If an exhaust system is used, air should be expelled only by a high-efficiency particulate air filter. Five percent povidone iodine should be used in preparation before the case, as it is viricidal and disinfects in 15 seconds. In order to maintain sterility, mask, face shields, and shoe covers should all be donned before gowning in the operating room. Goggles may be preferred when using a microscope, and they can be decontaminated and reused. N-95 respirators can be reused the same day as long as they are not soiled during a case or touched in between cases. Other surgical instruments should not be reused from one case to the next without sterilization to prevent infection spread. Proper draping with water tight seal is important especially around lower eyelid to prevent upward redirected airflow into the sterile field.

**SUMMARY**
COVID-19 required numerous changes as earlier in order to safely provide care to patients. This particular pandemic represented a steep learning curve
that resulted in many “lessons learned” that should continue to be used. By minimizing risk of transmission through good infection control principles, patients and providers are able to safely continue operations. Frequent hand hygiene, disposable lens, office social distancing, and contact surface disinfection should continue to protect patients from other viral pathogens. Although masks may no longer be required at some point in the future, ophthalmology providers may choose to continue their use given the close proximity required for examination. Efficient operating room use and triaging of patients and procedures for clinic visits may have provided an improved flow to the practice, with less impact on nursing or other staff after the initial driving force of decreasing exposure necessitated by the COVID-19 pandemic has passed. These lessons and the experience gained, if carried forward and not disregarded, should help protect and allow safe measures to be implemented more quickly and efficiently to provide excellent, sight-saving care for those with vision-threatening disease when the next eventual crisis presents itself.

**CLINICS CARE POINTS**

- In the post-COVID-19 era, patient and health care worker safety is of utmost importance while maintaining appropriate clinical care.
- In addition to regular handwashing and use of PPE, all equipment and patient rooms should be wiped down and cleaned between patient exposures.
- Providing up-to-date information on guidelines for patients to schedule appointments and triaging visits to urgent, semiurgent, and delayed appointments can help manage patient flow through the office.
- In-office visits, when appropriate, should be done with proper screening and care taken in the office to minimize patient exposure.
- Reducing frequency of visits using methods of treatment, whether medical or surgical, that can extend follow-up time should be considered.
- Because society relieves restrictions, it is important to maintain safe practices and screening to minimize exposure.
- When permitted elective surgeries should be conducted with appropriate screening and safety precautions.
- Emergent procedures can be conducted with COVID-positive patients by following safe procedural protocol.

**Disclosure**

The authors have nothing to disclose.

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