



SARS-CoV-2: An Ophthalmological Insight into the Pandemic; Challenges and Management Strategies

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Abstract

Objective: To formulate a protocol for safe and effective management of an ophthalmologic practice in a hospital or a clinic during the Covid - 19 pandemic.

Methods and analysis: Literature was reviewed regarding Covid-19 pandemic and ophthalmology. The following key words were used. Covid-19, telemedicine, challenges, management strategy.

Result: An efficient protocol for ophthalmology practice during the Covid-19 pandemic was established which covered various protective measures that are essential and vital in the Covid-19 pandemic.

Conclusion: An evidence-based protocol was formulated which may be modified in future as per the latest developments and trends in the ongoing pandemic.

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Key words: Covid-19 pandemic; Ophthalmology; Challenges; Management strategy.

Introduction

Since late 2019 and continuing for a foreseeable future, SARS-CoV2 has interrupted every aspect of medical care globally. From the preliminary period of the pandemic, ophthalmologists were at a high risk. The first physician to blow the whistle about COVID-19 causing human disease was the dauntless ophthalmologist Li-Wenliang, MD in Wuhan, China. Tragically he succumbed to the disease just weeks afterward heightening concerns within the ophthalmic community [1]. Since then, many reports have suggested that ophthalmologists may be at particular risk of infection perhaps due to proximity to patients,

large numbers of patient interactions, spread through contact with infected secretions or the variable use of personal protective equipment [2,3].

The recent pandemic lockdown has resulted in cancellation of many ophthalmologic visits and surgeries allowing only emergency services to be continued which could have potentially led to permanent and significant harm to patient's vision [4]. A survey among public with eye diseases highlighted a significant negative psychosocial impact of lockdown on individuals with visual impairment and many of them expressing fear of further sight loss due to delayed review or treatment [5]. In



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developing eye care systems physicians face myriad difficult decisions. The number of patients overwhelms the capacity, deciding who receives treatment cannot simply be a question of diagnosis. Determining how to allocate care is agonizing, but necessary. Therefore, it is important that efficient measures are implemented during and after the Covid pandemic to avoid irreversible sight loss in eye disease which are vision threatening.

Challenges faced by ophthalmologists

Ophthalmologists are at a high risk due to various factors of which significant issues are discussed below.

1. Proximity to the patients during examination

- a. Proximity to the patients while examining in the clinic (conjunctival discharge, tears, nasal, or oral secretions) can pose a hazard to ophthalmologists [6-8]. SARS-CoV-2 via its surface spike glycoprotein binds to the Angiotensin-Converting Enzyme 2 (ACE2) receptors. These ACE2 receptors are found distributed in various human organs, including the surface of the cornea and the conjunctiva and these act as potential entry points [9,10]. Coronavirus was spotted in the conjunctival discharge of COVID-19 positive patients [11]. Loon et al have isolated virus from the tears of corona virus infected patients by Reverse Transcription Polymerase Chain Reaction (RT-PCR) [12]. There is potential risk of tears contaminating the fingers of the examiner and various equipment used.
- b. One of the main challenges faced by ophthalmologists is while using a direct ophthalmoscope which is crucial in the diagnosis of many conditions like papilledema, small bleeds, microaneurysms, microvascular abnormalities and other vascular changes which aid in the management of various ocular pathologies and also in examination of a patient with poor GCS where examination with an Indirect Ophthalmoscope is almost impossible. While using a direct ophthalmoscope, the doctor needs to be as close as 1.5cm to the patient for apt visualization of the fundus which poses a great danger to the examiner because of the close proximity to the patient where chances of spread of infection is very high.
- c. Yet another maneuver done routinely in an ophthalmology clinic is the eversion of eyelids which is done for visualization of the fornices, palpebral conjunctiva which are vital in the examination of a patient of conjunctivitis, foreign Body in eye, delineation of a hemorrhage and various other ocular pathologies. This maneuver increases chance of transmission of infection via ocular secretions if adequate precautions are not taken.
- d. Each patient visiting the ophthalmology clinic requires evaluation using multiple contact based equipment like autorefractometer, non-contact tonometer, slit lamp, IOL machines, OCT which require the patient to be aptly positioned by placement of chin on the chin rest and forehead touching the forehead rest. This acts as potential sources of infection both for other patients and also ophthalmologists.

2. Routine use of reusable equipments

Ophthalmology is a unique practice requiring use of reusable equipment in close contact with patients and with many high-risk high-touch surfaces, thereby increasing the risk of transmission of the disease among patients [13]. Some of

these equipment includes Goldmann Applanation Tonometer heads, Slit lamp Biomicroscopes, Humphrey Visual Field Analyzers, Optical coherence Tomography, Specular microscopes, IOL Masters, Ultrasound Biomicroscope and even Trial frames and lenses which are routinely used in any ophthalmology clinic. Patients come in direct close contact with various parts of such instruments like chin rests, forehead rest and various probes provided with such instruments. This couple with the fact that corona viruses can survive up to 96 hours in biological fluids and in high relative humidity and low temperature makes contaminated surfaces key sources of iatrogenic transmission of infection [14-17].

3. Atypical symptoms

Unfortunately, the covid-19 virus not only affects the respiratory tracts, but it may also manifest in other regions like the gastrointestinal tracts, and the ocular tissue as conjunctivitis has been reported during this outbreak. The conjunctival secretions yielded positive RT-PCR results in cases of conjunctivitis [18]. Eyecare professionals can also be caught unaware because conjunctivitis being one of the first signs of covid-19 at presentation [19].

Effective management strategy guidelines

Covid -19 outbreak continues to challenge the healthcare ecosystem. The healthcare infrastructure needs to aim at early diagnosis of cases, increasing the testing protocols to increase the detection of cases and minimize the risk of transmission at all levels. Several measures to control infection were universally recommended and few manuscripts have detailed experience, gained during the ongoing corona virus pandemic [20-22].

Infection control measures can be divided into 4 main categories. Use of PPE, General Infection control Measures and Administrative control.

1. Use of PPE

With the stringent triaging and screening system in place, most of the routine patients coming for ophthalmologic consult would be at low risk for Covid -19. Current recommendations from the WHO and the CDC and prevention are use of PPE as a standard precautionary measure. The AAO and IOS have published a report advising ophthalmologists to wear masks and eye protection when seeing patients infected with Covid-19 [23,24].

2. General infection control

To minimize the risk of contamination with respiratory droplets, tears and conjunctival secretions of infected patients; large protective plastic shields are being attached to slit lamps which acts as a barrier between the patient and ophthalmologist. IOS and AAO has also recommended such installation [23].

Ophthalmic instruments can be a high source of virus contamination as patients often come in close contact with them. Routine disinfection/sterilization with the appropriate agents should be done. CDC recommended the use of disinfectants specific to COVID -19 including diluted household bleach (5 tablespoons of bleach per gallon of water and alcohol solutions with at least 70% alcohol) [25]. Disinfection of surfaces may also be performed using UV light, once manual chemical disinfection process is completed, to compensate for errors in manual disinfection process and thereby ensure a complete disinfection of the equipment and surfaces. Investigations have shown that

222-nm far-UVC light at low doses of between 1.7 and 1.2 mJ/cm² inactivates 99.9% of aerosolized coronavirus though the SARS-Cov-2 strain was not specifically tested. Use in public locations at the current regulatory exposure limit (~3 mJ/cm² /h) would result in approximately 90% viral inactivation in 8 min and 99.9% inactivation in ~25 min [26].

It is also recommended to avoid the use of air puff to measure intraocular pressure to prevent the generation of aerosols from infected conjunctival secretions that risk transmission to healthcare workers [27].

Lai et al reported the importance of air ventilation in waiting areas and suggested opening the fresh air dampers of the air handling equipment to achieve higher rate of fresh air with improved air dilution [20].

It was also recommended that health care workers should wash their hands with combination of chlorhexidine with ethanol and cetrimide, or hand rub with alcohol based solutions and routinely clean “high-touch surfaces” after every patient [23].

3. Administrative measures

This is the most important step adopted to reduce risk of exposure of uninfected individuals which also involves a structural reorganization in the overall working environment and clinical practices during COVID-19 pandemic. It requires a joint effort from all health care professionals involved in patient care in the ophthalmology department.

It was evident that even subclinical patients can transmit the infection [28]. A well-planned system of triaging at different levels of patient care will help to achieve this in an effective manner [20]. Patients who won't be adversely affected by postponing their routine OPD visit need to be identified, segregate and informed accordingly depending upon their disease condition. This can be done by contacting them through Short Message Service (SMS), text message services or even calling personally and passing the information at least a week prior to their scheduled appointment. They may be provided with an enquiry number through which necessary information about rescheduling an appointment as well as consideration of a drug-refill if appropriate, may be enquired.

Tele services play an important role in delivering patient care in this scenario. The use of tele medicine in ophthalmology was first described in 1999 by HK Li and it is defined as the use of information technology to support healthcare between participants who are separated from each other [29,30].

Suspending elective services and surgeries will add on to the measures obtained to reduce transmission risk. Remote telephone-based interviews, video examination visits can be a good alternative for managing non-urgent patients and thereby avoid direct patient-physician close contacts.

Installation of triage stations as first contact points help to scrutinize and screen patients as well as attenders. Emerging studies show that most of the COVID-19 cases present with fever as their primary symptom [31]. These stations should be equipped for symptomatic screening of all individuals visiting the OPD.

Additionally, a questionnaire-based triaging will help to further identify individuals with possible history of contact with COVID-19 positive cases and can be screened, segregate, and examined separately. This includes enquiry about symptoms

suggestive of fever, upper or lower respiratory tract infection (cough, sore throat, running nose, breathlessness), history of any family members or close contacts suffering from same symptoms, any history of travel to covid outbreak areas in past 14 days etc. (Figure 1). The case classification scheme launched by WHO which triaged patients into healthy, suspect, probable and confirmed COVID-19 categories may be made use of for the same [32].

COVID-19 PATIENT SCREENING QUESTIONNAIRE
(Indicate Yes/No by checking the boxes provided against each questions)

Patients Name _____ Age/Sex ____/____ Date ____/____/____

S/No	Screening Questions	Response
1.	Do you have fever or have felt feverish recently?	Yes <input type="checkbox"/> No <input type="checkbox"/>
2.	Do you have muscle pain, headache, body ache or fatigue?	Yes <input type="checkbox"/> No <input type="checkbox"/>
3.	Do you have chills or repeated shaking with chills?	Yes <input type="checkbox"/> No <input type="checkbox"/>
4.	Do you have any upper respiratory symptoms (running nose, cough, sore throat)?	Yes <input type="checkbox"/> No <input type="checkbox"/>
5.	Do you experience loss of taste or smell recently?	Yes <input type="checkbox"/> No <input type="checkbox"/>
6.	Have you been experiencing nausea and/or vomiting?	Yes <input type="checkbox"/> No <input type="checkbox"/>
7.	Have you been experiencing any recent GI upset or diarrhoea?	Yes <input type="checkbox"/> No <input type="checkbox"/>
8.	Were you diagnosed with pneumonia recently?	Yes <input type="checkbox"/> No <input type="checkbox"/>
9.	Did you have any contact with patients confirmed with coronavirus disease in the past 14 days?	Yes <input type="checkbox"/> No <input type="checkbox"/>
10.	Have you travelled in the past 14 days to any region which had COVID-19 outbreak?	Yes <input type="checkbox"/> No <input type="checkbox"/>
11.	Have you been advised to self-quarantine because of exposure to someone with COVID-19?	Yes <input type="checkbox"/> No <input type="checkbox"/>
12.	Are you a healthcare worker, or works in a wet market?	Yes <input type="checkbox"/> No <input type="checkbox"/>
13.	Have you been diagnosed with COVID-19? if yes, when?	Yes <input type="checkbox"/> No <input type="checkbox"/>
14.	Have you received a full dose of COVID-19 vaccine? If yes, when?	Yes <input type="checkbox"/> No <input type="checkbox"/>
15.	Are you over the age of 65?	Yes <input type="checkbox"/> No <input type="checkbox"/>
16.	Are you suffering from any of the following illness? a) Heart disease b) Lung disease c) Kidney disease d) Diabetes e) Autoimmune disorders	Yes <input type="checkbox"/> No <input type="checkbox"/>

Figure 1: Questionnaire for screening patients in COVID-19 Pandemic.

Attenders accompanying patients should be discouraged as far as possible except in unavoidable cases to prevent overcrowding. Social distancing in waiting areas as well as in front of registration desks or dispensaries can be ensured by blocking alternate seats or a set of seats with the help of suitable “cross mark” indicator stickers. Markings on floor to indicate positions that must be occupied to maintain social distancing while standing in a queue also helps to prevent cross infection to a significant extent.

Workflow systems made in the form of flow charts will ease out the triaging system and display of the same in relevant areas of patient segregation helps the supporting staff to adopt into such a revised working pattern (Figure 2).

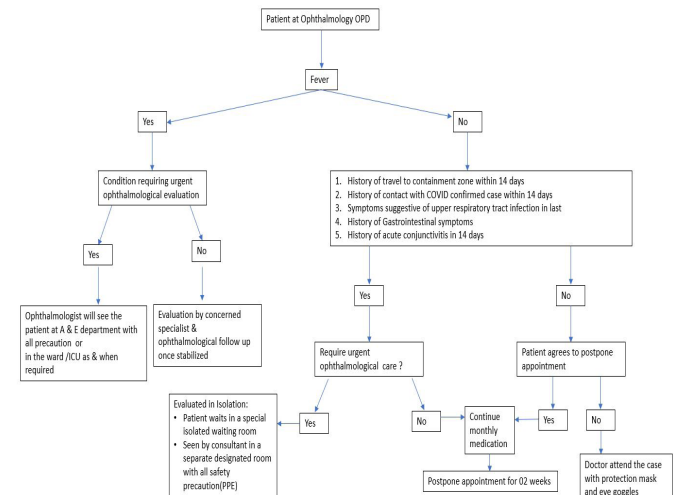


Figure 2: Flow chart of a revised functioning strategy in Ophthalmology clinic in COVID-19 Pandemic.

Separate rooms with complete set of ophthalmological instruments in duplication will help prevent intermingling of the patients once triaged. Ophthalmological instruments in which barrier protection may be installed can be improvised accordingly to prevent direct aerosol transmission from patient to the examining physician (Figure 3).

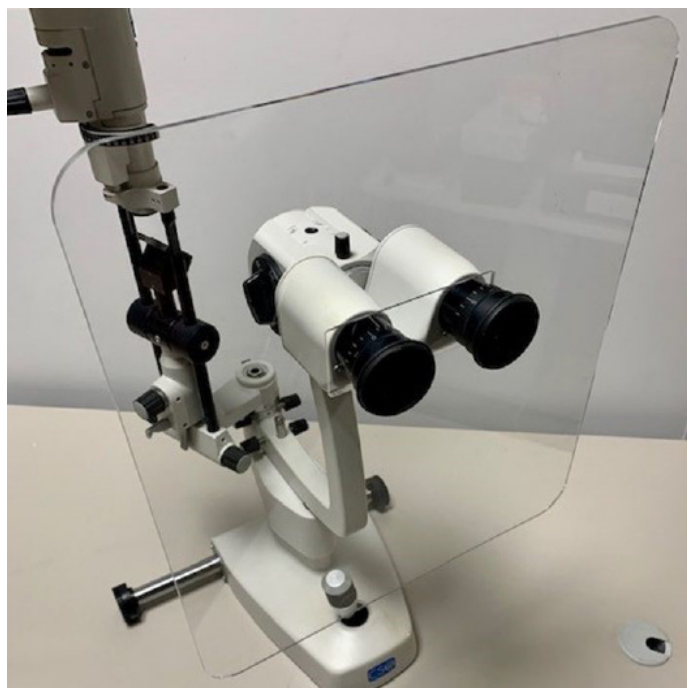


Figure 3: “Barrier Shield” - Improvisation on a slit lamp biomicroscope.

Workers should be divided into small and fixed teams and made to work in separate shifts in these pre-assigned rooms. Handing taking over between these teams should be minimized, performed in a virtual manner wherever possible and should be conducted with adequate personal protective measures taken by both teams.

Separate imaging rooms with allocation of a set of instruments in isolated rooms will help to minimize contacts. Suspected staff members based on contact with confirmed patients or on becoming symptomatic needs to be quarantined and tested to rule out SARS-CoV-2 infection. With the advent of vaccination, all health care professionals associated with routine patient care should be immunized on priority.

4. Specific measures

Specific measures may be adopted on a case-to-case basis depending upon various subspecialties in ophthalmology. Telemedicine is widely used in pediatric ophthalmology services in the form of Retinopathy Of Prematurity (ROP) screening, screening for amblyopia, refraction and strabismus. With the help of many web-based applications, follow up can be done based on sharing videos of various examinations that can be performed by guardians and thus postponing follow-up appointments in such conditions where vision is not at risk. Surgeries in pediatric age group needs extra caution since most of them are done in general anesthesia which required endotracheal intubation that may result in aerosol generation and cross infection.

Retina clinics have elderly group of individuals as majority who are vulnerable and suffers from some comorbidities. Categorization based on urgency of management may be applied

here also. Sight-threatening conditions like trauma, retinal detachments and vitreous hemorrhage would benefit from urgent evaluation and prompt intervention in separate rooms designated for examination of un-screened patients. Anti-Vascular Endothelial Growth Factor (VEGF) therapy is provided under a modified regimen [33-35]. Patients under monthly intravitreal injections can be called on appointment basis keeping their number to a minimum. Clinical examination can be postponed, diagnosis may be made based on Optical Coherence Tomography (OCT) images and fundus photography images which can be reviewed by the retina specialist at home with a remote connection and decision regarding the interval of injections for each patient following a “treat and extend” protocol can be given. Telemedicine is an innovative solution for evaluation of other retinal abnormalities such as acute floaters, Age Related Macular Degeneration (ARMD) and Diabetic Retinopathy (DR).

Cornea service can also be provided by telemedicine consultation by the doctor where the patient is asked about symptoms such as diminution of vision, photophobia, pain, redness, discharge, and pictures taken using their smartphones can also be asked for. However, an objective evaluation using a slit lamp and other modalities would be a limiting factor. Cases requiring urgent review at the cornea clinic including corneal ulcers, corneal perforation or melt, foreign body necessitating removal and keratitis could be instructed to review at the clinic by taking adequate personal protective measures on appointment. Patients having active posterior or pan uveitis or complications of uveitis like Cystoid Macular Edema (CME), inflammatory Choroidal Neo Vascular Membrane (CNVM) require visit to the clinic. Imaging modalities such as SSOCT and fundus cameras can be used for accurate documentation of the posterior segment findings.

Cancellation or postponement of non-urgent cataract surgeries can reduce the risk of viral transmission, outweighing the surgical benefits of cataract surgery [37]. Telemedicine may be used to follow up patients who underwent cataract surgery. Frequency of follow up can be reduced compared to the routine follow up schedule as it used to be during the pre-corona days. Visual acuity may be assessed by taking reviews from patients telephonically after training them to assess the same by digital assessment charts. For screening and monitoring patients of glaucoma, evaluation in the form of Intraocular Pressure (IOP), corneal thickness, anterior chamber depth, morphology of angle structures, optic disc changes, visual field analysis and RNFL thickness can be done by trained technicians; parameters measured remotely at the clinics and sent to the treating physician, thereby minimizing patient-doctor encounters. Tele-glaucoma may be used to follow up non urgent cases in whom optimization of medical management has already been achieved [37].

Transmission of SARS-CoV-2 through mucus membranes is already established [38]. Viruses enter the tears through droplets, which may then pass through nasolacrimal duct to enter nasal mucosa and thereafter to other parts of the respiratory tract [39]. In this context a high suspicion of probability of cross infection through trial sets and contact lenses should be considered. Hence, optometry services, contact lens and refraction clinics need to be closed and services providing biometry tests for urgent surgeries should only be made functional during this global pandemic.

Conclusion

Covid-19 has paralyzed the health care system globally and

understanding of the true impact helps to strategize, plan and allocate work force and resources during the post Covid-19 period, ultimately minimizing any harm to patient's vision and quality of life [40].

The circumstances of this pandemic are unprecedented, but our global community does have experience that is applicable. Though the impact of covid-19 has been uneven and is rapidly changing, these insights can help unify our response and preserve vision. In global ophthalmology, a broad enough perspective to overcome any problems has been developed over years [41].

Due to uncertainty of the disease transmission, strict adherence to safety guidelines should be always followed. The guidelines include proper donning of PPE, proper disinfection of ophthalmic equipment, thorough screening, and triage prior to appointment, on the day of evaluation at the clinic and while performing clinical examination of the patient. With continued efforts focusing on reduction of transmission by following proper safety guidelines, we strive toward the goal of offering safe and quality ophthalmological care.

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