

# The impact of COVID-19 on ophthalmology: A review for health care workers

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## INTRODUCTION

On March 11, 2020 the World Health Organization (WHO) declared that coronavirus disease 2019 (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) a global pandemic.<sup>1</sup> SARS-CoV-2 initially began in Wuhan, China, in December 2019 and has spread globally via human-to-human transmission.<sup>2</sup> As of December 2020, one year later, over 74 million people have been infected and 1.6 million people have died from COVID-19.<sup>3</sup>

It is believed that the virus originated from bats and spread to humans through interspecies transmission.<sup>4</sup> COVID-19 is highly contagious amongst humans; its reproduction number, known as the R0, which measures the number of people that an infected person can pass the virus onto, was calculated to be between 2.24 and 3.58. In comparison, the R0 for the seasonal flu typically ranges from 1.2 to 1.4.<sup>5</sup>

Dr Li Wenliang, an ophthalmologist working in Wuhan Central Hospital, China, was one of the first people to recognize the outbreak of COVID-19 in late 2019, after observing seven similar cases of patients with SARS-like symptoms, but was unfortunately silenced for making false statements. Dr. Li Wenliang was later infected by SARS-CoV-2 after examining an asymptomatic glaucoma patient and died shortly after on February 7, 2020.<sup>6</sup>

## PATHOPHYSIOLOGY

The SARS-CoV-2 virus most commonly enters the host through the nasal cavity.<sup>7</sup> Once it enters the host, SARS-CoV-2 infiltrates the host's cells by binding to ACE 2, the host target cell receptor.<sup>8</sup> More specifically, cellular entry of the virus occurs when the spike protein of the SARS-CoV-2 virus is cleaved by the protease TMPRSS2 allowing it to then bind to the ACE 2 receptor. SARS-CoV-2 has been shown to have an affinity for the upper respiratory tract and conjunctiva due to a large expression of ACE 2 and TMPRSS2.<sup>9</sup> ACE 2 receptors have also been detected in the human retina, retinal pigment epithelium, choroid, cornea and conjunctival epithelia.<sup>10</sup> Collin *et al* found that the ACE 2 receptor and TMPRSS2 are commonly found in the ocular surface epithelium, which can be a possible site of entry for coronavirus.<sup>11</sup>

## TRANSMISSION

Like other coronaviruses, the main mode of transmission of SARS-CoV-2 is through respiratory droplets, spreading by direct or indirect contact with nasal mucosa, conjunctiva or oral mucosa.<sup>9</sup> The risk factors for ocular transmission are frequent touching of the eyes with hands, elderly (age >60 years), immunosuppression, swimming and being healthcare workers.<sup>12</sup> In addition, ophthalmologists are at increased risk of COVID-19 via ocular transmission due to their proximity to patients when performing slit lamp examinations and using ophthalmoscopy.<sup>13</sup> Ophthalmic microsurgery could also pose an increased risk, although the evidence so far is divided.

## CLINICAL PRESENTATION

COVID-19's clinical presentation can range from being asymptomatic to being fatal.<sup>14</sup> However, individuals usually present with mild clinical symptoms which include fever, cough, myalgia, headache, loss of taste and loss of smell.<sup>15</sup> Early, but unexpected, manifestations of COVID-19 are ocular manifestations such as viral conjunctivitis.<sup>17</sup> Wu *et al* reported that ocular manifestation might be as high as 30% among patients with COVID-19.<sup>18</sup>

A common reason why ocular manifestation may be under-reported is because it can present a few days before the more common respiratory symptoms develop. Guangfa Wang, a member of the national expert panel tasked with investigating Wuhan was infected by SARS-CoV-2 and described having red eyes as an initial symptom prior to his other symptoms.<sup>19</sup> These ocular manifestations can occur before, during or after the presence of systemic manifestations. However, Scalinci *et al* report conjunctivitis is sometimes the only clinical presentation of COVID-19.<sup>20</sup>

Furthermore, having ocular signs in an individual with COVID has also been shown to have more severe manifestations of COVID-19 in general. In a study of 38 COVID-19 positive patients in China, 12 of the patients reported ocular symptoms and 2 had positive conjunctival swabs. One-third of the patients who had ocular signs were noted to have more severe manifestations of COVID-19.<sup>18</sup>

## DIAGNOSTIC INVESTIGATIONS

To diagnose patients suspected of having COVID-19 we take samples from nasal swab, tracheal aspirate or bronchoalveolar lavage and use real-time reverse transcription polymerase chain reaction (RT-PCR) to test the collected specimens. The preferred method for diagnosis is the collection of samples via nasopharyngeal and oropharyngeal swabs.<sup>19</sup>

However, we rarely speak about obtaining samples from the eyes. The virus can be transported to the nasopharyngeal mucosa through the nasolacrimal duct. SARS-CoV-2 replication in ocular surface may also continue for a longer period.<sup>16</sup> Studies have shown that SARS-CoV-2 PCR from tears of COVID-19 patients can still be positive up to three weeks from the onset of systemic symptoms even though the nasopharyngeal swab result is already negative.<sup>21</sup> Similarly, a case report from the National Institute for Infectious Diseases in Rome, Italy confirmed ocular symptoms and SARS-CoV-2-positive RT-PCR conjunctival samples in a COVID-19 positive patient.<sup>22</sup> The patient presented with bilateral conjunctivitis, cough, sore throat, and coryza. Ocular swabs were collected starting on day three of hospital admission and were continued until day 27. The conjunctivitis was noted to resolve at day 20 but, this patient had a subsequent positive ocular swab on day 27, which was days after SARS-CoV-2 was undetectable by a nasopharyngeal swab.<sup>22</sup>

## DISCUSSION

The infectivity of the tears and conjunctival secretion from COVID-19 patients may have an impact not only on the daily ophthalmology practice but also on the infection control measures adapted by hospitals and the general public.<sup>23</sup> A recent systematic review analyzed the data from 172 observational studies across 16 countries to investigate the effects of physical distancing, face masks and eye protection in addressing infection rates from coronaviruses. The investigators found a large reduction in infection rates for those wearing eye protection such as face shields and goggles (5%) compared to those with no eye protection (16%).<sup>23</sup>

Promising solutions to reducing transmission include educating patients on the possibility of ocular transmission and isolated ocular symptoms of SARS-CoV-2. Patients should also be told to avoid touching the eyes, nose, and mouth to prevent viral spread. In addition, the American Academy of Ophthalmology (AAO) in a recent communication, called for all contact lens wearers to reconsider switching to glasses during the outbreak as reducing contact lens wear will reduce the number of times patients touch their eyes.<sup>24</sup> In regard to ophthalmologists, Hong Kong set the trend implementing three levels of control measures to reduce transmission. Firstly, at the administrative level, all non-urgent elective services were suspended. Secondly, plastic shields were placed over slit lamps in order to act as a barrier against respiratory droplets. Finally, all ophthalmologists wore surgical masks and eye protection (face shields or goggles) when in the hospital and in clinic or theatres.<sup>14</sup> This has now become a standard practice across all ophthalmology units in the United Kingdom, although the eye protection has not caught up well.

## CONCLUSION

In conclusion, SARS-CoV-2 primarily spreads through respiratory droplets. However, the eye is an important portal of entry as the virus can spread via the nasolacrimal duct and respiratory droplets can infect the conjunctiva. To avoid unnecessary transmission in emergency departments and hospitals, appropriate precautions should be implemented to avoid potential ocular transmission of COVID-19. This includes performing proper hand hygiene before and after every patient encounter, wearing a surgical mask, wearing gloves, donning gowns and using eye protection to prevent viral entry via the conjunctiva or respiratory tract. This is especially important as the number of COVID-19 positive patients presenting to the emergency department with ocular complaints are more likely to increase with the rise in COVID-19 positive patients affected with the newer strains. At the moment we have enforced surgical masks as the only form of protection in our public spaces and most hospital wards, but due consideration should also be given to effectively implement eye protection (goggles or face shields) measures to reduce further transmission of COVID-19.

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