EDITORIAL

Corona Virus Nanoparticles and Enhanced Respiratory Protection for Outpatient Ophthalmic Practice

Nick Kopsachilis[1], Rashid Zia[2]
[1]*Lead Consultant Ophthalmologist; East Kent Hospitals University Foundation Trust, United Kingdom*
[2]*Lead New Hayesbank Ophthalmology Services, Ashford Kent United Kingdom*

The Covid-19 pandemic has emerged rapidly and is now part of our everyday life and work. At the time of writing this script, all routine clinical activity and surgery that had previously been stopped is set for a phased reopening over the next 6 weeks to 6 months. Extensive planning has been undertaken to cater to the significant backlog but the Sword of Damocles hangs over all of us as an imminent risk of a second peak and another lockdown looms.

Standard infection control precautions (SICPs) and transmission-based precautions (TBPs) must be used when managing patients with suspected or confirmed Covid-19. Public Health England has advised, "SICPs should be used by all staff, in all care settings, at all times, for all patients"[1]. At this stage, we believe it is extremely important to understand that the current discussion on using enhanced personal protective equipment (PPE) is to prevent specifically from Corona infection and transmission. Ophthalmologists, ophthalmic nurses and optometrists are at the frontline of this crisis and their work related risks are often undervalued. In its most recent guidelines, Public Health England (PHE) has advised that "COVID19 is no longer categorised as a high consequence infectious disease and therefore enhanced PPE is not recommended"[1] and that ophthalmologists should wear standard PPE including a surgical fluid resistant mask, plastic apron, gloves and eye protection when examining COVID positive patients[1]. As reassuring as this may sound, this recommendation is not scientifically backed by the literature citing systematic review on respiratory protection against airborne nanoparticles discussing nano particles' behaviour and penetration of facial seals of masks.[2] Corona particle is classified as a nanoparticle – an average diameter of the virus particles is around 125 nm (0.125 μm).[3,4]

It may seem counter-intuitive that a 0.3 microns particle that is 30 times larger would be harder to capture than 0.1 micron size Corona particle but the root of the problem is in our thinking that respiratory masks act like nets - if a particle is smaller than the holes in the net, it gets through and the smaller the particle, the harder it is to capture. This logic works for particles bigger than 0.3 microns. Such particles (i.e. > 0.3 microns) either cannot fit through or their inertia causes them to hit the filter fibres– a process called impaction and interception. Nanoparticles under the 0.3 microns have very little mass and they are bounced around like a pinball when they hit gas molecules. This is known as Brownian motion. These tiny particles are small enough to fit through 0.3 micron filters if they flow straight. As they fly in zigzag patterns, they end-up hitting the fibres and getting stuck. The smaller the particles, the fewer will slip through.[5] Electrostatic attraction is another efficient method of capturing particles of various sizes from the airstream. This method incorporates electrically charged fibres or granules, which are

How to Cite this Article: Kopsachilis N, Zia R. Corona Virus Nanoparticles and Requirement of Enhanced Respiratory Protection for Outpatient Ophthalmic Practice. Pak J Ophthalmol. 2020; **36 (3):** 191-193.

Doi: 10.36351/pjo.v36i3.1079

Correspondence to: Rashid Zia
New Hayesbank Ophthalmology Services, United Kingdom
Email: rashidzia@nhs.net

embedded in the filter to attract oppositely charged particles from the airstream. The attraction between the oppositely charged fibres and particles is strong enough to effectively remove the nanoparticles from the air.[6] Hence, even masks with electret filters that may not be effective against 0.3 microns may be more effective in stopping nanoparticles.[6] All N95, FFP2, FFP3 and many surgical masks have electret filters of varying efficiencies.

Thus, PHE guidelines of using simple masks may be protective against droplet and even against nanoparticles if they contain an electret filter. However, it completely ignores the increased risk of deadlier aerosol related infection via lack of facial seals in ordinary surgical masks.[7] PHE recommends wearing a respirator mask and enhanced PPE when performing an aerosol generating procedure[1]yet it fails to recognize aerosol generation and prolonged exposure to the virus by ophthalmologists during common daily outpatient procedures and examinations.

Ophthalmic examination includes close working distance to our patients at the slit lamp (< 20 cm). Many nasolacrimal outpatient procedures can easily convert into droplet infection and even aerosol i.e. refluxes from lacrimal washout. Handling of cleaning tissues contaminated with tears and excessive eye drops is a particularly high risk for droplet infection. It is known that the viral load accumulation can increase the severity of the disease.[8] In addition, many slit lamp based procedures and examinations can lead to prolonged exposure and in some cases even aerosol generation. Thus, loosely fitted surgical masks, despite their electret filter to trap nanoparticles may offer little or no protection at all.

Aerosol can be produced by talking alone and its contact with an exposed conjunctiva is known to cause infection.[9] Furthermore, conjunctivitis can be the first manifestation of COVID-19 without fever or coughing and ophthalmologists working in eye casualty can be caught off guard and be at increased risk of infection. It is probably not a coincidence that 3 out of 8 surgeons who died in Wuhan were ophthalmologists. Therefore, Ophthalmology should be considered as a high risk category between healthcare workers because of prolonged exposure to the patients, droplets and aerosol generating outpatient procedures during the ophthalmic examination.

To summarise, despite being significantly smaller than 0.3 microns (filtration limit of most masks including N95, FFP2 and FFP3), Corona virus particles (0.1 micron) can still be effectively filtered by all kind of masks with electret filters. However, none of the masks offer effective protection especially against aerosols unless fit tested. The evidence is overwhelming that ophthalmologists require enhanced PPEs including surgical cap, gown, fit tested mask, gloves and goggles for all ophthalmic examinations. Hesitation in implementing new PPE guidance for ophthalmology will probably cost lives.

Conflict of Interest

Author declared no conflict of interest

Authors' Designation and Contribution

Nick Kopsachilis; Consultant Ophthalmologist: *Manuscript writing, Literature review, Final review.*

Rashid Zia; Consultant Ophthalmologist: *Manuscript writing, Literature review, Final review.*

REFERENCES

1. COVID-19: infection prevention and control guidance (2020). Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/886668/COVID19_Infection_prevention_and_control_guidance_complete.pdf
2. **Ntlailane MGL, Wichmann J.** Effectiveness of N95 respirators for nanoparticle exposure control (2000–2016): a systematic review and meta-analysis. J Nanopart Res. 2019; **21 (8):** 170.
3. **Goldsmith CS, Tatti KM, Ksiazek TG, Rollin PE, Comer JA, Lee WW, et al.** Ultrastructural characterization of SARS coronavirus. Emerg Infect Dis. 2004; **10 (2):** 320-26.
4. **Fehr AR, Perlman S.** Coronaviruses: an overview of their replication and pathogenesis. Methods Mol Biol. 2015; **1282:** 1-23. Doi: 10.1007/978-1-4939-2438-7_1. 6.
5. **Shaffer RE, Rengasamy S.** Respiratory protection against airborne nanoparticles: A review. J Nanopart Res. 2009; **11 (7):** 1661-1672.
6. **Sun Q, Leung WW.** Enhanced nano-aerosol loading performance of multilayer PVDF nanofiber electrets filters. Sep Purif Technol. 2020; **240:** 116606.
7. **Doremalen VN, Bushmaker T, Morris DH, Holbrook MG, Gamble A, Williamson BN, et al.** Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1.N Engl J Med. 2020; **382**

(16): 1564-1567. Doi: 10.1056/NEJMc2004973. Epub 2020 Mar 17.

8. **Liu Y, Yan LM, Wan L, Xiang TX, Le A, Liu JM.** Viral dynamics in mild and severe cases of COVID-19. Lancet Infect Dis. 2020; **20 (6):** 656-657. Doi: 10.1016/S1473-3099(20)30232-2.
9. **Lu CW, Liu XF, Jia ZF.** 2019-nCoV transmission through the ocular surface must not be ignored. Lancet. 2020; **395 (10224):** e39. Doi: 10.1016/S0140-6736(20)30313-5.