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Evidence-based Contact Lenses Practice in Times of Sars-CoV-2 Pandemic

by Luigi Lupelli
Università degli Studi "Roma Tre" – Dipartimento di Scienze, Roma

Key words

COVID-19;
SARS-COV-2;
CORONAVIRUS;
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Abstract

The pandemic emergency caused by the worldwide spread of SARS-CoV-2 infection calls for the need to adopt containment measures in various settings. The application of these measures varies also in relation to the potential for transmission of the disease. In the optometry field, especially in professional practice regarding contact lens application and follow-up, this issue is particularly critical due to both the limited work distance and the possibility of direct contact with the periocular area and with tears, in which the virus has occasionally been isolated.
Although our knowledge of the SARS-CoV-2 phenomenon appears to be incomplete, this pandemic undoubtedly calls for the need to optimise protection against the confirmed and potential transmission pathways and personal and environmental hygiene practices. This has considerable implications with regard to the sustainable management of contact lenses, which remain a safe, efficacious and, often, invaluable solution for the correction of refractive errors, even in the COVID-19 time.

Luigi Lupelli, Optometrist. Present: Contract professor, Department of Science, Università "Roma Tre". Past: Full professor at Scuola di Ottica Statale E. De Amicis, Rome; Director of studies and lecturer at the ISSO (Rome); lecturer at IBZ Vision Science Dept-BO; Visiting professor at Aston University (UK) and IOS (Tel-Aviv/Israel); Member of the editorial board of "The Contact Lens Journal" (UK); Co-editor of the journal "LAC" (It); Vice president (1992-93) of IACLE Europe. Co-founder and first President of SOPTI and AILAC; Lifetime fellow of IACLE (Austral); Fellow of BCLA (UK). Co-author of one book in English and three in Italian.

luigi.lupelli@uniroma3.it, luigi.lupelli@tin.it

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1. Introduction

The coronaviruses (CoV) belong to the family of respiratory viruses that can cause mild illnesses, like colds, but also severe acute respiratory syndromes (SARS). The spread of the new coronavirus, known as SARS-CoV-2, resulted in the development of a disease that, on 12 February 2020, the World Health Organisation (WHO) named COVID-19. On 11 March 2020, this disease was officially assigned pandemic status[1].

Just before going to print (03/05/2020) Italy, with 210,717 confirmed cases (Ministry of Health, 2020)[2] was the country with the third highest number of cases, after the United States and Spain.

As the pandemic involves, to a greater or lesser extent, all five continents of the inhabited world, it is reasonable to assume that a global vision of the condition is required, with common measures to be implemented by the various health services all around the world. In this sense, a key role is played by the WHO, which, amongst its various functions, is committed to providing guidance on global health issues, establishing regulations and standards and formulating evidence-based health policy[3].

As is only to be expected, this highly explosive event has polarised the attention of the media, both social and traditional, which have reported a mixture of useful information and misinformation. At a time, characterised by strong emotional reactions and drastic containment measures to stem the spread of the disease, it may not be easy, especially for non-specialists, to make a distinction between hypotheses, disrespectful speculation and scientific evidence.

2. COVID-19 grammar for the management of contact lens practice

Optometric practice in general, and contact lens practice in particular, are characterised in certain phases by a limited distance between the practitioner and the subject being examined that sometimes involves touching the eye and periocular area. This calls for a thorough appraisal of the scientific evidence available, from the most solid to the weakest, in order to better understand the question, including the more controversial aspects of the condition, in order to optimise and review the practices to be adopted during contact lens application and consultation sessions.

2.1 Symptoms and mechanisms of infection

The decision to confirm or postpone a contact lens appointment depends primarily, but not exclusively, on the presence or absence of systemic or ocular symptoms, whereas the management of the consultation, for example the use of personal protective equipment (PPE), depends primarily on the setting and the means by which it is believed infection occurs.

COVID-19 causes a variety of **signs and symptoms**. The most common include a dry cough, fever, fatigue and breathlessness, which usually present between 2 and 14 days after exposure[4-5]. In the more serious cases, the infection can cause pneumonia, severe acute respiratory syndrome and renal impairment. Ocular involvement, as will be analysed later in this paper, has often been considered of marginal interest in severe acute respiratory syndromes[6].

Although the mechanism by which SARS-CoV-2 is transmitted is still not fully understood, the WHO suggests that, in the absence of unusual air turbulence, the main transmission pathways are saliva droplets and direct and/or indirect contact[7] (Fig. 1). This assumption is supported by a number of studies[8-14].

Nevertheless, a fourth pathway has been postulated, namely the **airborne diffusion** of the virus. This is thought to occur through the dispersal in the air of droplet nuclei that can be considered the residues of evaporated droplets, smaller than 5 µm, or through contaminated aerosol particles that can travel considerable distances[15-17], up to 8 metres[18], from the source of infection. This contamination mechanism has already been confirmed for other conditions, such as tuberculosis and measles[19]. There is a certain degree of consensus that the viral transmission of airborne nuclei is made possible by certain medical procedures, such as nebuliser therapy, which generates aerosols, or in the presence of strong ventilation when the virus can be found on air vents[12-13; 20-21].

Therefore, the likelihood that RNA of the virus is spread by the airborne pathway is somewhat low; however, a cautious approach, for an environment such as that in which contact lenses are applied by eyecare practitioners, involves minimising the ventilation generated, for example, by air conditioning systems, and avoiding use of instruments that generate jets of air, such as the contactless **tonometers,** used to perform the air-puff test[22-23].

2.2 Persistence of the virus on surfaces

One aspect that warrants clarification, also on account of the confusion that it has generated, is that regarding the viral contamination of inanimate surfaces that can act as a source of **indirect infection**. Despite being particularly pertinent in hospital settings[13], this issue exists everywhere. The studies available on SARS-CoV-2, in this area, are limited. A study conducted in the US[21] experimentally analysed, in an infection-favourable environment, viral decay on various surfaces. The virus remained viable for up to 4 hours on copper, 24 hours on cardboard and 2-3 days on plastic and stainless steel, albeit at significantly diminished concentrations. These results are comparable with those observed for SARS-CoV-1[15].

One positive finding is that the new virus is susceptible to decontamination treatment, with a drastic reduction in decay time (approximately 1 minute), using standard procedures and readily-available products, such as 61-71% ethanol, 0.5% hydrogen peroxide or 0.1-0.5% sodium hypochlorite[24-25].

In order to minimise the contamination of surfaces in environments such as exam rooms used for the application of contact lenses and, where applicable, the adjacent eyecare outlet, a cautious approach could be to periodically favour air turnover in order to disperse any infected particles[26-27].

Another aspect to be considered is the contamination of the contact lenses. Misleading warnings regarding this

MAIN SARS-COV-2 TRANSMISSION PATHWAYS		
Droplet flow	Through the droplets released, by the respiratory tract, from an infected person who coughs, sneezes or talks, if the interpersonal distance is less than 1 metre	
Direct contact	Through contact between an infected person and a healthy person, very often by means of the hands.	
Indirect contact	Through contact between a contaminated object and the body (usually the hands) of a healthy individual.	

Figure 1: Sars-CoV-2 transmission pathways. Unlike other infections, the possibility of transmission through droplet nuclei (evaporated droplets) in the form of aerosols is considered unlikely

issue have been published in blogs and online newspapers (for example[28-29]), declaring that the use of *silicone* contact lenses involves an increased risk, because coronavirus can remain viable on this material for several hours. They refer to an article published in February 2020[24] reporting the results of a study published in 2015[30], on a different coronavirus to SARS-CoV-2. The claim made, presumably incorrectly assumes that "silicone" (silicon rubber) is identical to the silicone hydrogel currently used to make most soft contact lenses, which, however, has a different chemical surface composition[31-32].
In short, the alarmism generated is not in any way justified, because no studies have been published on the persistence of SARS-CoV-2 (or other coronaviruses) on contact lens materials or even regarding the disinfectant capacity of the maintenance solutions[32]. In addition, the research conducted on the efficacy of certain disinfectants, such as hydrogen peroxide (0.5%) and povidone (0.23%), with concentrations considerably lower than those usually utilised for contact lens care, on SARS-CoV-1 and Mers strains deposited on "silicon rubber", have shown rapid disinfectant efficacy, of 1 minute and 15 seconds, respectively[24; 30].

2.3 Controversial aspects regarding the respiratory protection devices of interest to contact lens practitioners

Information on the personal protective measures intended to minimise the likelihood of contracting SARS-CoV-2 to be adopted by the general public have been distributed, in various ways, by a number of sources, including the Ministry of Health[33]. This guidance, which draws solid inspiration from that issued by the WHO, are of fundamental importance in all areas and, therefore, also for contact lens practice. However, it is interesting to note that, due to the weakness of the evidence characterising certain points, the health regulators of different countries seem to provide conflicting instructions.
As regards **social distancing** the 1 metre guideline adopted in Italy is shared by the WHO[34] and the European Centre for Disease Prevention and Control (ECDC)[35], whereas the Australian government indicates a distance of 1.5 metres[36], and the British government of at least 2 metres[37], an approach replicated by the Centers for disease control and prevention (CDC)[38], an authoritative public health monitoring body in the US.
The other controversial aspect regards the **medical devices for respiratory protection (facemasks)** (Table 1) for which, numerical filtration capacity aside, there is a certain amount of confusion amongst the general public as to how they should be used. The information available regarding the specificity of their potential efficacy is still limited. In the absence of solid evidence, the indications for the use of facemasks are provided primarily on the basis of long-standing convictions that take into account the setting within which they are used (medical settings or the community) and the status of the individual (healthy or infected).
One widely-acknowledged assumption is that the use of facemasks should always be associated with other prevention actions, such as hand and respiratory hygiene practices[39]. The fact that the use of facemasks, of any kind, is not based on solid scientific evidence appears obvious from a comparative analysis, that reveals clear critical aspects, due to the conflicting guidance issued by the various national and regional authorities[40]. This conflictual scenario provided the stimulus for a recent meta-analysis conducted to assess and compare the various studies on the two main types of respiratory tract protection in the prevention of viral infections[41].
The authors suggest that, albeit with modest evidence, the results show that surgical facemasks and respirators provide, to healthcare professionals during treatment, similar protection against respiratory viral infections, including SARS-CoV-2. In agreement with the WHO, they state that respirators should in any case be preferred for procedures that generate aerosols[41]. In actual fact, due to the weakness of the evidence, this meta-analysis does not provide clear evidence regarding the type of facemask to be used by contact lens practitioners.

2.4 How and when to use personal protective equipment (PPE)?

Considering that, in symptomatic subjects, the diffusion of the virus is greater in the upper respiratory tract, especially during the first three days after the onset of symptoms[42-43], the management of any infection focus would appear relatively straight-forward. However, it is necessary to consider two other (similar) potential transmission pathways: from **presymptomatic subjects**, who are in the incubation period (2-14 days, with an average of 5 days before symptom onset)[44] and **asymptomatic subjects** who, although they have been infected (as confirmed by a swab test), do not develop symptoms. Although it is not easy to track potential infection contacts, the data acquired suggest that presymptomatic subjects may also be a source of infection, especially in the 3 days before they develop symptoms[5; 45-47]. One recent study reports that 12.6% of analysed cases were due to presymptomatic transmission[48]. In a recent study conducted in a long-stay care facility in the USA, more than half of residents who tested positive for the virus, were asymptomatic when the test was performed and had very

MEDICAL DEVICES FOR RESPIRATORY TRACT PROTECTION AGAINST INFECTIOUS AGENTS	
Surgical (or medical) facemasks *Legislative Decree no. 46 of 24 February 1997, as amended*	**Protective facemasks (Respirators)** *Legislative Decree 475/1992 and on the basis of harmonised technical standards*
They can be classified according to filtration efficiency into four types: I, IR, II, IIR. IIR is splash-resistant. They are tested in the expiration direction. Their main purpose is to prevent the wearer from contaminating the environment or other individuals, by limiting the transmission of infectious agents. Used in hospitals and other healthcare settings (for example nursing homes, outpatient clinics, etc.) They are manufactured in compliance with technical standard UNI EN 14683:2019 (in Italy). They do not fit snugly to the contours of the wearer's face (and therefore do not provide protection against aerosols), but they are able to prevent respiratory droplets from coming into contact with the mucosae of the mouth and nose. Comfortable and easy to adjust to the shape of the face.	Classified according to the class of protection (FFP2 and FFP3) (USA standards: N95 and N99). They are tested in the inspiration direction. Used in hospital and other healthcare settings to protect the user against external agents (including the transmission of droplets and aerosols), they are certified in compliance with standard UNI EN 149:2009 (in Italy). They fit snugly on the wearers face, protecting him/her against very fine aerosols that may contain infectious particles. Less comfortable and more critical adjustment to the shape of the wearer's face.

Table 1: Medical devices for respiratory protection. Some facemasks on the market are not certified by Istituto Superiore di Sanità [Italian Institute of Health] or Inail [National Institute for Insurance Against Occupational Injuries], but with a manufacturer's declaration of responsibility (art. 16, subsection 2, of Legislative Decree 18/2). These are neither medical devices nor personal protective equipment and are therefore unsuitable for use in healthcare settings.

likely contributed to transmission[49]. At the current time, there is a lack of solid data regarding asymptomatic subjects.
In short, at least in a pandemic situation, when occupational activities involve an interpersonal distance of less than 1-2 m, as in contact lens practice, and other organisational solutions are not plausible, it is **always** necessary to consider the use of facemasks and, where appropriate, also other PPE (shields, gloves, safety glasses, face guards, hair caps, overalls) in compliance with the provisions issued by the scientific and health authorities. Table 2 provides a scheme for the use of PPE in the contact lens practice.

3. Ocular involvement with SARS-CoV-2

There are at least two often overlapping aspects that appear to alter the equilibrium of the ocular surface during this pandemic: the presence of the virus in the tear film and the possibility of an inflammation of the ocular surface, particularly the conjunctiva.

3.1 The virus and the tear film

For the first time, polymerase chain reaction on the tear film of patients with SARS-CoV-1 was reported, in 2004, in 8% of patients with a probable or suspected infection[50]. During the same period, it was shown that none of the 17 patients diagnosed with the disease had a positive tear test[51]. The research group coordinated by Xia[52] examined pairs of tear or conjunctival secretion samples taken from 60 eyes (30 COVID-19 patients) in which SARS-CoV-2 RNA was isolated in just one patient who also presented conjunctivitis.
Referring to the aforesaid study by Xia et al., Peng and Zhou[53] postulate that the finding of SARS-CoV-2 RNA in the tear film and conjunctival secretions, complicated by conjunctivitis, in just one of the thirty COVID-19 patients may suggest that SARS-CoV-2 does not replicate in the conjunctival epithelium, something that was considered unlikely during the SARS-CoV-1 epidemic[54] and, therefore, the conjunctivitis itself can be considered more a coincidence than an event caused by the virus. Another study conducted in Singapore[55] reported that there was no evidence of SARS-CoV-2 either conventional viral culture or reverse transcription polymerase chain reaction (RT-PCR) in any of the 64 tear samples obtained from 17 COVID-19 patients. The authors suggest that the possibility of transmission is low.
The presence of viral RNA in tears was confirmed for the first patient (a Chinese tourist) identified, in Italy, as having SARS-CoV-2. It is interesting to note that the virus was isolated in the tears even when the nasal swabs did not show traces of the virus[56].

3.2 The virus and conjunctivitis

Conjunctivitis is the most common eye infection[57] and the viral form is the most common[58]. The presence of a conjunctival inflammation was not reported for either Mers-CoV, or SARS-CoV-1[59-60]. There is evidence that some of the other coronaviruses can cause conjunctivitis in humans[61].
In clinical investigations conducted during the initial stages of the outbreak in Wuhan and involving over 150 patients, conjunctivitis was not reported as a clinical characteristic of the condition[12]. The hefty report (55924 patients) of the WHO-China Joint Mission reports that the conjunctivitis rate in patients with COVID-19 (confirmed in the laboratory) was 0.8%[6].
Quantitatively conflicting data were reported in a study conducted on a limited number of COVID-19 patients. It was calculated that in almost 1/3 of cases, in the advanced stages of the illness, some kind of inflammatory reaction of the ocular surface was observed[62]. Noteworthy is a rare, recently described case of viral keratoconjunctivitis in a person with moderate respiratory symptoms, associated with SARS-CoV-2, and no fever[63].
The information that can be gleaned from studies on the tears and conjunctival mucosa is that, with a very low

CONTEXT	PRACTITIONER IN EXAM ROOM	CL WEARER WITHOUT RESPIRATORY SYMPTOMS	CL (OR SPECTACLE) WEARER WITH RESPIRATORY SYMPTOMS AND UNDEFERRABLE NEEDS	CHAPERONE WITHOUT RESPIRATORY SYMPTOMS
In the optical practice reception		No PPE (if distance is greater than 1m; otherwise surgical mask)	Surgical mask	No PPE or surgical mask (if distance is greater than 1–2 m; otherwise surgical mask)
Waiting room seats more than 1 m apart		No PPE	Surgical mask	No PPE or surgical mask (if distance is greater than 1–2 m)
Exam room with asymptomatic CL wearer	Surgical mask. Use trasparent face shield and use long-sleeved disposable gloves if necessary	Surgical mask		Surgical mask
Exam room with CL wearer with respiratory symptoms (for undeferrable cases only)	Respirators, trasparent face shield (or goggles), long-sleeved gloves, disposable apron, disposable hair cap, where necessary		Surgical mask	Surgical mask
Perform hand hygiene: before each consultation; before putting on and after removing and disposing of any PPE; before putting in or removing contact lenses, even when using gloves. If an air-conditioning unit is used, minimise ventilation or switch off.				

Table 2: PPE recommended for in-person contact lens application and check-up consultations using the slit lamp and keratometer with breath shields. It is considered essential that appointments be postponed in the case of a contact lens wearer with respiratory symptoms and deferrable needs (Adapted from the ISS Covid-19 Report • no. 2/2020 Rev, updated to 28 March 2020).

frequency, SARS-CoV-2 RNA can be isolated in tears and may also cause an inflammation of the ocular surface.
In contact lens practice prior to SARS-CoV-2, viral conjunctivitis concomitant to the use of contact lenses was rarely considered a complication of their use[64]. It is worth mentioning, given its rarity, an isolated case of Herpes Simplex keratitis postulated to have been caused exclusively by the use of daily disposable contact lenses, which may have affected immune response[65]. The results of these studies make it possible to conclude that although the risk of ocular transmission of SARS-CoV-2 has not been demonstrated, it is potentially plausible[66].
It is reasonable to say that, despite the lack of evidence as to whether COVID-19 can be transmitted by an ocular pathway, any eyecare practitioner who has to work in close proximity with the eyes, must consider adequate facial protection in addiction to the face mask[32; 55; 66].

4. Contact lens management

During the period in which the COVID-19 pandemic infection rates soared to alarming levels in Italy, it was common to encounter, on the Internet or in the conventional media, such as national TV news broadcasts with high audience rates, or in the daily newspapers, verbal or written statements advising the public to discontinue contact lens use, in some cases suggesting they be replaced with permanent wear of personal corrective spectacles, on the grounds that they provide greater protection against the virus[28-29;67].
Subsequently, primarily due to the effect of the article published by the group coordinated by Jones[32] and the positions of the International Association of Contact Lens Educators[68] and the British Contact Lens Association[69], the information available became more balanced[70]. It is interesting to note that in an article by Mukamal et al.[67], published on 10 March on the website of the American Academy of Ophthalmology (www.aao.org) a first version (viewed on 20 March) states that: "*Contact lens wearers touch their eyes more than the average person. Consider wearing glasses more often, especially if you tend to touch your eyes a lot when your contacts are in*".
On the same website, the same article, with the same date of 10 March, subsequently (16 April) changed its position, with the inclusion of an important background section that conflicts with the content of the article: "*There's no evidence that wearing contact lenses increases your risk of coronavirus infection*". It is worthy of acknowledgement that the Academy realised that it had published misleading statements, that had, in the meantime, attracted the attention of press agencies the world over.
The arbitrary association of silicon rubber with silicone hydrogel that allegedly represents a risk factor for SARS-CoV-2 contamination, was dealt with in section 2.2.
Two other factors implying a risk of SARS-Cov-2 that would suggest not using contact lenses have also been brought to light:

- "*Contact lens wearers tend to touch their eyes more often than individuals who do not wear lenses*[67]."
- "*Standard prescription spectacles provide better protection against viral infection and/or the onset of viral conjunctivitis than contact lenses*[67]."

4.1 Who touches their face more often?

Being careful not to touch the face, especially the mucosa, is considered an efficacious way to avoid the onset of a viral infection[71]. The number of times an individual touches his/her face depends on the context[72]. In one study conducted on medical students who had received prior information on infection control, it was observed that in one hour on average they touch the mouth 4 times, nose 3 times and eyes just less than the nose[72].

These data demonstrate the importance of hand hygiene practices. Affirming that contact lens wearers tend to touch their face more often has not been confirmed by scientific studies; similarly, it has not been confirmed that contact lens wearers are used to not touching their eyes, precisely because they use contact lenses or, if they do, they are conscious that their hands must be clean. In any case, it goes without say that contact lens wearers need to touch their eyes when applying and removing their lenses.

Hand washing has always been considered by contact lens wearers as an essential stage in these operations, although compliance must be taken into consideration. In a 2012 survey conducted in Italy on 110 contact lens wearers, with an average usage experience of nine years, it was seen that 92% wash their hands with soap and water before touching their lenses. Compliance regarding lens case care on the other hand, was seen to be poor[73]. In a study conducted in the Maldives, just 39.2% of users wash their hands with soap[74]. These data suggest that the viral pandemic could be an opportunity to promote the need to follow the instructions provided by eyecare practitioners (see also section 5.2).

In the attempt to minimise the habit of touching the eyes (regardless of whether the individual wears contact lenses or not) there is presumably scope for the use of electronic sensors or applications that discourage face-hand contact. With this in mind, there would appear to be some simple automatic learning algorithms for recognising the images of each individual user who touches or does not touch his/her face[75].

4.2 Do spectacles provide better ocular protection?

As regards the presumed ability of prescription spectacles or sunglasses to protect the eyes against the possibility of viral conjunctival infection[67], once again, there is no evidence.

It has been emphatically reported that, like contact lenses, the use of personal eyeglasses does not have any protective function[76].

5. Planning models for contact lens practice

In Italy, as in other Western European countries[77] during the current COVID-19 pandemic, the work of eyecare practitioners is considered a basic necessity, meaning that they have remained open/on call throughout. As regards **professional practice in Italy,** the Decree[78] imposes "**the adoption of safety protocols against infection and, when it is impossible to maintain an interpersonal distance of 1 metre as the primary containment measure, use of personal protective equipment, in addition to encouraging workplace sanification practices…**"

Below is a list of considerations and recommendations to guide the behaviour of both the practitioner applying contact lenses and the lens wearer that can be considered as not conflicting with the national directives issued by the competent agencies.

Firstly, the practitioner can consider whether a remote consultation, which should be the preferred option, is possible, or whether a physical consultation is required.

5.1 Remote consultations

In the recent past, online activities have developed considerably in contact lens practice in terms of reminders when replacements and supplies are due, but not in terms of aspects regarding consultations. The critical issues generated by the need to avoid potential opportunities for infection will most likely favour the development of electronically-assisted procedures.

Practitioners should consider allowing contact lens wearers the possibility of making telephone appointments in order to clarify any doubts and, where appropriate, to make arrangements for a new supply of lenses that can then be delivered to the wearer's home. Even more so now than in the pre-COVID era, another simple action could be to provide concrete information on the practices to be reviewed and revised, also in order to improve compliance regarding contact lens wear and care. This can be implemented (by audio or video messages) using a number of platforms, including WhatsApp, Skype e-mail or social media. One option that could be contemplated is promoting the contact lens wearer's awareness of the need to rigorously follow contact lens care steps. This could be done by attaching the simple and efficacious scheme devised by the Centre for Ocular Research & Education of Waterloo University in Canada (Figure 2).

Practitioners could encourage the use of photographs or videos to observe the presence of signs on the ocular surface (Figure 3a; b) or changes in lens conditions (Figure 4). In some cases, this may make it possible to avoid making an appointment for an in-person consultation. In many cases, an interview with the contact lens wearer, combined with photographs or videos, make it possible to re-order contact lenses, by associating the signs observed with any reported symptoms. Important considerations regarding this aspect were dealt with in a recent report[79].

5.2 In-person consultations

Within the restrictions imposed by the SARS-CoV-2 emergency, appointments for both new applications and follow-up consultations should only be made when a remote consultation is not possible and the person making the request is experiencing problems such as to classify the appointment as an "**essential optometric activity**", which does not include eye health emergencies (which will be redirected), but includes situations in which, in the practitioner's professional opinion, delaying the examination could be detrimental to the patient's sight or wellbeing[80]. For example, the person has damaged or lost his/her spectacles or a contact lens, or his/her sight does not make it possible

Figure 2: Graphical representation of the guidelines for optimising hygiene practices for hands, contact lenses and lens cases (*Courtesy of Prof. Lyndon Jones and CORE, Centre for Ocular Research and Education, School of Optometry & Vision Science, University of Waterloo, Ontario, Canada*).

to perform his/her normal functions. It is reasonable to suppose that the parameters for choosing the type of intervention should suit the phases of severity that may characterise the endemic evolution of the disease.

6. Model for contact lens management and application and/or follow-up consultations at the exam room

In the management of contact lens practice, which necessarily involves a lens coming into contact with the ocular surface, considerable attention has always been placed on the need to maintain excellent hygiene levels in order to prevent situations that pose a risk of inducing external ocular reactions. Although before application, contact lenses are always subject to disinfection (either by the manufacturer or the practitioner), for the hands an accurate cleaning process is considered sufficient, while with the equipment it is safer to use a cleaning / disinfection system. This means that in the situation created by the viral pandemic, it is necessary to consider when it is appropriate to continue using and if appropriate optimising the usual practices, and when it is necessary to deploy new ones.

6.1 Preliminary information on contact lens consultations

The first step is to establish a checklist of preliminary measures. Contact lens application consultations should take place by appointment only and in the absence of respiratory symptoms. (Unless in exceptional cases, at the practitioner's discretion).

Appointments must be scheduled to time to clean and / or disinfect surfaces at risk of contact and air the exam room between appointments.
Waiting room seats must be arranged with a distance of between 1 and 2 metres between them.
Before entering the waiting room or exam room, take the person's temperature using a contactless thermometer.
Clients must be told to wear a surgical facemask to the appointment. The practitioner must wear at least a surgical mask (or respirators), and any other PPE deemed appropriate.
Whenever possible, adults to be examined should not be accompanied by children.
When it is necessary to measure the strength of the client's spectacles using a lensmeter, he/she should be given a cleansing/ disinfectant wipe to clean them before performing the measurement.
Tell the subject to restrict talking (but not answers to questions) to the initial discussion for data acquisition phase and the end part of the consultation, when the interpersonal distance is greater than 1 meter.
In the exam room, the patient (wearing a surgical facemask) should first be invited to wash his/her hands thoroughly or, alternatively, to put on new disposable gloves.
Perform only those sight/ eye tests needed to resolve the case.

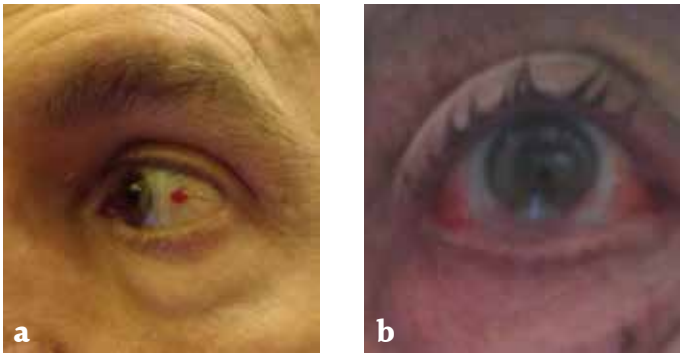

Figure 3: Images sent remotely by contact lens wearers to inform the practitioners of the presence of a hypothetical ocular reaction.
a) subconjunctival haemorrhage concomitant with, but not caused by, soft contact lens use; b) circumferential congestion of the conjunctival blood vessels in a subject who wore scleral RGP lenses overnight.

Figure 4: Image sent remotely by a wearer of rigid corneal contact lenses with central corneal opacification.

6.2 Optimise daily wear and care practices

Wash hands thoroughly using warm water and soap before handling and applying contact lenses and for any contact with the patient's eyes or the surrounding area. Take care not to touch other surfaces. Dry hands thoroughly using a disposable paper towel. When using disposable gloves, they must be removed in an appropriate manner, disposed of and replaced at the beginning of each new consultation.
Most soft contact lenses are sterile, packaged in blisters or vials by the manufacturer and belong to a diagnostic assortment. Other soft, hybrid or hard lenses are supplied in containers with disinfectant solution. The contact lenses should, therefore, be in ideal conditions; however, it is advisable to check their condition and decide whether to replace the storage solution. Given the lower incidence of inflammatory events in individuals who wear daily disposable lenses,[81] consider the possibility of recommending this type of lens over other kinds, whenever possible.

6.3 Introduce new wear and care practices

Use of personal protective equipment (PPE)

During the pandemic, regardless of the status of the patient's health, the practitioner should wear a facemask which will generally be of the surgical type. Consider using a respirator facemask for patients with respiratory symptoms (see table 2).

Biomicroscopy or keratometry exam

In addition to facialmask consider using an additional protective barrier against respiratory droplets as a large (approximately 25 x 35 cm) breath shield for slit lamp[82]. These should be considered as an alternative to the smaller guards that are standard issue for certain models. To facilitate slit lamp management, guards should be made of transparent plastic (plexiglass or the like). They can be secured, with one hole, between the eyepiece and the lens of the microscope (Figure 5a) or, with two holes, to the eyepiece (Figure 5b).
When using any optometry equipment that comes into contact with or very close to the face, cover at least the forehead – and chin – rests with a polyethylene film, a wad of gauze or a tissue that can be discarded and replaced between appointments. Before the biomicroscopy exam, politely advise the subject not to talk. Stand as far away from the patient as possible when using instruments like corneal topographer or Scheimpflug cameras.

6.4 Sanification of the exam room

Perform general sanification of the room before use and subsequently, between patients, sanitise selected parts at the end of each consultation (the optometry equipment used, including the breath shield on the slit lamp, any test kit ophthalmic lenses used, which should be previously separated from those not used, test frames, desk, power switches, and any handles subject to contact).
Products: **alcohol-based disinfectant solutions, with a 75% alcohol** (ethanol) **content, for small surfaces or optometry instruments.** Products contaning sodium hypochlorite: 0.1% for small surface while the percentage of 0.5 is suitable for larger surface.

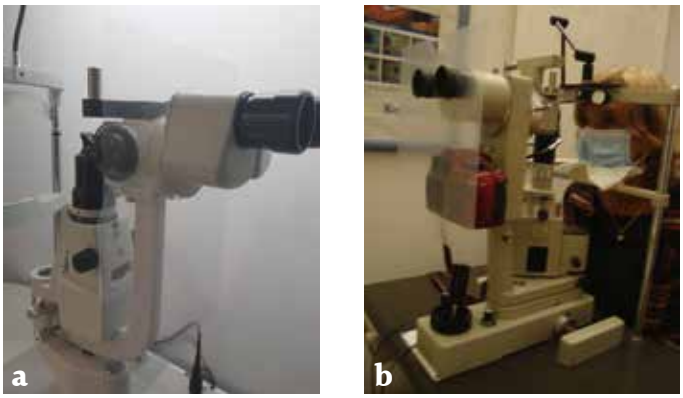

Figure 5: Transparent slit lamp breat shield. a) positioned between the eyepiece and lens of the biomicroscope (Courtesy of Pietro Paffetti, UK); b) positioned on the biomicroscope eyepiece.

Although the research conducted on the use of germicidal lamps (UV-C radiation with a wavelength of 222 nm) appears promising, their efficacy in the inactivation of a virus (not belonging to the coronavirus family) has only been demonstrated in vitro on human epithelial cells and laboratory animals[83].

6.5 Guidance for contact lens wearers

There is no evidence that the use of contact lenses is not safe during the current COVID-19 pandemic. At the same time, there is no evidence that either eyeglasses for the correction of refractive errors or contact lenses help protect the eyes[84]. Any claims to the contrary[67] are not supported by scientific evidence[32].
The use of contact lenses is, however, **not recommended**, as was strongly advised before the COVID-19 pandemic, if the subject has any respiratory tract disease[85], including suspected cases of COVID-19 infection.
Hands must be **washed thoroughly**[86] with soap and water (with a total rubbing time of approximately 20 seconds), not only before applying or removing lenses, but also during the day, and contact lens wearers should be advised not to touch the facial mucosae.
The non-disposable contact lens **care** must be at least as scrupulous as usual, if not more so. Wearers should use the products recommended by their eyecare practitioner.
0.5% hydrogen peroxide has been seen to be efficacious in inactivating SARS-CoV-2[87]. Therefore, contact lens solutions, which contain this active substance, at a higher concentration (3%), are undoubtedly effective for the storage of both soft and hard contact lenses[88]. The efficacy of the active substances of many one-step solutions has not yet been confirmed for SARS-CoV-2; however, considering that these solutions also contain surfactants for cleaning, it is important to stress that lenses should be rubbed before storage[89]. The genome, which consists of a single strand of RNA, is enveloped by a protein shell surrounded by a lipid bilayer. On the one hand, these solutions remove the virus from the surface of the contact lens, on the other, they attack the virus by breaking down its structure. Special care must also be dedicated to the contact lens case, which should be managed considering to type of case used

(everyone can be used but it is necessary to be aware if it is of the antibacterial type or not), the need to rinse with saline and dry it after the lenses have been applied[90], as well as the surface on which it is rested, which must be clean and decontaminated[88].
If the wearer simultaneously uses **auxiliary glasses** (for example to correct presbyopia), advise cleaning them, for example, using disinfectant wipes.

Conclusion

Although a great many research projects have been launched and publishers make study results available very rapidly, at the current time, our knowledge of the SARS-CoV-2 phenomenon is still incomplete. It is clear that this pandemic has highlighted the need, in general, to improve hygiene practices, with a consequent considerable impact on a sustainable management of contact lenses, which remain a safe, efficacious and, often, invaluable solution for the correction of refractive errors, even in the COVID-19 era. At the same time, there is no evidence that either corrective spectacles or contact lenses help protect the eyes.
When we return to work as normal, it is likely that we will have to live with a lower, but long-term, possibility of infection. We will have to get used to the idea that the measures that we are learning to implement in this phase will be essential for a long time to come. Our knowledge of the effects generated by the spread of COVID-19 evolve day by day, meaning that we will have to continuously update our knowledge by taking the new evidence into account.

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