

WHITE PAPER

Coronavirus outbreak in China: Personal protective equipment and other protective measures

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In order to control the new serious coronavirus outbreak, which started in Wuhan at the end of 2019, the successful interaction of many diverse measures plays a decisive role. Suitable personal protective equipment (PPE) is one of the most important factors to ensure safe working for medical staff and other emergency services. The following article reflects at the beginning the fundamental aspects of the epidemic. Furthermore, the essential requirements for protective measures are presented with the main focus on personal protective equipment according to the European standards.

Keywords: Coronavirus, Covid-19, personal protective equipment, PPE

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The new coronavirus epidemic in China was declared an international health emergency on 30 January 2020 by the World Health Organization (WHO). This was done in particular, to be able to effectively combat the spread of the disease with international support, even in countries with a less developed health system. The new corona virus is now known as SARS-CoV-2 (SARS = severe acute respiratory syndrome), the associated disease as Covid-19 (corona virus disease 2019). The epidemic started in late 2019 in the Chinese metropolis of Wuhan in Hubei province and initially remained largely localised in China. Hubei in particular, but also some other affected regions in China, were quickly sealed off after the potential of the viral infectious disease was recognised. Correspondingly, over 99% of the documented cases occurred in China in the first six weeks of the outbreak, and around 75% were concentrated in the place of origin around Wuhan. Up to now, less than 1% of the total infections were found in other Asian countries, North America, Australia or Europe. However, since mid-February, due to developments in some countries outside of China, there have been some signs that Covid-19 is expanding into a pandemic or may already be regarded as such. The vast majority of cases outside of China initially came from people with a recent history of traveling from China. Relatively few cases of transmission outside of China had been confirmed for some countries. In the meantime, however, more and more cases are becoming apparent in which Covid-19 was able to spread significantly in the affected countries, including South Korea, Japan, Singapore, Italy and Iran. The WHO documents corresponding statistical data on SARS-CoV-2 in its daily "situation reports" [1].

In the case of Covid-19, about 80% have only a mild form of the disease, similar to a flu-like infection, partly without any striking symptoms, partly with fever, respiratory problems or diarrhoea. About 20% of cases are associated with more severe symptoms such as pneumonia, acute respiratory syndrome or kidney failure. The global mortality rate is 2.0 - 3.0%, which is significantly lower than for the break out of the closely related SARS virus in 2002/2003 (approx. 11%; [2]). For comparison: the mortality of influenza viruses in a typical flu season is just 0.1 - 0.2% [3]. However, the number of cases is in the millions each year. The WHO estimates that the number of flu-related deaths per year is 290,000 to 650,000 [4]. Influenza and SARS-CoV-2 infections have in common that severe courses and deaths predominantly affect patients with previous illnesses, with a weakened immune system and at a higher age.

From the current point of view, SARS-CoV-2 is transmitted mainly by droplet infection. The incubation period is assumed to be a maximum of 14 days. In addition to direct contact with an infected person, it is very likely that the infection can also occur via hand or surface contact (smear infection). According to a current publication, corona viruses can be detected on surfaces for up to 9 days [5]. Therefore, there is also the possibility of nosocomial infections over a limited period of time, i.e. during a stay or treatment in a hospital [6]. Because the ability of viruses to reproduce is limited on

surfaces parcels, letters or goods from China are considered to involve no risk of infection. The RKI represents this assessment on its website in the form of an answer to FAQs [7]. It is shared by the WHO on its website "Myth busters", which also answers current questions about Covid-19 [8].

Measures to combat the spread of the disease include isolating suspected and actual disease cases and paying special attention to hygiene rules in the event of increased risks of infection. Various organisations such as the WHO [9], the Robert Koch Institute (RKI) in Germany [10] or the European Centre for Disease Prevention and Control (ECDC) [11] provide comprehensive information directly related to Covid-19. Experts believe that, in addition to controls and safe working practices, suitable personal protective equipment (PPE) plays a central role in protecting health workers and patients. The most important PPE components in this sector are respiratory masks, protective goggles or face masks, disposable gloves and protective gowns or suits.

CE 0086

Figure 1: CE-mark of the notified body (BSI)

It is important to know that PPE used for dealing with (potentially) contaminated patients or materials must comply with category III in accordance with the PPE Regulation (EU) 2016/425 [12], for protection against fatal hazards and irreversible damage to health. This is indicated by the CE marking (Fig. 1) with a four-digit identification number of the notified body. This marking is usually affixed to the product and/or to the smallest individual packaging. In addition to

personal protective equipment, general hygiene measures such as effective hand and surface disinfection are of particular importance. For the inactivation of coronaviruses (e.g. SARS and MERS-CoV) on surfaces, the following active substances have proven to be effective: 62-71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite [5].

In the field of PPE, [respiratory masks](#) (Fig. 2) tested to EN 149 [13] and corresponding to at least category FFP-2 or better FFP-3 should be used for medical personnel. These masks ensure the retention of particles in a size range of 0.4 to 10 µm with a filter performance of at least 92 or 98 %.

Some respiratory masks are also designed for smaller particles in the nanometer range, which also include the diameter of smaller viruses such as SARS-CoV-2 (0.06 - 0.14 µm or 60 to 140 nm). In addition to the filtration efficiency, the correct fit or individual shape is important; the desired protective function can only be achieved if the mask is tightly sealed to the wearer's face.



Figure 2: [FFP-3 respiratory mask BLS 860 also for nano particles](#)

Medical face masks are defined and tested according to EN 14683 [14]. This type of face mask is not primarily a personal protection against microorganisms from the outside, but is designed to retain pathogens originated from the breath of the wearer. Medical masks, therefore, can be used to prevent transmission of the infectious agent. A type II medical face mask retains more than 98% of a bacterial test aerosol in the test procedure. There are already shortages of all respiratory protection products in hospitals worldwide, as private individuals are increasingly - and unnecessarily - stocking up on them.

Safety glasses must comply with EN 166 [15]. They should fit closely to the skin of the face, fit the contours of the face well and also be suitable for wearers of glasses. The eye area should be covered as much as possible. The lens material should be made of scratch-resistant plastic and have an anti-fog coating. Possibilities for flexible adjustment, e.g. with an elastic band system, as well as indirect ventilation are also important features.



Figure 3: [Protective gloves Manu L against chemicals and micro-organisms with virus protection test](#)

Disposable gloves must comply with EN ISO 374-1 [16] and should be made of synthetic rubber (nitrile, neoprene) or latex, be powder-free and have a minimum length of 280 mm. The cuff should cover the wrist well, preferably approximately to the middle of the forearm. High-quality protective gloves against chemicals and micro-organisms (Fig. 3) are tested and approved according to various standards. With regard to highly infectious viruses, such as SARS-CoV-2, the special virus protection test according to EN ISO 374-5 [17] or ASTM 6319-19 [18] is of particular importance for the protection of the user.

Protective gowns and other partial protective clothing (Fig. 4) should be designed for single use and changed regularly. They should be equipped with tight-fitting wristbands or loops to prevent slipping. It is crucial that the protective clothing is proven to be liquid-tight and has a tested infection protection function, also, and especially, against viruses. PPE in Europe has to be successfully tested according with EN 14126 [19], which also takes account of virus penetration.



Figure 4: [The protective gown cleo® saphir offer the greatest resistance against biological agents such as viruses, bacteria and fungi](#)

A particular hazard arises from the handling of waste contaminated by SARS-CoV-2. According to the information of the RKI, they are assigned to the waste code 18 01 03* [20] and thus belong to the category of waste "whose collection and disposal is subject to special requirements with regard to infection prevention". This also includes all non-inactivated or disinfected cultures with these pathogens [21]. Important aspects are, that 18 01 03* waste must be transferred into tear-resistant, moisture-resistant and leak-tight containers at the place of origin. Decanting and sorting is not permitted. The collection - and ultimately the destruction in a waste incineration plant - must take place in closed, type-approved disposable containers. The handling is generally complex and dangerous. Non-contact waste collection systems, which prevent the escape of liquids and aerosols during limited storage, can therefore make handling much safer and easier (Fig. 5). In accordance with current WHO recommendations for medical personnel, detailed information on suitable protective equipment was compiled in tabular form as a "disease commodity package -novel coronavirus" [22].

When handling biological agents, the most important legal regulation in Germany is the Ordinance on Biological Agents [23] and the supplementary Technical Guidelines for Biological Agents (TRBA).

Other countries in the European Union have comparable regulations, following the Directive 2000/54/EC - biological agents at work. These regulations define the minimum measures for safety and health protection that employers and employees must comply with. In Germany, the TRBA 100 [24] applies to laboratories and the TRBA 250 [25] to health care and welfare institutions. Measures such as the use of technical protective devices, e.g. safety cabinets (Fig. 6) organisationally correct behaviour and the use of suitable PPE are specified here. The requirements take into account the hazard arising from the activity and the classification of the biological agent into risk groups.



Figure 5: [Claire® pro safety cabinets for high personal and product protection](#)



Figure 4: [SealSafe® pro SealSafe® pro waste sealing system for the safe conditioning of toxic and infectious waste](#)

The classification of viruses into risk groups is based on TRBA 462 [26]. The evaluation of the new coronavirus SARS-CoV-2 has not yet been completed and is currently being carried out by the responsible Committee for Biological Agents (ABAS). Due to the great similarity of the pathogenicity and the course of propagation, there is a strong case for classifying SARS-CoV-2 in the second highest risk level, risk group 3. This corresponds to a classification as for the closely related coronaviruses SARS-CoV and MERS-CoV, which have also led to a high number of cases of illnesses and deaths in recent years. Based on that, the committee gave the preliminary risk group 3 on February 19 to the new virus.

Links:

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- [3] <https://www.uni-bielefeld.de/gesundhw/aq2/infepi/influenza.html>
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- [15] DIN EN 166: Personal eye protection - Specifications; German version EN 166:2001, Beuth Verlag, Berlin, 04.2002
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