



Disposable masks: Disinfection and sterilization for reuse, and non-certified manufacturing, in the face of shortages during the COVID-19 pandemic

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ABSTRACT

The COVID-19 pandemic is posing a huge global health threat. To deal with this problem, in addition to research and work in the medical field, the main health measures being taken in the workplace and at home involve the establishment of safety protocols, which include distance measures, hygiene and the use of personal protective equipment, such as masks, etc. The WHO still does not recommend the use of masks for the general population. However, their successful use in China, South Korea and the Czech Republic has encouraged their widespread use, and the shortage that already existed. This has caused that companies and individuals are looking at the best way to reuse them, and to manufacture, homemade or not, of non-certified masks. This paper is based on two objectives: to consult the scientific literature to identify the main strategies for disinfecting them, and to determine the effectiveness of non-certified disposable masks. A rapid review has been conducted in which the main publications and other information available online have been analyzed. Results showed that the most promising methods are those that use hydrogen peroxide vapor, ultraviolet radiation, moist heat, dry heat and ozone gas. Soapy water, alcohol, bleach immersion, ethylene oxide, ionizing radiation, microwave, high temperature, autoclave or steam are not fully recommended. Regarding the effectiveness of surgical masks compared to PPE, the former have been seen to be slightly less effective than PPE. As for other types of masks the effectiveness of homemade or non-certified masks is very low.

1. Introduction

The COVID-19 pandemic caused by the virus SARS-COV-2, which first emerged in Wuhan, China, in the province of Hubei in December 2019, is posing a huge global health threat. The total number of global deaths on the date of submitting this paper (24 April 2020) has risen to 191,263, with 2,717,004 infected (European Centre for Disease Prevention and Control, 2020c). The economic impact will be undoubtedly colossal and we are still unaware of the real consequences this will have on each country's economy and on the labor market. It is not the first pandemic that we have suffered, but the dimensions of this one are especially shocking and only comparable to the flu pandemic of 1918, a little over a century ago. It is certainly a public health threat that goes beyond occupational health and safety, and it transgresses the borders of business organizations, being of primary concern to virologists and epidemiologists, but also to technicians, specialists and academics in the field of safety who can make a significant contribution to its prevention. In addition to the past and present research carried out

to create detection tests, vaccines, antivirals and other treatments, the main measures used in the health, work and domestic spheres have focused on social distancing and lockdown, as well as on the monitoring of safety protocols, the adoption of hygiene measures, and the use of personal protection equipment such as masks, gloves, etc. This has meant that terms that were previously used by occupational health and safety professionals alone, such as FFP2, FFP3, N95, KN95, etc., have become part of the common language and have had a positive effect in the field of health and safety by popularizing and increasing the culture of prevention of society as a whole.

However, we cannot forget the importance that the World Health Organization (WHO) has played in this context. It initially made different recommendations for the groups including healthcare personnel, people in direct contact with the infected and people with symptoms (Holland et al., 2020, Jansson et al., 2020) on the one hand, and for the rest of the people on the other. While recommending the use of masks for the first three groups of people, it did not do the same for individuals, where it focused on measures of social distancing, minimum

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5. Conclusions

Although technical standards are the main reference that should be used as a guide to the manufacture and use of personal protective equipment such as disposable masks, in situations of extreme scarcity caused by epidemics, and in this particular case, the COVID 19 pandemic, other strategies should be considered. Among them, the reuse of disposable filtering facepiece respirators does not seem like a bad transitional solution until the shortage is over. Among the different methods, the available literature seems to point out that the most promising methods are those that use hydrogen peroxide vapor, ultraviolet radiation, moist heat, dry heat and ozone gas. Within them, hydrogen peroxide vapor treatment appears to be the best system and is being widely recommended. Although ultraviolet reduction has also been recommended in some countries, there are those who point to doubts about its effectiveness in the inner layers due to shadows. Dry heat also appears to be effective although it has not been widely recommended. There is even a study that points out the effectiveness of dry heat using a hair dryer for disinfection. The moist heat is currently being evaluated to verify that it does not degrade the fit or the filtration capacity. Ozone gas appears to be effective in decontaminating FFP respirators without damaging them, although it presents risks for the safety and health of workers who carry out the process if it is not handled properly.

Other decontamination procedures allow reuse for a limited number of times and with certain limitations and negative side effects, including the deformation of the elastic, the metal strip to fasten it to the face, or the possibility of causing the accumulation of humidity with the consequent risk of exposure to the virus and self-infection.

In addition to effectiveness, other variables may influence the selection of one or another decontamination method by organizations, hospitals or companies that need to apply them to guarantee the supply of PPE during the COVID-19 pandemic. In fact, some methods require specific technology or resources that make the decontamination process more expensive. In this sense, dry heat seems to be cheap. Another factor to consider would be that the method chosen for disinfection must be adapted to the needs of the companies in terms of time and amounts of decontaminated FFP respirators. They must also be logistically and organizationally viable. Even it can take into account other issues such as the traceability of the process or the confidence that is generated in the workers who must reuse the FFP respirators.

Furthermore, surgical masks, compared to Personal Protection Equipment, have a similar effectiveness and are therefore a good alternative. Disinfection processes for reuse have not been described for this type of masks. The hygienic mask offers a lower level of protection than the previous ones. However, in the case of recommending the use of mask by the uninfected and asymptomatic population during the shortage of Personal Protection Equipment and surgical masks, hygienic masks seem the best option since they are certified according to a specification.

Finally, **improvised homemade or non-certified masks are the worst alternative of those studied, although it seems better than using nothing at all. However, some bodies say that they may even increase the risk of infection due to humidity, the diffusion of liquids and the retention of the virus in the mask, which would facilitate self-infection. The washing machine and dryer should be used for decontamination.**

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