Should face masks be worn to contain the spread of COVID-19 in the postlockdown phase?

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Background: In East Asia, face masks are commonly worn to reduce viral spread. In Europe and North America, however, their use has been stigmatised for a long time, although this view has radically changed during the ongoing severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic. Notwithstanding this, it is still unclear whether face masks worn by COVID-19 carriers may indeed prevent viral transmission and environmental contamination. The objective of this study was to evaluate the effectiveness of surgical face masks in filtering SARS-CoV-2.

Methods: Four male patients with COVID-19 were recruited for the study. Two patients wore a surgical mask for 5 h, while two others did not. The spread of the virus in the environment was evaluated through the approved Allplex 2019-nCoV assay.

Results: In the room with the two patients without surgical masks, the swab performed on the headboard and sides of the beds was positive for SARS-CoV-2 contamination. In the other room, where two patients were wearing surgical masks, all of the swabs obtained after 5 h tested negative.

Conclusions: The results of the current study add to the growing body of literature supporting the use of face masks as a measure to contain the spread of SARS-CoV-2 by retaining potentially contagious droplets that can infect other people and/or contaminate surfaces. Based on the current evidence, face masks should therefore be considered a useful and low-cost device in addition to social distancing and hand hygiene during the post-lockdown phase.

Keywords: non-pharmacological interventions, health care organisation, SARS-CoV-2, viral spread

Introduction

The WHO has declared the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection a pandemic disease and many countries around the world have made emergency declarations. The first studies of COVID-19 mostly focused on the clinical, biological and radiological characteristics of patients with suspected or confirmed SARS-CoV-2 infection.1,2 The need to lift lockdown emergency measures has sparked a great deal of interest around possible strategies for containing COVID-19 transmission. The use of face masks is now recommended by major health authorities, including the WHO, to reduce SARS-CoV-2 transmission indoors or outdoors when social distancing cannot be guaranteed. However, the effectiveness of face masks for the control of COVID-19 transmission is still under debate. The current study was therefore undertaken to evaluate whether surgical face masks were effective for filtering SARS-CoV-2 in a hospital setting.

Methods

The study was conducted in a COVID-19 acute care ward at the Fondazione Policlinico Universitario “Agostino Gemelli” IRCCS in Rome, Italy. Four male patients with a laboratory-confirmed diagnosis of COVID-19 were recruited. At the time of hospi-
tal admission, all the patients had fever and cough and were <1 wk after onset of symptoms. Upon admission, all the patients tested positive for SARS-CoV-2 by RT-PCR of nasopharyngeal and oropharyngeal swabs. High-resolution chest computerised tomography scans were also obtained for all patients, showing diffuse ground-glass opacity with initial consolidation areas in all cases. Overall, the disease severity was mild to moderate in all patients. Hence, they were isolated in two standard double-bed hospital rooms, each with its own bathroom. Patients showed good oxygen saturation on room air, were autonomous in getting out of bed, ate at the dining table and used the bathroom.

Three days after admission, the two rooms were classified as Room 1 and Room 2. In both rooms, at the end of lunch (13:00 h) the environment was sterilised and surfaces were swabbed with aseptic Dacron swabs in the following order: (1) headboard and sides of beds; (2) surfaces of the bedside tables; (3) dining table surfaces; and (4) bathroom entry and exit handles. After performing these four environmental swabs, the two patients in Room 1 were invited to spend the afternoon performing all of their activities without wearing surgical face masks. The patients in Room 2 were asked to wear surgical masks without ever taking them off. Three additional facial masks were made available to both of the patients in Room 2 in case of deterioration (e.g. the cords snapping or excessive wetting due to coughing or sneezing). Patients in both rooms were instructed on how to wash their hands properly using soap and water according to WHO recommendations. The number of times patients used the bathroom and washed their hands was obtained by self-report. All of the patients were unaware of the study protocol and no invitation to perform forced coughs were made. The rationale of the study was to focus on recovering SARS-CoV-2 emitted through exhaled breath in a real-life situation.

Before dinner (18:00 h), the same assessor entered the two rooms and again performed the four environmental swabs in the same sequence and on the same surfaces tested at baseline. The assessor was equipped with appropriate personal protective equipment so as not to contaminate himself or the environment. He was also blind to the study protocol and aims.

Viral RNA detection was performed using the Korean Ministry of Food and Drug Safety approved Allplex 2019-nCoV assay (Arrow Diagnostics, Genoa, Italy), a single-tube assay able to detect the three target SARS-CoV-2 genes (E gene, RdRP gene and N gene), as in WHO-recommended protocols. The study protocol was approved by the Ethics Committee of the Università Cattolica del Sacro Cuore, Rome, Italy (protocol ID number: 0013008/20). Written informed consent was obtained from all participants prior to enrolment. Because of possible contamination, a photograph was taken of the signed sheet, which was immediately disposed of as potentially hazardous material. The manuscript was prepared in compliance with the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) reporting guidelines for observational studies.

### Results

The patients in the two rooms were comparable in terms of age and clinical characteristics. The patients in Room 1 were aged 57 and 58 y, while the patients in Room 2 were aged 55 and 59 y (p=0.83). All of the patients had cough and mild dyspnea during the observation period. The average time spent in bed by the two patients in Room 1 was similar to that of the patients in Room 2 (200.0±28.2 vs. 205.0±7.0 min, respectively; p=0.83). Overall, the bathroom was used four times by patients in Room 1 and three times by those in Room 2. The two patients in Room 2 confirmed that they had worn surgical masks all of the time; one patient had changed masks twice, while the other had done this once.

All baseline swabs tested negative for environmental SARS-CoV-2 contamination (Figure 1). In Room 1, the three swabs obtained after 5 h on the bedside table, the dining table and the bathroom handles tested negative. The swab performed on the headboard and sides of the bed was positive for SARS-CoV-2 contamination. In Room 2, all of the swabs obtained after 5 h tested negative (Figure 1).

### Discussion

While the use of face masks is recommended by several health authorities, it is still unclear whether surgical face masks worn by patients hospitalised for COVID-19 can indeed prevent contamination of the environment. Our findings, although obtained in a small patient sample, indicate that surgical masks can effectively reduce the emission of SARS-CoV-2 particles into the environment through respiratory droplets.

Leung et al. determined the efficacy of surgical face masks in preventing the transmission of seasonal coronaviruses, influenza viruses and rhinoviruses in breath and coughs of young and adult persons with acute respiratory diseases. The results indicated that surgical face masks prevented the transmission of human coronaviruses and influenza viruses from symptomatic cases. A single interesting case report revealed that one acute COVID-19 patient with a productive cough had transmitted the SARS-CoV-2 infection to five people in one vehicle when he did not wear a face mask, although nobody was infected in a second smaller vehicle the same patient traveller in wearing a face mask. More recently, Chi-Chung Cheng et al. analysed the incidence of COVID-19 per million population in the Hong Kong Special Administrative Region with community-wide masking compared with that of non-mask-wearing countries (Spain, Italy, Germany and France). These countries were chosen because they are comparable with Hong Kong in terms of population density, healthcare system organisation and social distancing measures. The incidence of COVID-19 in Hong Kong (129.0 per million population) was significantly lower than that observed in the other countries, suggesting that community-wide mask wearing may help control SARS-CoV-2 dissemination by decreasing the emission of respiratory droplets from people with subclinical and/or symptomatic COVID-19.

From the beginning of the COVID-19 pandemic, social distancing and careful hand hygiene have been promoted as strategies to reduce the spread of SARS-CoV-2 in the community. The extensive use of face masks has only recently been added to the recommendations by the WHO and the US Center for Diseases Prevention and Control. People habitually wear a face mask to protect themselves, but this custom also has a major public health implication as it protects others from respiratory droplets.
The extensive use of face masks may therefore play a strategic role in mitigating the spread of COVID-19. Currently available data suggest that, along with more robust evidence-based recommendations such as social distancing and hand hygiene, extensive face mask use may help reduce droplet-based transmission of SARS-CoV-2 infection. Indeed, the government of Hong Kong managed to limit the COVID-19 outbreak without issuing a lockdown, by enforcing the use of face masks.

Although reporting potentially relevant findings, our study has limitations that require consideration. First, the sample size was small, which prevents definite conclusions being drawn regarding the effectiveness of surgical face mask use. Hence, the findings need to be replicated in larger-scale studies. In addition, at the time the study was conducted, the detection of SARS-CoV-2 RNA in nasopharyngeal and oropharyngeal swabs was based on qualitative RT-PCR. Therefore, we were unable to evaluate whether viral load in individual patients had an impact on environmental contamination. Although unlikely, the possibility cannot be omitted that both patients in Room 2 were SARS-CoV-2-negative by the time the study was conducted. Finally, although the participants were instructed regarding the handwashing procedure and were requested to carefully report the number of times they washed their hands and used the bathroom, none of these parameters were objectively recorded.

**Conclusion**

The results from the current study add to a growing body of literature suggesting that face masks should be considered as a cost-effective intervention to contain COVID-19 in the postlockdown phase. Based on our findings and those made by others, the use of face masks should therefore be recommended in addition to social distancing and hand hygiene during the COVID-19 postlockdown phase. The new perspective is to shift from selfishness (‘I only care about my protection’) to altruism (‘I care about protecting others’), considering the face mask a symbol of social solidarity.

**Authors’ contributions:** FL and RB coordinated the overall study. FL, FC, MT, FB, GB, VB and AC were involved in the concept and the design of the study. FL, EM, AMM, LMMR and AR drafted the manuscript. MS, EDA, DF, FP, ER, SR, AS, PC and SM contributed to data acquisition and interpretation and revised the manuscript. All the authors have read and approved the manuscript in its final version.

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Availability of data and material: All data and material are available from the corresponding author upon reasonable request.

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