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Universal use of face masks for success against COVID-19: evidence and implications for prevention policies

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Take home message (max 256 characters, including spaces): Cloth masks are a simple, economic and sustainable alternative to surgical mask as a means of source control of SARS-CoV-2 for general community.

Running title: Face masks for success against COVID-19.

Key-words: COVID-19; facial mask; surgical mask; prevention, airborne diseases

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Dear Editor,

A hot debate is taking place on the use of face masks (including cloth and surgical) as a prevention tool in the community vis-à-vis the recent World Health Organization (WHO) recommendations. To shed light on this important topic we reviewed relevant literature focused on the key words 'infection control', 'prevention', 'masks', 'respirators', 'viral infections' and 'COVID-19' without time restrictions to identify a minimum set of references from an electronic database (PUBMED), existing guidelines, viral diseases, airborne diseases, and grey literature.

The core findings of the references identified are summarised in Table 1.

According to the WHO report from February 2020 (https://www.who.int/docs/default-source/coronaviruse/who-chinajoint-mission-on-covid-19-final-report.pdf.), the proportion of truly asymptomatic carriers of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection was relatively small and not a major driver of virus circulation, infection transmission, and new disease development. However, in blanket testing of an isolated village of approximately 3,000 people in northern Italy, 50%-75% of people with positive pharyngeal molecular tests were totally asymptomatic [1]. This finding was echoed by a more recent daily surveillance report from China, where all people arriving from overseas were rigorously tested [2]: among 166 persons with newly identified infections, 78% were asymptomatic. Although the infective dose associated with transmission is not known, the viral load in the respiratory tract in an asymptomatic patient has been reported to be similar to patients with symptoms [3], and transmission of SARS-CoV-2 infection from an asymptomatic contact has also been described [4].

Until some weeks ago, it was thought that the virus could be transmitted only by droplets that are coughed or sneezed out or by contaminated fomites, with differences according to the initial load and surface characteristics [5]. Airborne transmission of SARS-CoV-2 was considered possible only when care procedures generating aerosols (e.g. intubation, bronchoscopy, and positive-pressure ventilation) are performed [6]. However, other studies seem to indicate the opposite, i.e., the virus can be present in exhaled air produced by talking and breathing [6]. Moreover, a potential role of aerosols in virus diffusion was evident in a complex laboratory study. Aerosols containing a viral load quite similar to that observed in human respiratory samples were created to generate an aerosolized environment. SARS-CoV-2 was detected up to 3 hours after the start of the study [7]. Although these findings were not considered fully convincing by some authors [5], they

deserve attention and require further studies to establish whether and when airborne transmission of SARS-CoV-2 truly occurs and how it can be reduced.

It is well known that surgical masks can prevent the inhalation of large droplets and sprays but have limited ability to filter submicron-sized airborne particles [8,9]. As SARS-CoV-2 is also embedded in aerosols <5 μm in diameter, it cannot be determined whether they are always effective. However, mask wearing by patients with pulmonary tuberculosis (an airborne infectious disease) has been shown to reduce infectivity to guinea pigs by 56% [9,10]. The surgical mask has also been shown to intercept other human coronaviruses during coughing [11]. A meta-analysis of randomized controlled trials also showed that surgical masks and N95 respirators were similarly effective in preventing influenza-like illness and laboratory-confirmed influenza among healthcare workers [12]. Similar results were obtained in a case-control study comparing the protective effect of surgical masks and N95 respirators against SARS among healthcare workers in five Hong Kong hospitals [13].

Controlling a respiratory infection at source by a face mask is a well-established strategy. For example, symptomatic patients with cough or sneezing are generally advised to put on a face mask, and this applies equally to patients with pulmonary tuberculosis (airborne transmission) and influenza (predominantly droplet-transmitted). With the large number of asymptomatic patients unware of their own infection [1,2], the comparable viral load in their upper respiratory tract [3], droplet and aerosol dispersion even during talking and breathing [6], and prolonged viral viability outside our body [7], we strongly advocate universal use of face mask as a means of source control in public places during the COVID-19 pandemic. Extreme forms of social distancing is not sustainable, and complete lockdown of cities or even whole countries is extremely devastating to the economy. Universal masking in public complements social distancing and hand hygiene in containing or slowing down the otherwise exponential growth of the pandemic. Universal masking protects against cross-transmission through unavoidable person-to-person contact during the lockdown and reduces the risk for resurgence during relaxation of social distancing measures on reopening.

A high degree of compliance will maximize the impact of universal masking in public. The global shortage of surgical masks and N95 respirators is a serious concern. In line with the recent recommedation by US CDC for healthy people to wear a cloth face cover in public [14], we strongly support the use of cloth masks as a simple, economic and sustainable alternative to surgical mask as a means of source control for general community use, so that disposable surgical masks and N95 respirators can be reserved for use in health care facilities. Such intervention is likely to be life-saving in many resource limited settings.

Author contributions

S.E. and N.P. co-wrote the manuscript. GBM and CCL wrote sections of the manuscript, edited the text for major intellectual components and designed the Table. All authors approved the text.

Conflict of interest

Authors declare no competing interests.

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Table 1. Main studies on severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission.

Authors	Setting	Study	Main findings and comments
Day M. BMJ 2020;368:m1165. [1]	Vo' Euganeo, Italy	RNA testing of the entire village population (3,000 inhabitants)	50-75% of infected individuals asymptomatic, representing "a formidable source" of contagion. Isolation of asymptomatic individuals essential for controlling virus spread and epidemic seriousness
Day M. BMJ 2020; 369:m1375. [2]	China	Screening on overseas arrivals	130 of 166 new infections (78%) identified in the 24 hours to the afternoon of Wednesday 1 April 2020 were asymptomatic. Asymptomatic infections would not be able to cause another major outbreak of COVID-19 if such individuals were kept in isolation.
Zou L et al. N Engl J Med 2020; 382: 1177–79. [3]	Zhuhai, Guangdong, China	Monitoring SARS-CoV-2 viral loads in upper respiratory specimens of 18 patients	Higher viral loads were detected soon after symptom onset and viral load in an asymptomatic patient was similar to that in the symptomatic patients.
Rhote C. et al. N Engl J Med 2020;382:970-971. [4]	Munich, Germany	Report of transmission of COVID-19 from an asymptomatic individual to 4 contacts	The fact that asymptomatic persons are potential sources of COVID-19 infection may warrant a reassessment of transmission dynamics of the current outbreak.
World Health Organization. Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations . [5]	Global	Precaution recommendations	The routes of COVID-19 transmission are via droplet, fomites and airborne transmission of droplet nuclei (<5µm), with less evidence for intestine transmission. WHO continues to recommend droplet and contact precautions and not airborne precautions.
Lewis D. Is the coronavirus airborne? Experts can't agree. Nature 2020. [6]		Reporting of different viewpoints	Arguments in favour and against airborne transmission and related prevention are discussed.
van Doremalen N. et al. N Engl J Med 2020. [7]	USA	Stability of SARS-CoV-2 and SARS-CoV-1 in aerosols and on various surfaces was evaluated and their decay rates estimated using a Bayesian regression model	Aerosol and fomite transmission of SARS-CoV-2 is plausible, since the virus can remain viable and infectious in aerosols for hours and on surfaces up to days.
University of Maryland. ScienceDaily, 3 April 2020. [8]	USA		Wearing surgical masks in public could help slow COVID-19 pandemic's advance: masks may limit the spread diseases including influenza, rhinoviruses and coronaviruses.
Migliori GB, et al. Eur Respir J 2019; 53(6). [9]	Europe	WHO Consensus document	The core components of infection control are discussed, together with precautions to prevent unnecessary admissions, with focus on tuberculosis. The importance of personal protection (respirators to protect health care staff, other patients and visitors and surgical masks for infectious patients) is discussed.

Dharmadhikari AS. et al. Am J Respir Crit Care Med 2012; 185(10): 1104–1109. [10]	South Africa	17 MDR-TB patients wore face masks on alternate days. Ward air was exhausted to two identical chambers, each housing 90 guinea pigs breathing ward air either when patients wore surgical face masks (intervention group) or when patients did not wear masks (control group).	Sixty-nine of 90 control guinea pigs (76.6%) became infected, compared with 36 of 90 intervention guinea pigs (40%) representing a 56% (95% CI, 33–70.5%) decreased risk of TB transmission when patients used masks. Surgical face masks on patients with MDR-TB significantly reduced transmission and offer an adjunct measure for reducing TB transmission from infectious patients.
Leung NHL et al. Nature Medicine 2020. [11]	Hong Kong	Quantification of the amount of respiratory virus in exhaled breath of participants with medically attended ARIs and determination of the potential efficacy of surgical face masks to prevent respiratory virus transmission	246 patients were studied. Surgical face masks significantly reduced detection of influenza virus RNA in respiratory droplets and coronavirus RNA in aerosols, with a trend toward reduced detection of coronavirus RNA in respiratory droplets. The results indicate that surgical face masks could prevent transmission of human coronaviruses and influenza viruses from symptomatic individuals.
Long Y. J Evid Based Med 2020. [12]	China	Systematic Review and meta-analysis on the effectiveness of N95 respirators versus surgical masks to prevent influenza	The use of N95 respirators compared with surgical masks is not associated with a lower risk of laboratory-confirmed influenza. It suggests that N95 respirators should not be recommended for general public and non high-risk medical staff those are not in close contact with influenza patients or suspected patients.
Seto WH. Lancet 2003;361:1519-1520. [13]	Hong Kong	Case-control study in 5 hospitals	241 non-infected and 13 infected staff were surveyed about use of mask, gloves, gowns, and hand-washing. 69 staff reporting use of all four measures were not infected, while all infected staff omitted at least one measure ($p=0.0224$). Fewer staff who wore masks ($p=0.0001$), gowns ($p=0.006$), and washed their hands ($p=0.047$) were infected compared with those who did not; stepwise logistic regression was significant only for masks ($p=0.011$). Practice of droplets precaution and contact precaution is adequate in significantly reducing the risk of infection after exposures to patients with SARS. The protective role of masks suggests that in hospitals, infection is transmitted by droplets.
Centers for Disease Control and Prevention. Coronavirus Disease 2019 (COVID-19). How to Protect Yourself & Others.[14]	USA	Guidance to the public	Core recommendations are: 1. Clean your hands often; 2. Avoid close contact; 3. Cover your mouth and nose with a cloth cover when around others; 4. Cover cough and sneezes; 5. Clean and disinfect.

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