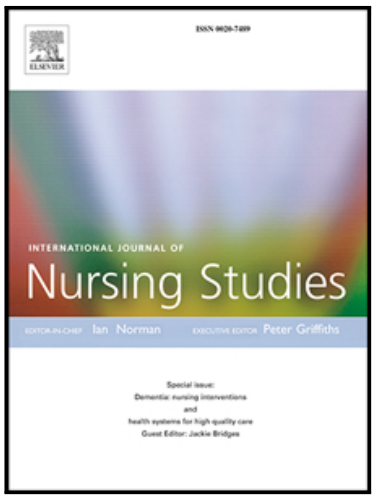

Policies on the use of Respiratory Protection for Hospital Health Workers to Protect from Coronavirus Disease (COVID-19)

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Guest Editorial

POLICIES ON THE USE OF RESPIRATORY PROTECTION FOR HOSPITAL HEALTH WORKERS TO PROTECT FROM CORONAVIRUS DISEASE (COVID-19)

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Introduction

Novel Coronavirus (COVID-19) emerged in China in December 2019 and as of 3rd March 2020, more than 90,800 cases and 3100 deaths have been reported from 72 countries (1). Most of the cases and deaths have occurred in Wuhan city in China where the outbreak started. As drugs or vaccines are not yet available, various non-pharmaceutical measures have been recommended to reduce the spread of infection, including hygiene and disinfection, improving environmental control, early detection and reporting, isolation, quarantine, use of personal protective equipment , social distancing and travel restrictions(2, 3). In most pandemic plans, tiered strategies which target front line health workers first, followed by the general community, are usually defined. Yet many of these strategies have some level of controversy attached and lack a large evidence base (4). Some are starting to be phased out in some settings such as the use of thermal scanners at airports, due to a lack of evidence, especially for infections with pre-symptomatic transmission (5). However, the use of other interventions continues to be debated.

The lack of agreement on the selection and use of masks (medical or surgical facemasks) and respirators (N95/P2/FFP2 or equivalent) is reflected in inconsistent and conflicting policies worldwide (4, 6). Masks and respirators are commonly used to protect healthcare workers from respiratory infections, particularly during the initial periods of outbreaks/ pandemics when other control measures not yet available (7, 8). In this paper we examined existing policies of selected health organisation and countries on the use of masks and respirators to protect hospital health workers from COVID-19.

Health workers' policies for the use of masks/respirators for novel coronavirus (COVID-19)

While there is a high level of agreement amongst key agencies that masks and respirators play a role in the protection of health workers, there are currently discrepancies between these agencies regarding how and when the different products are used. The World Health Organization (WHO), the US Centers for Disease Control and Prevention and other leading health organisations have different recommendations for the selection of respiratory protection. For example, the WHO recommends using masks to protect health workers from COVID-19 during routine care and respirators during aerosol generating procedures (9). In contrast, the US Centers for Disease Control and Prevention (10) and the European Center for Disease Prevention and Control (11) recommend using respirators during both routine care of COVID19 patients and high risk situations. Individual countries also have different policies; some are in line with the WHO, and others with the US Centers for Disease Control and Prevention. For example, the Australian (12) and Canadian guidelines (13) align with the WHO, while UK (14) and Chinese guidelines (15) align with the US Centers for Disease Control and Prevention and European Center for Disease Prevention and Control. While all organisations recommend using N95/ P2/FFP2 or equivalent respirators, Public Health England (UK) recommends using filtering facepiece 3 (FFP3) respirators for all cases and the European Center for Disease Prevention and Control recommends using FFP3 during aerosol generating procedures. Australian guidelines also recommend powered air purifying respirators while performing aerosol generating procedures. on multiple patients. Although US Centers for Disease Control and Prevention guidelines also discuss powered air purifying respirators indication of their use is not clear.

These conflicting policies may cause confusion for hospital managers, nurses and other health workers. Conflicting guidelines have resulted in a large amount of online debate between infectious disease providers and infection prevention control experts about what approaches should be adopted. History is repeating itself with the same controversies around powered air purifying respirators during the Ebola epidemic in 2014 (4, 16). The policies and guidelines regarding the use of masks/respirators for health organisations are also inconsistent for other infections such as severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV), pandemic influenza and Ebola virus disease (4, 6).

The only similarity is that all health organisations and countries generally recommend the use of masks by suspected or infected cases of COVID-19 (i.e. source control) to prevent spread of infections. They simultaneously state that community use of masks has no benefit. Yet there are more randomised controlled clinical trials (RCTs) supporting the use of masks in the community than for source control. The community trials show a benefit of face masks with or without hand hygiene, conditional on compliance (17-22). There are only two RCTs of clinical efficacy of source control (23,

24), and one small experimental RCT of 9 subjects (25). These suggest a benefit, but larger trials are needed.

What level of respirator protection should be used for coronavirus (COVID-19)?

The main difference in masks and respirators is their intended use. Masks were originally designed to prevent spread of infections from wearers to other people around them, referred to as "source control". They are also used to protect from infections transmitted through the droplet mode and splashes or sprays of blood or body fluids. Disposable medical or surgical masks are common types of face masks used by both health workers and general public. In contrast to this, respirators are designed for respiratory protection. A medical or surgical mask may be enough to prevent droplet transfer, while a respirator is required for airborne infection. In terms of mask use, the physical barrier may also prevent contact transmission such as hand to face/mouth/nose. A respirator or mask may provide protection against multiple modes of transmission, including droplet, airborne and hand-to-mouth/nose transmission. Whilst the relative contribution of each mode is difficult to quantify, clinically, the debate about the modes of transmission is academic if an intervention is shown to prevent infection.

Like other coronavirus diseases (e.g. SARS and MERS), COVID-19 is believed to be transmitted through droplet and contact modes however other transmission modes, such as airborne, are likely given the virus is found in higher concentrations in the lungs than the upper respiratory tract (26). There had been evidence of airborne transmission of SARS as well, therefore respirators were recommended for SARS during 2002-03 outbreak(27). In Canada, initially masks were recommended, but this recommendation was later changed to respirators due to the deaths of health workers. A recent study demonstrated the presence of coronavirus in anal swabs from infected patients and possibility of transmission through faecal-oral route (28). Transmission dynamics for COVID-19 are still unclear and pharmaceutical control measures are not yet available, therefore N95 or higher respirators should be offered to health workers who are working at the frontline (4, 16). Health workers and other first responders in high coronavirus transmission areas (e.g. Wuhan) should use respirators during routine care of coronavirus cases. Health workers and first responders in low risk countries should use a respirator when encountering a suspected or confirmed case of coronavirus. If respirators are not available, then masks should be used.

Policies on extended use and reuse of masks

Use and reuse of masks and respiratorswas a common practice during past epidemics and pandemics due to shortage of products (29-32). According to the US Centers for Disease Control and Prevention, extended use refers to "the practice of wearing the same N95 respirator for repeated

close contact encounters with several patients, without removing the respirator between patient encounters" (33). The US Centers for Disease Control and Prevention defines re-use as "the practice of using the same N95 respirator for multiple encounters with patients but removing it ('doffing') after each encounter" (33). Shortages of respirators were reported in many hospitals in US and Japan during the 2009 influenza H1N1 pandemic and staff had to use medical masks (31, 32, 34).

Currently, the single use of medical mask and FFP respirators is recommended, but this is not always feasible. During a pandemic or extended outbreak, medical masks and FFP respirators may not be available for everyone. Therefore the US Centers for Disease Control and Prevention and other health organisations have previously considered the extended use and re-use of medical masks and respirators during outbreaks, pandemics and other high demand situations (33, 35, 36). During recent COVID-19 epidemics the shortage of masks and respirators have been reported from many countries. However, the outer surface of medical masks or respirators may be contaminated and may be a source of infection (37, 38). A recent study showed that pathogens may be present on the outer surface of around 10% masks and risks increase with prolonged mask use (39). The number of viral particles and length of survival are important factors to consider in case re-use is deemed essential (37).

Currently there is a lack of data regarding the period for which the same mask or respirators may be continuously used, and none of guideline address this. Available data suggest that respirators may be used intermittently or continuously for around eight hours (40) and that adverse effects of facemasks increase with more than eight hours use (41). It has been suggested that extended use of facemasks is acceptable if the mask is not wet and soiled. However there are currently no clinical studies supporting this practice (35, 42). Considering the high demand for respirators during pandemics, the Occupational Safety and Health Administration in the US (34) recommends the extended use of respirators, if they are not soiled or damaged and are still functioning properly.

Respiratory protection program

Policies and guidelines should also mention implementation of a comprehensive respiratory protection program for respirator use, which includes selection of certified respirators, training and fit checking and testing, and inspection, maintenance and storage (43). Certified respirators should be used in healthcare settings and certification processes should be managed by a regulatory body, for example in the US the National Institute for Occupational Safety and Health regulates the certification process under regulation 42 CFR 84(44). Similarly, in Europe,the European Norm standard(45) and in Australia, AS/ NZS 1716 standard regulates respirator use(46). All guidelines, except the WHO and the Australian guidelines, briefly discuss the need for fit testing but do not

provide detail on fit testing procedures. The WHO and the Australian guidelines do not mention fit testing and instead mention fit check (or seal-check) which is not equivalent to fit testing. All guidelines however highlight the importance of training for respiratory (and other personal protective equipment) use.

Conclusion

Summing up, in the case of serious emerging infections, like COVID-19, the precautionary principle should be used for frontline health workers and a properly fitted respirator should be used. If respirators are not available, masks should be used. Extended use and reuse are high risk practices and may lead to self-contamination to the wearer and should be avoided. In case of shortage, extended use should be balanced against the risk of infections and the wearer should not remove masks between patients encounters. There should be a uniform policy around the use of personal protective equipment to avoid confusion which places occupational health and safety of health workers as a high priority.

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Conflict of intertest

Abrar Ahmad Chughtai had testing of filtration of masks by 3M for his PhD more than 5 years age. 3M products were not used in his research. He also has worked with CleanSpace Technology on research on fit testing of respirators (no funding was involved).

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REFERENCES

1. World Health Organisation (WHO). Novel Coronavirus (2019-nCoV) situation reports 2020 [Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports.
2. World Health Organization (WHO). Infection prevention and control of epidemic- and pandemic-prone acute respiratory infections in health care. 2014.

3. Bell D, Nicoll A, Fukuda K, Horby P, Monto A, Hayden F, et al. Non-pharmaceutical interventions for pandemic influenza, national and community measures. Emerging infectious diseases. 2006;12(1):88-94.
4. MacIntyre CR, Chughtai AA, Seale H, Richards GA, Davidson PM. Respiratory protection for healthcare workers treating Ebola virus disease (EVD): Are facemasks sufficient to meet occupational health and safety obligations? Int J Nurs Stud. 2014;51(11):1421-6.
5. Gunaratnam PJ, Tobin S, Seale H, Marich A, McAnulty J. Airport arrivals screening during pandemic (H1N1) 2009 influenza in New South Wales, Australia. Medical Journal of Australia. 2014;200(5):290-2.
6. Chughtai AA, Seale H, MacIntyre CR. Availability, consistency and evidence-base of policies and guidelines on the use of mask and respirator to protect hospital health care workers: a global analysis. BMC research notes. 2013;6:216.
7. Aiello AE, Coulborn RM, Aragon TJ, Baker MG, Burrus BB, Cowling BJ, et al. Research findings from nonpharmaceutical intervention studies for pandemic influenza and current gaps in the research. American journal of infection control. 2010;38(4):251-8.
8. Aledort JE, Lurie N, Wasserman J, Bozzette SA. Non-pharmaceutical public health interventions for pandemic influenza: an evaluation of the evidence base. BMC public health. 2007;7:208.
9. World Health Organisation (WHO). Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected. Interim guidance 2020 [Available from: https://www.who.int/publications-detail/infection-prevention-and-control-during-health-care-when-novel-coronavirus-(ncov)-infection-is-suspected.
10. Center for Disease Control and Prevention (CDC). Interim Healthcare Infection Prevention and Control Recommendations for Patients Under Investigation for 2019 Novel Coronavirus. January 2020 2020 [Available from: https://www.cdc.gov/coronavirus/2019-nCoV/infection-control.html.
11. European Centre for Disease Prevention and Control (ECDC). Infection prevention and control for the care of patients with 2019-nCoV in healthcare settings 2020 [Available from: https://www.ecdc.europa.eu/sites/default/files/documents/nove-coronavirus-infection-prevention-control-patients-healthcare-settings.pdf.
12. Communicable Diseases Network Australia (CDNA). CDNA National Guidelines for Public Health Units [Available from: https://www1.health.gov.au/internet/main/publishing.nsf/Content/cdna-song-novel-coronavirus.htm.
13. Canada Go. Coronavirus disease (COVID-19): For health professionals [Available from: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals.html#i
14. Public Health England. Guidance. COVID-19: infection prevention and control guidance [Available from: https://www.gov.uk/government/publications/wuhan-novel-coronavirus-infection-prevention-and-control/wuhan-novel-coronavirus-wn-cov-infection-prevention-and-control-guidance.
15. Chinese Center for Disease Control and Prevention. New Coronavirus Pneumonia Prevention and Control Plan (Fourth Edition) 2020 [Available from: http://www.nhc.gov.cn/jkj/s3577/202002/573340613ab243b3a7f61df260551dd4.shtml.
16. MacIntyre CR, Chughtai AA, Seale H, Richards GA, Davidson PM. Uncertainty, risk analysis and change for Ebola personal protective equipment guidelines. Int J Nurs Stud. 2014;52(5):899-903.
17. Simmerman JM, Suntarattiwong P, Levy J, Jarman RG, Kaewchana S, Gibbons RV, et al. Findings from a household randomized controlled trial of hand washing and face masks to reduce influenza transmission in Bangkok, Thailand. Influenza and other respiratory viruses. 2011;5(4):256-67.
18. Aiello AE, Perez V, Coulborn RM, Davis BM, Uddin M, Monto AS. Facemasks, hand hygiene, and influenza among young adults: a randomized intervention trial. PloS one. 2012;7(1):e29744.

19. Aiello AE, Murray GF, Perez V, Coulborn RM, Davis BM, Uddin M, et al. Mask use, hand hygiene, and seasonal influenza-like illness among young adults: a randomized intervention trial. The Journal of infectious diseases. 2010;201(4):491-8.
20. Suess T, Remschmidt C, Schink SB, Schweiger B, Nitsche A, Schroeder K, et al. The role of facemasks and hand hygiene in the prevention of influenza transmission in households: results from a cluster randomised trial; Berlin, Germany, 2009-2011. BMC infectious diseases. 2012;12:26.
21. MacIntyre CR, Cauchemez S, Dwyer DE, Seale H, Cheung P, Browne G, et al. Face mask use and control of respiratory virus transmission in households. Emerging infectious diseases. 2009;15(2):233-41.
22. Cowling BJ, Chan KH, Fang VJ, Cheng CK, Fung RO, Wai W, et al. Facemasks and hand hygiene to prevent influenza transmission in households: a cluster randomized trial. Annals of internal medicine. 2009;151(7):437-46.
23. Canini L, Andreoletti L, Ferrari P, D'Angelo R, Blanchon T, Lemaitre M, et al. Surgical mask to prevent influenza transmission in households: a cluster randomized trial. PloS one. 2010;5(11):e13998.
24. MacIntyre CR, Zhang Y, Chughtai AA, Seale H, Zhang D, Chu Y, et al. Cluster randomised controlled trial to examine medical mask use as source control for people with respiratory illness. BMJ open. 2016;6(12):e012330.
25. Johnson DF, Druce JD, Birch C, Grayson ML. A quantitative assessment of the efficacy of surgical and N95 masks to filter influenza virus in patients with acute influenza infection. Clinical infectious diseases : an official publication of the Infectious Diseases Society of America. 2009;49(2):275-7.
26. World Health Organisation (WHO). Novel Coronavirus (2019-nCoV) 2020 [Available from: https://www.who.int/westernpacific/emergencies/novel-coronavirus.
27. McKinney KR, Gong YY, Lewis TG. Environmental transmission of SARS at Amoy Gardens. Journal of environmental health. 2006;68(9):26-30; quiz 51-2.
28. Zhang W, Du R-H, Li B, Zheng X-S, Yang X-L, Hu B, et al. Molecular and serological investigation of 2019-nCoV infected patients: implication of multiple shedding routes. Emerging Microbes & Infections. 2020;9(1):386-9.
29. Chughtai AA, MacIntyre CR, Peng Y, Wang Q, Ashraf MO, Dung TC, et al. Practices around the use of masks and respirators among hospital health care workers in 3 diverse populations. . American journal of infection control. 2015;43:1116-8.
30. Beckman S, Materna B, Goldmacher S, Zipprich J, D'Alessandro M, Novak D, et al. Evaluation of respiratory protection programs and practices in California hospitals during the 2009-2010 H1N1 influenza pandemic. American journal of infection control. 2013;41(11):1024-31.
31. Lautenbach E, Saint S, Henderson DK, Harris AD. Initial response of health care institutions to emergence of H1N1 influenza: experiences, obstacles, and perceived future needs. Clinical infectious diseases : an official publication of the Infectious Diseases Society of America. 2010;50(4):523-7.
32. Rebmann T, Wagner W. Infection preventionists' experience during the first months of the 2009 novel H1N1 influenza A pandemic. American journal of infection control. 2009;37(10):e5-e16.
33. Center for Disease Control and Prevention (CDC). Questions and Answers Regarding Respiratory Protection For Preventing 2009 H1N1 Influenza Among Healthcare Personnel 2014 [Available from: http://www.cdc.gov/h1n1flu/guidelines_infection_control_qa.htm#ex_use.
34. Tomizuka T, Kanatani Y, Kawahara K. Insufficient preparedness of primary care practices for pandemic influenza and the effect of a preparedness plan in Japan: a prefecture-wide cross-sectional study. BMC family practice. 2013;14:174.
35. Occupational Safety and Health Administration (OSHA). U.S. Department of Labor. Pandemic Influenza Preparedness and Response Guidance for HealthcareWorkers and Healthcare Employers. 2009.
36. Institute of Medicine (IOM) National Academy of Sciences. Reusability of Facemasks During an Influenza Pandemic: Facing the Flu. 2006.

37. Institute of Medicine (IOM) National Academy of Sciences. Preventing Transmission of Pandemic Influenza and Other Viral Respiratory Diseases: Personal Protective Equipment for Healthcare Personnel Update 2010. The National Academies Press. Washington D.C2010.
38. Viscusi DJ, Bergman MS, Eimer BC, Shaffer RE. Evaluation of five decontamination methods for filtering facepiece respirators. The Annals of occupational hygiene. 2009;53(8):815-27.
39. Chughtai AA, Stelzer-Braid S, Rawlinson W, Pontivivo G, Wang Q, Pan Y, et al. Contamination by respiratory viruses on outer surface of medical masks used by hospital healthcare workers. BMC infectious diseases. 2019;19(1):491.
40. Center for Disease Control and Prevention (CDC). Recommended Guidance for Extended Use and Limited Reuse of N95 Filtering Facepiece Respirators in Healthcare Settings 2014 [Available from: http://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html.
41. Shenal BV, Radonovich LJ, Jr., Cheng J, Hodgson M, Bender BS. Discomfort and exertion associated with prolonged wear of respiratory protection in a health care setting. Journal of occupational and environmental hygiene. 2012;9(1):59-64.
42. Sonoma County Department of Health Services. Pandemic influenza – phase 6 infection control recommendations template 2006 [Available from: http://www.sonoma-county.org/health/topics/pdf/infectioncontrol/phase6icrecommendations.pdf.
43. Occupational Safety and Health Administration (OSHA). U.S. Department of Labor. Respiratory Protection. OSHA 3079. 2002 (Revised).
44. National Institute for Occupational Safety and Health (NIOSH). NIOSH Guide to the Selection and Use of Particulate Respirators. 1995.
45. European Directive. Guidelines on the application of council directive 89/686/EEC of 21 December 1989 on the approximation of the laws of the Member states relating to personal protective equipment. .
46. Standards Australia Limited/Standards New Zealand. Respiratory protective devices. Australian/New Zealand Standard. AS/NZS 1716: . 2012.