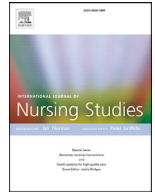




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## Guest Editorial

# Policies and procedures for personal protective equipment: Does inconsistency increase risk of contamination and infection?



## 1. Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first identified in Wuhan, Hubei province, China in 2019 as the cause of a cluster of pneumonia cases later confirmed to be the COVID-19 disease (World Health Organization (WHO) 2020a). A novel coronavirus, SARS-CoV-2 is similar to other human and animal viral pathogens including some of those which cause the common cold and is most similar to severe acute respiratory syndrome (SARS/ SARS-CoV-1). The SARS-CoV-2 virus has spread to many countries and was declared a pandemic by the World Health Organization (WHO) on 30 January 2020 (World Health Organization (WHO) 2020b). The individuals most at-risk of infection are those in close contact with patients with COVID-19 which includes health and aged care staff. Governments, employers, local, national, and global health and aged care agencies and organisations including those that represent and advocate for health and aged care workers, such as international and national nursing associations, recommend and provide guidance regarding the use of personal protective equipment (PPE), both directly related to the current COVID-19 pandemic and more broadly around infection prevention and control. A lack of consistency regarding PPE policy and recommendations has been discussed recently by Chughtai and colleagues in an editorial which focussed particularly upon differences in the recommended type/level of PPE, policies on extended use and reuse, and the importance of respiratory protection programs (Chughtai et al., 2020). In this paper, we focus more specifically on recommended processes for the use of PPE, particularly donning and doffing practices; and discuss the issue of inconsistent recommendations and messaging leading to confusion, concern, avoidable errors, and most seriously, increased risk of contamination and infection for both health and aged care staff, as well as patients and community members.

## 2. Selection of appropriate PPE

Most guidance regarding the selection of PPE urges precautions for droplet and contact transmission and airborne precautions with respirators (often minimum P2 or N95) in settings when aerosols may be generated (United States Centers for Disease Control and Prevention (CDC) 2020; Australian Government Department of Health, 2020a; Australian Government Department of Health, 2020b; World Health Organization (WHO) 2020c; European Center for Disease Prevention and Control (ECDC) 2020). Guidance is not universally consistent however, with the WHO and

Australian Government recommendations urging precautions for droplet and contact transmission in the setting of caring for people with COVID-19 and airborne precautions only in settings when aerosols may be generated (World Health Organization (WHO) 2020c). The United States Centers for Disease Control and Prevention (US CDC) and the European Centre for Disease Prevention and Control (ECDC) recommend airborne precautions for any situation involving the care of patients with COVID-19, but also consider the use of medical masks as an acceptable option in case of respirator shortages (United States Centers for Disease Control and Prevention (CDC) 2020b; European Centre for Disease Prevention and Control (ECDC) 2020).

Evidence and opinion regarding potential modes of COVID-19 transmission is rapidly evolving and dialogue particularly centres around the potential for airborne transmission via small aerosolised droplets (<5µm) which would be similar to the SARS-CoV-1 virus (Yu et al., 2004). Based on currently available evidence, SARS-CoV-2 is transmitted when virus particles enter the body via the mucosae or conjunctiva which can occur through (World Health Organization (WHO) 2020c); direct person-to-person contact, respiratory droplets >5-10µm in diameter, and indirect contact from touching infected environmental surfaces/formites and subsequent transfer of viral particles to the mucosae or conjunctiva.

One difficulty is that aerosol generating procedures (AGP) are themselves not universally and consistently defined with different jurisdictions having varying classifications of what is and what isn't regarded as an aerosol generating procedures. Indeed, evidence regarding the risk of infection from aerosol generating procedures and aerosolised particles more generally, such as those from coughs, sneezes, and speaking, is not unequivocal, with past studies finding varying levels of aerosolisation and transmission risk with different procedures (O'Neil et al., 2017; Tran et al., 2012). Clearly, this has implications for the type of PPE precautions that staff should follow and upon organisational policy that directs both supply and selection. It is likely that a definitive answer regarding whether or not SARS-CoV-2 is transmitted via small aerosolised particles will be a long time coming, so until then basing recommendations upon risk minimisation in the interests of patient and staff safety as well as rational use and supply would be advisable. Further research regarding the specific and relative risks that a comprehensive range of aerosol generating procedures pose in terms of contamination, transmission, and infection is also necessary and could likely draw upon evidence regarding both SARS-CoV-2 as well as similar respiratory infections.

### 3. Using Personal protective equipment

Precautions for contact, droplet, and airborne transmission are relevant depending upon the context. It is vital that health and aged care services have robust respiratory protection programs (Hines et al., 2014), and that staff have access to appropriate PPE supplies and receive information and training regarding how to correctly put on (don), wear/use, take off (doff), and dispose of PPE in different situations (Huh, 2020). In order to work properly, correct size, fit, use, and disposal of PPE is essential and must take place within the broader range of infection prevention and control activities such as hand hygiene, environmental and equipment decontamination and cleaning, screening, testing, and contact tracing as well as organisational policy regarding isolation and quarantine of suspected and confirmed cases (World Health Organization (WHO), 2020d). Many health and aged care services around the world are suffering shortages in terms of access to suitable types and sizes of PPE, so correct, rational use is vital to conserve supply and protect staff and patients (World Health Organization (WHO) 2020d).

Correct procedures regarding donning, wearing, doffing, and disposal are vital components of infection control and maintenance of staff and patient safety but are often improperly followed (Zellmer et al., 2015). Training staff to follow procedural guidelines is one way of enhancing staff knowledge and skill in PPE use and seeks to support the maintenance of high standards in terms of infection prevention and control through the minimisation of errors and potential contamination (Mulvey et al., 2019). Despite the existence of protocols for use, deviations from procedural guidelines for PPE donning and doffing appear to be relatively common and result in increased contamination of both staff and environmental surfaces (Kwon et al., 2017; Lim et al., 2015). Deviations from doffing procedure has been noted to be the most risky (Okamoto et al., 2019), as this occurs once PPE has potentially become contaminated; notably, incorrectly doffing respirators has been found to be a primary cause of contamination when removing PPE (Lim et al., 2015).

There is currently no single evidence-based, gold-standard approach to the process of donning and doffing PPE, with many jurisdictions recommending and training staff to follow procedures that do not exactly match those of neighbouring jurisdictions, other national and/or international authorities, or different sites (see Appendix I) (Verbeek et al., 2020). While donning procedures are relatively consistent across guidance, it is doffing instructions that appear to vary widely and could lead to the most confusion and risk. One study has found that doffing gloves before gowns may lead to greater risk of hand contamination, but gloves before gowns is a consistent recommendation across all procedures (Okamoto et al., 2019). This emphasises the need for hand hygiene following each step, which is not suggested by many guides.

Appendix I illustrates how donning and doffing procedures vary somewhat across Australia and appear inconsistent with a number of international guides. Recommended doffing procedures appear to vary most considerably with the order of removing items, number of points of hand hygiene, suggested or implied (i.e. via images) use of variously hand washing or hand rub/sanitiser, and location/s of where the doffing process should occur frequently being quite different between guidelines. Another point of inconsistency is the way that the procedures are explained; various approaches including written narrative, dot points, diagrams, and videos are used.

There has been relatively little examination of the impact of different approaches to donning and doffing despite known risks of incorrect process and errors. A recent Cochrane systematic review of low-certainty evidence included eight studies that compared different donning and doffing procedures (Verbeek et al., 2020).

In all studies, investigators examined the US CDC's procedure in comparison to no guidance and noted that CDC guidance outperformed the use of no guidance in terms of minimising contamination. Further, results suggested that one-step glove and gown removal, double-gloving, verbal instructions guiding doffing, and disinfecting gloves may be effective for minimising contamination and increasing procedural compliance (Verbeek et al., 2020). The systematic review located no studies comparing different approaches to donning and doffing and it appears that such a comparison has not been reported.

Ambiguity is a known reason for non-compliance with guidelines and non-compliance increases risk of harm (Gurses et al., 2018). We contend that the lack of consistent information and guidelines regarding PPE, from what equipment should be used as discussed by Chughtai and colleagues (Chughtai et al., 2020), to what procedures should be followed for donning and doffing are a risk to staff, patient, and community safety. While it might be that any systematic process for donning and doffing PPE that maintains certain principles to minimise contamination (i.e. adherence to hand hygiene at particular points, ensuring a particular order of doffing where items at risk of greater contamination do not make contact with items at less risk) may perform similarly in terms of contamination and infection risk reduction, this is not known for sure. We believe it could be likely that the existence of inconsistent guidance – even if equivalently effective when followed carefully – across even reputable organisations may cause uncertainty, indecisiveness, and confusion among health and aged care staff who may then make otherwise avoidable errors and omissions when attempting to follow one particular process after having come across several similar but varying approaches. This may be a particular issue in the context of surges in the number of patients and the redeployment of staff to different and unfamiliar sites where PPE procedures may be dissimilar. Doffing PPE is complex and mentally demanding (Mumma et al., 2019), so adding further elements of uncertainty particularly in the context of a highly stressful global pandemic is likely to result in errors.

### 4. Conclusion

Personal protective equipment is but one element of an effective infection prevention and control strategy, but one that is related to a considerable amount of concern and risk during the ongoing COVID-19 pandemic. Access to and correct use of the right type, size, and fit of PPE is vital and for safety to be maintained, staff must have adequate training, information, and education regarding use. Understanding and being able to correctly follow a systematic donning and doffing process is integral to using PPE safely and effectively, but differing guidelines – even if each were to be confirmed to be equivalent – may result in staff confusing or omitting steps or making other errors which can result in contamination and infection. With such distressingly high numbers of front-line health and aged care workers dying and putting themselves at risk every day, the evidence underpinning PPE use and the clarity and consistency of guidance that staff receive in settings worldwide must be improved as a matter of priority.

### Conflict of Interest

Micah Peters declares that he is an Associate Editor of the International Journal of Nursing Studies.

No other authors have any conflicting interests to declare.

## Supplementary materials

Appendix 1. Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.ijnurstu.2020.103653](https://doi.org/10.1016/j.ijnurstu.2020.103653).

## CRedit authorship contribution statement

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