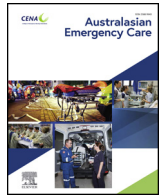




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## Research paper

# Enablers of, and barriers to, optimal glove and mask use for routine care in the emergency department: an ethnographic study of Australian clinicians

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## ABSTRACT

**Background:** The risk of healthcare-acquired infection increases during outbreaks of novel infectious diseases. Emergency department (ED) clinicians are at high risk of exposure to both these and common communicable diseases. Personal protective equipment (PPE) is recommended to protect clinicians from acquiring, or becoming vectors of, infection, yet compliance is typically sub-optimal. Little is known about factors that influence use of PPE—specifically gloves and masks—during routine care in the ED.

**Methods:** This was an ethnographic study, incorporating documentation review, field observations and interviews. The theoretical domains framework (TDF) was used to aid thematic analysis and identify relevant enablers of and barriers to optimal PPE use.

**Results:** Thirty-one behavioural themes were identified that influenced participants' use of masks and gloves. There were significant differences, namely: more reported enablers of glove use vs more barriers to mask use. Reasons included more positive unit culture towards glove use, and lower perception of risk via facial contamination.

**Conclusion:** Emerging infectious diseases, spread (among other routes) by respiratory droplets, have caused global outbreaks. Emergency clinicians should ensure that, as with gloves, the use of masks is incorporated into routine cares where appropriate. Further research which examines items of PPE independently is warranted.

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## Introduction

Healthcare-associated infections are an ongoing threat to patients and clinicians, resulting in significant morbidity and economic cost [1]. The risk of infection, for vulnerable hospital patients, their family members and healthcare professionals, increases during outbreaks of novel and re-emerging infectious diseases, such as

severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS) and pandemic influenza A [2]. Healthcare-associated transmission of these viral infections, into previously unaffected communities, was a key feature of the early stages of, for example, SARS in Toronto and MERS in Seoul [3,4]. A notable feature of both outbreaks was the high proportion of those affected who were healthcare workers, with reports of up to 27% and 57% for MERS and SARS, respectively [5]. First responders and emergency department (ED) clinicians are at high risk of exposure to both common and emerging communicable diseases of high consequence, as they are in close contact with symptomatic patients before a diagnosis is made [5–7]. For example, ED staff are among

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the highest-risk healthcare professionals for exposure to blood-borne viral infections [8] and respiratory diseases such as influenza [9]. Hunter et al. [10] reported an estimated 16% rate of MERS among ED clinicians in Abu Dhabi and, of those infected, 93% had been exposed before the diagnosis was made.

Personal protective equipment (PPE), including gowns, gloves, masks and protective eyewear, is crucial for protecting clinicians from acquiring, or acting as a vector of infection to other staff and patients [11]. In addition to appropriate use of PPE, as part of transmission-based precautions (contact, droplet or airborne), standard precautions indicate use of PPE when there is a risk of exposure to pathogens: non-sterile disposable gloves if hands are likely to become contaminated and a surgical mask and eye protection when at risk of exposure to aerosols or direct splash with blood and body fluids. N95/P2 masks are usually reserved for a few diseases (chickenpox, measles, tuberculosis) in which pathogen-contaminated droplet nuclei (residue from evaporated droplets) or dust particles can remain suspended in air for long periods and enter the upper and lower respiratory tracts.

Sub-optimal use of PPE (i.e. contrary to the indications for standard and transmission-based precautions) by clinicians has been reported in different hospital settings [12–14]. While gloves are the most frequently used item, masks are less appropriately used [15]. Although clinicians' use of PPE has been shown to increase when an outbreak is declared [3,16–18], routine compliance is typically sub-optimal [19,20] which increases the risk of occupationally-acquired infection and disease.

There is limited recent literature examining the use of PPE in EDs. Following the introduction of universal precautions in the early 1990s [21], a number of studies reported poor compliance with these measures in the ED [22–24]. More recently, Singh et al. used self-administered questionnaires to determine compliance with (what are now referred to as) standard precautions in the ED, and found that gloves were frequently used, but there was poor compliance with other PPE, especially eye protection [15]. Evanoff et al. [25] observed video footage to assess compliance with PPE during 304 invasive procedures in an ED and reported 96% glove use for trauma patient encounters, compared with 68% and 78%, for use of mask and protective eyewear, respectively. In a trauma centre study, the compliance rates for use of masks and eye protection, after an educational intervention, were 16% and 44%, respectively [26]. ED clinicians are regularly at risk of facial contamination during invasive procedures, intubation and other resuscitative measures [27]. They are also exposed to both seasonal and emerging respiratory infectious diseases. In one paediatric ED setting, only 1–12% of clinicians reported that they always or usually wore a mask or eye protection, while assessing febrile respiratory patients during winter [28]. Although gloves are worn frequently, patient safety may be compromised by misuse, such as not changing them between dirty and clean tasks on the same patient or between different patients and/or failing to comply with hand hygiene before and after use, which often contaminates the clinician's hands [29–31]. Commonly cited factors contributing to sub-optimal compliance with PPE in healthcare include inadequate knowledge and training, perception of risk, organisational culture and environmental barriers [32,33]. Reid et al. [28] identified knowledge, access to PPE, patient diagnosis and unit culture, in the ED context, as factors influencing PPE compliance.

Healthcare transmission of novel infectious diseases can occur prior to recognition of an outbreak [10]. While it is difficult to plan in advance for such a rare event, staff who are competent in the principles and practice of routine infection prevention and control (IPC) and PPE use are more likely to be better protected from the start and more prepared to implement high-level precautions rapidly and safely. In this area there is a paucity of literature which examines factors that facilitate or hinder the use of PPE during routine clinical

care in the ED. Most previous studies have focused primarily on compliance with standard precautions during procedures that pose a high risk of exposure to blood and body fluids [25,26] or on overall compliance with PPE use, without elucidating determinants of those behaviours [15]. They have described 'how' clinicians use PPE, whereas the present study aimed to show 'why' PPE is, or is not, used by exploring the factors that influence the use—specifically of gloves and masks—during routine care, in one ED. We employed methods that allowed close engagement with clinicians so as to understand their choices and behaviours and utilised the Theoretical Domains Framework (TDF) [34] to assess the relevant enablers and barriers. A better understanding of these practices in this context could assist managers, educators and clinicians to optimise enablers and address barriers, locally, and inform health policy and pandemic planning more widely.

## Methods

### *Study design*

This qualitative study used ethnography to explore the use of gloves and masks by clinicians in an ED. This is a suitable methodology for the study of complex social and clinical interactions in the context of healthcare quality and safety [35] as it involves direct observation of the behaviour of people and their social environment using varied data collection methods.

### *Theoretical domains framework (TDF)*

The theoretical underpinnings of this research are grounded in behavioural science, in particular the TDF, which was used to inform the interview guide and subsequent data analysis. The TDF synthesises multiple theories of behaviour and behavioural change into 14 domains which provide a framework for examination of cognitive, affective, social and environmental determinants and influences on behaviour [36]. It has been used widely in patient safety research [37], including clinicians' IPC practices [38] and is particularly useful for informing policy and planning practice improvement.

### *Setting and participants*

The setting was a busy ED with over 72,000 presentations per year in a major tertiary hospital in Sydney, Australia. Departmental staff were informed about the study through a staff e-newsletter and during several morning staff meetings which are attended by all staff on duty that day. A purposive snow-ball sampling technique [39] was used to recruit clinical and non-clinical staff working in the department for semi-structured interviews, so as to obtain a cross-section of professional roles, experience and clinical expertise.

### *Human research ethics*

Approval for this study was given by the Western Sydney Local Health District Human Research Ethics Committee. Written consent for interview was obtained by the researcher after negotiation with each participant in accordance with the approved study protocol.

### *Data collection*

The researcher attended the ED during day shifts for one to two hours at a time, observing and taking notes on activities directly related to the aim of the study. Local and hospital policies, signage, and other documentation relating to use of PPE in the ED context,

**Table 1**  
Emergent themes mapped to the TDF domains.

	TDF domain	Theme
1.	Knowledge	<ul style="list-style-type: none"> <li>• Knowledge of hospital PPE policy and procedures</li> <li>• Specific knowledge about masks</li> <li>• Department poster about PPE</li> </ul>
2.	Skills	<ul style="list-style-type: none"> <li>• Infection control education and communication</li> <li>• Prior training in PPE</li> <li>• PPE refresher training including Ebola scenario practices</li> </ul>
3.	Social/professional role & identity	<ul style="list-style-type: none"> <li>• Patient / clinician relationship</li> </ul>
4.	Beliefs about capabilities	<ul style="list-style-type: none"> <li>• Professional responsibility towards IPC</li> <li>• Self-efficacy donning and doffing PPE</li> </ul>
5.	Optimism	<ul style="list-style-type: none"> <li>• Confidence (or lack of) in protective properties of PPE</li> <li>• Perceptions of risk from infectious diseases</li> </ul>
6.	Beliefs about consequences	<ul style="list-style-type: none"> <li>• Previous experience with infectious diseases</li> <li>• Protecting self and family from getting ill</li> <li>• Protecting the immune-suppressed patient from infection</li> <li>• Patients' use of protective masks</li> </ul>
7.	Reinforcement	<ul style="list-style-type: none"> <li>• Peer reinforcement of gloves use</li> <li>• Increase in respiratory viruses in winter</li> </ul>
8.	Intentions	<ul style="list-style-type: none"> <li>• Purposeful deviance from policy</li> </ul>
9.	Memory, attention & decision processes	<ul style="list-style-type: none"> <li>• Habitual use of gloves for procedures</li> <li>• Risk assessment for choice of PPE</li> <li>• Busy, chaotic ED environment</li> <li>• Time constraints / urgency of care</li> </ul>
10.	Environmental context & resources	<ul style="list-style-type: none"> <li>• Unknown diagnosis of patients</li> <li>• Ease of access to PPE</li> <li>• Usability of PPE</li> <li>• Lack of isolation facilities</li> <li>• Isolation trolleys</li> </ul>
11.	Social influences	<ul style="list-style-type: none"> <li>• Leadership and role models in department towards using PPE</li> <li>• Culture of PPE use in department</li> </ul>
12.	Emotion	<ul style="list-style-type: none"> <li>• Anxiety about diseases</li> </ul>
13.	Behavioural regulation	<ul style="list-style-type: none"> <li>• IPC audits</li> <li>• Hand hygiene audits</li> </ul>

\*No data was identified that related to the TDF domain 'Goals'.

Abbreviations: PPE = Personal Protective Equipment; ED = Emergency Department; IPC = Infection Prevention and Control.

were examined. Reflexive review of field observations and documentation, was used to inform the interview guide [40] but not included in the analysis reported here.

Twenty-two face-to-face, semi-structured interviews, lasting 10–45 min (average 28 min), were conducted with clinicians (nurses and doctors) and non-clinical support staff at times and places convenient for them during the day. Interviewees comprised five senior doctors (DR), seven nurses in senior roles (clinical nurse consultant [CNC]/ nurse manager [NM]/ nurse practitioner [NP]), two registered nurses (RN), one enrolled nurse (EN), two nurse graduates (NG), two support workers (SW) and two senior external clinicians from the IPC (CNC) and infectious diseases (DR) departments. The questions were guided by the 14 domains of the TDF and focused on the desired behaviours of optimal compliance with glove and mask use. Interviews were audio-recorded and subsequently transcribed verbatim. Interviewees were invited to review their transcripts for accuracy.

#### Data analysis

The data was analysed using a content and thematic approach in order to gather an in-depth understanding of factors affecting optimal glove and mask use. Transcripts were reviewed independently by two researchers, the content was coded into TDF behavioural domains relating to the target behaviours [36] and analysed thematically. No data were lost in the transcription or the interpretive analysis.

#### Findings

Thirty-one behavioural themes were identified that influenced participants' use of protective masks and gloves. These were

mapped against the theoretical domains (Table 1) and further analysis allowed them to be classified as enablers and barriers to optimal use.

The data revealed interdependency between some domains, resulting in natural grouping of the findings. For example, "participants' beliefs about the consequences" (TDF6) of glove and mask use were linked to "emotion" (TDF12) such as anxiety; therefore, the findings are described together. There was also mirroring of themes whereby one could be either an enabler or barrier within the same domain. For example, "knowledge" (TDF1), was an enabler of glove use but a barrier to appropriate mask use. Findings are reported under TDF domain titles within the categories of enablers and barriers.

#### Enablers

In this study, enablers of optimal PPE use were represented in all domains; however, there were more enablers of optimal glove, than protective mask, use. Enablers include a variety of factors that encourage, facilitate or are likely to increase glove or mask use (not necessarily appropriately) including internal/personal factors such as self-protection and/or external factors, as detailed next.

#### Knowledge/Skills/Beliefs about capabilities/Optimism

Participants' knowledge and skills, self-efficacy and confidence in the equipment, were interconnected as key enablers of optimal PPE use. All participants reported having received instruction in the use of PPE during either their professional or induction training. Optimal use of gloves and masks was further enabled through education provided by the hospital IPC team or by some other clinicians with broader knowledge and/or interest in IPC. Participants

reported that high-level PPE skills had also been enhanced in recent years through simulation exercises for Ebola virus disease.

'Look, whenever there's attention to something, like the Ebola, we had a lot of in-services regarding donning and doffing.' (Doctor [DR] 2)

Most clinicians' perceived knowledge of IPC policies supported their use of gloves as appropriate for standard and transmission-based precautions. Optimal PPE use had been further promoted recently through the introduction of an ED-specific poster that identified PPE required for specific diseases, which was attached to isolation trolleys and positively received by staff as helpful, particularly in choosing the correct mask.

The majority of participants reported they were confident with the protection provided by the equipment and in their ability to correctly don and doff gloves and protective masks.

'I got taught that fitting of the mask, when the Ebola . . . was out. I remember being taught properly then how PPE should be worn.' (Enrolled Nurse [EN]1)

The participants' understanding and abilities in PPE use were consistent with their professional responsibilities as described in the next section.

#### *Social/Professional role & identity*

An important enabler of optimal glove and mask use was the professional responsibility some clinicians felt towards protecting patients from infections. For example:

'So yeah, the staff should also then be taking on some of that PPE responsibility, infection prevention responsibility.' (DR4)

Another associated professional responsibility that influenced appropriate glove use was the perception, by several doctors, that when there was no obvious risk of contamination, not wearing gloves facilitated a better doctor/patient relationship.

'It's [wearing gloves] a less human contact. I mean it's different if I'm doing a procedure obviously, but if I touch a patient, I think it's a lot more personal if you don't use gloves.' (DR2)

This professional role identity was interconnected with the participants' beliefs about the consequences of not using PPE, as outlined next.

#### *Beliefs about consequences/Emotion*

Protecting themselves and not taking infection home to their family were reported to be strong motivators of PPE use. This belief in the negative personal consequences of not using PPE was often emotive:

'My concern is (a) infecting me and then taking it home to my family.' (DR3)

Glove use in particular was determined by the perception of personal risk, as summarised by this participant:

'Personally, I will put gloves on if obviously there's blood, patient's got blood on them, so a trauma patient, I would generally put gloves on. Patients who are a bit unhygienic, I'll put gloves on. So, both of these instances are to protect myself.' (DR3)

For others, their use of PPE was influenced by previous experiences, such as working in the early days of HIV or having a urine splash to the face.

'Certainly from my perspective I started my emergency nursing career . . . in a time when there was a big risk around HIV . . . so had a very strong philosophy around the use of gloves.' (Clinical Nurse Consultant [CNC] 3)

The many participants who described a personal motivation for PPE use may have influenced the overall social culture within the department.

#### *Reinforcement/Social influence*

The departmental norms and peer behaviour in the ED both reinforced and positively enabled clinicians' use of gloves, but less so for masks. Glove use was reported to be embedded in routine tasks and patient encounters and clinicians would wait for, or remind, colleagues to don gloves when attending a patient:

'There's definitely a culture of these are the tools that we use to do our work. . . . And what I do notice is that people wait for you to put your gloves on.' (CNC 1)

During the winter respiratory virus season, visual signals such as patients wearing surgical masks or an increase in boxes of masks in clinical areas helped to reinforce mask use. Staff were also expected to wear a mask when caring for a neutropenic patient:

'Just the only other time when I think about wearing masks, is in patients who are in neutropenic. Because that's the other setting where we say that it's required.' (DR1)

The behavioural norms within the ED also influenced the individual's routine and habitual practices related to gloves and masks.

#### *Intentions/Memory, attention & decision processes*

Although some medical staff reported using risk assessment to determine the need for gloves, as described above, the entrenched habit of most staff using gloves routinely for patient contact had the positive effect of facilitating their use when it was indicated as part of standard precautions. As this nurse explains:

'It's an autopilot thing, as soon as they go and get a new patient, straightaway grab a set of gloves and start doing what they need to do.' (Registered Nurse [RN] 4)

While glove use was almost automatic for the participants from the department, clinicians reported making a conscious decision to wear a mask. Medical staff in particular reported making a risk assessment for mask use which was prompted by visual cues such as isolation trolleys and signs by the bedside or certain clinical information handed over about the patient:

'Like the measles or something along those lines. That would prompt me to think, I need a mask and then let [the] nursing staff as well know. Or a TB patient.' (DR2)

Support staff also chose to wear masks and gloves on occasions when they deemed there to be a risk of infection to themselves, as described by the following support worker:

'If I'm near a patient, like, I do fix things around the unit. If I'm near an infectious patient I'll gown up, gloves, mask, what-not.' (Support Worker [SW] 2)

#### *Environmental context & resources*

Within the physical environment of the ED, staff were generally satisfied with the brand of gloves provided and noted that they were very accessible, which was an enabler of optimal use. The recent introduction of isolation trolleys, for patients in transmission-based precautions in curtained bed spaces, facilitated

the use of masks and other PPE and was deemed a success by participants.

'I really like them [isolation trolleys]. Super easy to use ... It makes life a lot easier.' (CNC3)

The support staff also found the isolation trolleys useful to alert them to the infectious status of a patient:

'If they go to enter a room and see the trolley outside they won't bother 99% of the time as not urgent enough to do so. Or if they really have to they will put on the type of mask that is on the trolley.' (SW1)

Behaviour towards PPE was also influenced by the organisational IPC requirements for hospital accreditation.

### *Behavioural regulation*

Although no specific PPE monitoring was in place, annual training was encouraged.

'So we're trying to instil that they need to do an annual [PPE] competency. It's available, we're definitely not there yet.' (CNC IPC)

The introduction of hospital-wide hand hygiene audits helped to promote correct hand hygiene behaviour around glove use and was reported to be an enabler.

'I am more compliant with hand washing prior to glove use than I probably was when I first trained.' (DR1)

As illustrated, a range of factors were identified by participants as enablers of optimal PPE behaviour, primarily for glove use. Within the same TDF domains, barriers to mask and gloves use were also described.

### **Barriers**

Unlike enablers, which mainly related to glove use, barriers to protective mask use were more frequently described by participants.

### *Knowledge/Skills/Beliefs about capabilities/Optimism*

As noted earlier, knowledge of policy was an important enabler of optimal PPE use. However, despite the ready availability of PPE policies and educational resources, participants described mask and glove practices that did not adhere to policy. Thus, in this department, information resources and policy were sometimes a barrier because they were confusing. One clinician pointed to the various posters and guidelines as '*information overload*', while others suggested that hospital-wide policies were not clear or did not work well in the ED context.

'I think that some of our bad practices, or some of our practices that, where you find someone wearing the wrong mask is all due to the fact that when we're educating and when we're following policy, the policy has been very, very ambiguous.' (CNC1)

Indications for which type of mask to use are described in the IPC policy relating to transmission-based 'airborne' and 'droplet' precautions. However, as the following participants describe, these terms were not always well understood and indicated a knowledge gap around the functionality and usage of the different types of masks. Consequently, both medical and nursing staff reported choosing whichever mask was handy, not necessarily the one required, as the following nurse participants reported:

'If you said droplet or airborne you'd just mostly get a blank face and look at you and they might come up and go, well, maybe I need for the airborne the orange but I'm not sure ...' (RN4)  
'... like knowledge base, I think there's a pretty big deficit with mask use ... there is still a lot of confusion as to what masks to wear, when to wear it, what to give to the patient – what we're meant to wear.' (RN2)

Equally, a few participants perceived the surgical mask did not provide adequate protection for respiratory diseases and always chose to use the N95/P2 masks.

'I do feel safer using the orange [N95/P2].' (RN3)

Just for general I would wear the blue [surgical mask], if I was near a highly infectious, a duck bill [N95/P2].' (SW2)

Despite a knowledge of hospital policy towards masks, several participants preferred to apply their own professional autonomy in relation to mask use.

### *Social/Professional role & identity*

Professionally, some medical staff felt that using a mask restricted their ability to provide good clinical care, as it hindered communication and empathy with patients. The following participant felt that the mask interfered with their clinical assessment:

'The problem is, if you need to communicate with people, the mask can, particularly the N95, can muffle your voice as well.' (DR5)

Another doctor perceived the mask as an obstacle to establishing a good understanding between themselves and the patient:

'But I don't want to be the one that's wearing the mask and making the patient feel like there's a barrier.' (DR6)

These aspects of the use of PPE that clinicians presented as barriers to their use, because it interfered with their professional role, were interconnected with their beliefs about the consequences of not using PPE, as outlined next.

### *Beliefs about consequences/Emotion*

As described previously, an exaggerated perception of infection risk, leading to overuse, was a potential barrier to appropriate use of gloves:

'I'm probably not the best person because I think I probably overdo gloves. I do not even feel comfortable shaking hands with a patient without gloves.' (DR6)

By contrast, minimal concern towards the risk of respiratory infection was a barrier to mask use. One clinician attributed this to her own immunity, while another suggested that he was as likely to get a cough or cold as a member of the general public as when working.

'I never wear a mask during the flu season unless obviously I felt like I had the flu. You know, my view of the flu is I get immunised. I catch a train and everyone coughs on me anyway. And I'm more likely to have immunity against things like that because I never get sick.' (DR2)

'So, yes, if they have a respiratory symptom, if they have a fever, there is a history of overseas travel and I'm suspecting some unusual organisms, yeah then I will ... but if it's like cough and cold, just minor symptoms, probably not because we get exposed to it when we are out in public and in the shopping centre, anyway, and I wouldn't.' (DR6)



Another participant suggested that in the absence of visual reminders for infectious respiratory diseases such as a productive cough, they did not perceive enough risk to wear a mask. Similarly, participants also felt a lack of personal risk if the patient was wearing a mask, although they acknowledged that it was often not worn correctly by the patient.

'If they [the patient] have one on I automatically feel safer.' (Nurse Practitioner [NP] 3)

'I've noticed patients take them off all the time, because they are really hot in them, and they get a bit claustrophobic.' (Nurse Graduate [NG] 2)

However, potential consequences for other patients were not reported as a motivation for PPE use outside of caring for the immune-compromised patient.

'... gloves are really more for our protection, especially, way more than they are for the patient's protection.' (RN2)

These common perceptions of risk were re-enforced within the social setting of the unit.

#### *Reinforcement/Social influence*

Unlike glove use, there was no departmental norm for wearing protective masks, except when attending to immunosuppressed patients. Although there was a general consensus that mask use could be improved, peer influence or role modelling was limited to a few senior nurses and doctors.

'I mean part of your PPE, you probably should put a mask on, but we generally don't.' (DR3)

'I guess, in general we don't use masks.' (RN3)

The absence of a departmental culture of wearing protective mask impacted on the clinicians' intentions and decision-making, as described below.

#### *Intentions/Memory, attention & decision processes*

One of the barriers to optimal mask use was the lack of habitual mask use in daily care requiring the individual to make a conscious decision to use a mask as illustrated in this excerpt:

'But because it's not business as usual the only thing that would prompt me initially would be to think, oh I could get a splash here, so therefore I'll wear a mask.' (CNC1)

Conversely, although glove use was prompted by unconscious behaviours, this could lead to unnecessary glove use:

'But I've noticed that's something that happens a lot nowadays, that just to touch a patient, people will put gloves on, and I encourage them not to do that; that they don't need to, that the patient is not dirty.' (RN2)

The individual's decision-making processes were also related to the environment within which they worked, as outlined next.

#### *Environmental context & resources*

The busy, chaotic context of an ED, was reported by many participants to be a barrier to optimal PPE use:

'And it's just so busy that sometimes you can see that, yeah, something might not be quite by the books because of the pressure and the stress of the environment and the amount of people coming in and out.' (Enrolled Nurse [EN]1)

Participants cited urgency of care as barriers to performing hand hygiene prior to donning gloves (it took too long for the hands to dry) or mask.

'The fit test can be a bit of a deterrent in a busy environment, to have to make sure it's fitted properly.' (CNC1)  
'... the time to put it on and off, particularly if someone's sick.' (CNC3)

There was also a belief that the differences between the ED environment and an inpatient unit allowed for different PPE practices.

'It's culturally acceptable in an emergency to do - attend your cares of a patient without those precautions where it's not in the ward.' (NP1)

The lack of a designated place for boxes of masks - other than isolation trolleys - sometimes made it difficult to locate a mask and was a barrier to the use of masks for standard precautions.

'At the bedside, there's just gloves, so you have to go in search of the mask.' (DR3)

The open-plan layout of the department, with only two single isolation rooms, was also identified by several participants as a deterrent to implementing good IPC practices.

'So once they're not in those [isolation] rooms and they're just out in the general acute area, I think [staff are] much less so likely to adhere to those precautions.' (DR3)

Compared to general satisfaction with the gloves provided, participants described more undesirable qualities with using the masks. Some participants reported that the N95/P2 masks were more difficult to don, while others described discomfort and fogging of their glasses or protective goggles when wearing a mask. For one participant the discomfort of wearing a mask interfered with her ability to provide clinical care.

'Like I really think it does make me abridge my assessment and examination because my desire to get the mask off is great.' (DR3)

#### *Behavioural regulation*

Unlike hand hygiene audits, participants reported other external IPC monitoring as a barrier to optimal PPE use. This participant changed her behaviour with masks due to expectations of PPE audits:

'I think it's a bit of a throw-back from infection control. They will teach us about this mask and that mask, and then come and audit you, and then you're always afraid you're using the wrong one. So you just choose the higher one.' (CNC1)

## **Discussion**

This ethnographic study explored the behaviour of clinical staff towards use of gloves and protective masks in a busy ED. Analysis using the TDF elucidated factors that either promote or impede (occasionally both, in different circumstances) optimal PPE use, some of which have been identified previously in the literature [6]. However, we also revealed ED-specific determinants of glove and mask use that have not been previously described.

In addition to providing emergency care of patients, front-line clinicians play a central role in the initial screening, detection and IPC management of suspected but undifferentiated infectious diseases. This role inevitably puts them at personal risk of infection. Therefore, protective barriers such as PPE are essential to minimise the risk both to themselves and to other patients. Although occu-

pational health and safety is important, clinicians should be aware of their professional duty towards patient safety.

An important finding in our study was a significant difference, in use, between gloves and masks in that there were more reported *enablers* of use of the former and *barriers* to use of the latter.

Existing research has demonstrated that gloves are the most frequently used item of PPE, much more so than masks [15]. A significant factor associated with frequent glove use identified in this study was some participants' motivation to use them for their own protection as a routine precaution. Glove use was even more prevalent when there was a higher risk of blood and body fluid contamination, such as in the trauma and resuscitation areas. This aligns with the literature which reports compliance rates of 93–99% for glove use during trauma encounters in ED [25,26]. Less obvious contamination risks, such as an unrecognised MRO-colonised patient, were also identified by participants as reasons for glove use. These patients present a significant risk in the ED for environmental contamination and staff acquisition [41].

Some participants argued that *habitual* use of gloves was a barrier to *optimal* use. It is difficult to ascertain whether the glove use was excessive as there is no published research that explores the indications for and use of gloves in an ED. A recent systematic review of glove use and transmission of infection in other inpatient departments concluded that gloves were often overused and misused [42]. The published literature related to hand hygiene auditing provides some indication of ED rates for glove use. During a hand hygiene observational study in an ED, Carter et al. [43] reported that only 32% of hand hygiene opportunities, whether or not hand hygiene was performed, were associated with glove use, indicating that in this setting, the majority of patient encounters did not incur the use of gloves. Nevertheless, when optimising behaviour for cross infection, attention should also be focused on hand hygiene practices associated with the use of gloves [29].

In comparison, participants described fewer enablers of mask use, which reflects that they are used much less so than gloves [15]. The apparent under-use of protective masks in this study reflects literature reports of low rates (3–25%) for mask compliance in the ED setting [25,26,44]. The optimal use of protective masks by healthcare workers has been shown to reduce transmission of sporadic and epidemic infectious diseases. During the global SARS outbreak in 2003, SARS-CoV transmission in a Vietnamese hospital was significantly reduced when protective mask use among clinical staff increased [45]. Skowronski et al. [46] attributes the prevention of SARS transmission within a Vancouver hospital to the prompt implementation of IPC measures, including PPE, in the ED for a traveller returning from Asia with severe influenza-like illness. This is in contrast to the outcome for a similar case in Toronto, when droplet and airborne precautions were not put in place in the ED for over 21 h, resulting in 14 further cases of cross infection [4].

Many participants blamed the chaotic, fast-paced ED environment, as a significant barrier to using a mask. While this argument has been reported previously [44], the same contextual reasoning could also apply to gloves, which are in fact regularly used and take longer to don and doff—at least if hand hygiene is included. Thus, other factors may be more influential determinants of mask use, such as the team behavioural norms in the department or the individual's perception of risk of infectious diseases. One barrier to optimal mask use demonstrated in our research was the strong personal belief about PPE use of some senior medical staff, which overrode IPC policy. This is reflective of a recent study which found that the clinical autonomy of doctors was a significant factor in their IPC practice [47]. In an ED where there are numerous 'leaders', different role models and aberrant behaviour can impact negatively on the IPC culture of the department. Participants identified a lack of positive role modelling and leadership which has been shown elsewhere to influence individual behaviour towards

PPE [26,47,48]. In contrast to our findings, a recent qualitative study that utilised focus groups with nurses and assistants, reported a positive peer culture for encouraging respirator mask use [49]. This may indicate a greater perception of risk associated with diseases that required an N95/P2 respirator mask. In our study, a clinician's reduced perception of risk of infection from facial exposure was a barrier to wearing a mask. Furthermore, clinicians perceived less risk to themselves when the patient was wearing a protective mask for a potential respiratory disease and felt protected enough not to wear a mask. Public Health guidelines recommend that symptomatic persons in hospital waiting rooms and other public spaces are given a mask to wear to prevent transmission of respiratory infection [50,51]. This measure is largely accepted by the public and has had some success in community settings [52–54]. However, research is limited on its protective effect for clinicians engaging in direct patient care. The literature also reports the problem of non-compliance with mask use by the public [55]. This risk may increase in the ED setting, where, as identified by participants in our study, patients are unwell and often non-compliant in correct mask use.

To prevent early transmission of either routine or outbreak infectious diseases, frontline staff must be vigilant and adhere to routine IPC measures [51]. This study identified the barriers to implementing effective protective mask use, which can be difficult in facilities with few isolation rooms or where staff rely on visual or verbal cues to instigate appropriate precautions [56]. In addition, the placement of boxes of masks was a practical barrier. Poor access to masks is also a common finding in the literature [44,57,58]. In our study setting the introduction of ten isolation equipment trolleys addressed some of these barriers. Applying human factors design principles is one method to address some of the contextual environmental barriers to optimal IPC behaviour such as difficult access to PPE [14,59].

It is worth noting that in this study an exclusively policy-driven approach to PPE use was not a consistent enabler of optimal practice. Although normally viewed as a facilitator, policy in this setting was viewed as a barrier to optimal mask and gloves use. Bouchoucha and Moor [60] suggest that deviating from IPC guidelines and policy can have serious consequences for patient safety. On the other hand, other authors have recognised that the unique complexity of an ED environment can challenge conventional IPC protocols and practices. For example, Liang states that overcrowding, multiple clinician-patient encounters, limited isolation facilities and other factors unique to an ED are barriers to good IPC practice [61]. Chen et al suggests that, compared to inpatient settings, it is more difficult to implement IPC measures in an emergency or outpatient department [62].

The study has some limitations. It reports participants' perceptions of the enablers of and barriers to optimal PPE use for routine care in one Australia ED. This is a single-site study, and the findings are not expected to be representative in their totality of other EDs. Other EDs will inevitably have characteristics which mediate enablers or, and barriers to, optimal PPE use, although it is expected that those identified in this study have resonance. The study design did not permit verification or otherwise of these findings beyond what was possible to observe during the field immersion.

## Conclusion

Our findings have demonstrated that the determinants of PPE behaviour in an ED differed significantly between gloves and masks. The spread of emerging infectious diseases that have been responsible for global outbreaks recently, has included respiratory droplets. ED clinicians should therefore ensure that, as with gloves, the use of masks is incorporated into routine care where appropriate.



These results support the need for further research which examines items of PPE independently.

### Authors' contributions

RB, GLG, SH and MW conceived and designed the study and prepared the study protocol. GLG supervised all data collection and study procedures. All authors contributed to interpretation of the results, preparation of the manuscript and approval of the final version.

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### Provenance and conflict of interest

RS is Editor-in-Chief of Australasian Emergency Care but played no role in the peer review or editorial decision-making of the manuscript whatsoever. The authors declare no other conflict of interest.

#### What is known about the topic?

- Emergency department clinicians are at high risk of exposure to common and emerging infectious diseases.
- Personal protective equipment (PPE) is important in protecting clinicians and patients from these diseases.
- Sub-optimal use of gloves and masks has been reported in the literature.
- However, the determinants of mask and gloves use in the ED setting are not well understood.

#### What this paper adds or contributes?

- The many enablers of and barriers to optimal gloves and mask use in the ED setting include: level of perception of risk to self and the departmental culture towards use of PPE.
- Gloves are used frequently for patient encounters but there are more barriers to optimal mask use.
- Sub-optimal mask use may be related the ED clinician perceiving a lesser risk of infection via facial exposure.

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