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Research paper

COVID-19 personal protective equipment protocol compliance audit

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Abstract Background: Personal protective equipment (PPE) compliance is important to reduce the rate of transmission of virulent pathogens to health care workers. Medical officer compliance with PPE protocol for COVID-19 was audited in a regional hospital in Australia early in the pandemic response.

Methods: Compliance was assessed based on the order and technique of donning and doffing PPE, with medical officers from multiple departments and levels of seniority audited.

Results: Average compliance from all participants was 58.61% with donning and 68.84% with doffing.

Conclusion: Medical Officer compliance with PPE donning and doffing was poor and additional training was required.

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Highlights

- PPE donning and doffing was performed poorly by medical staff.
- Mid-level (registrar) staff performed the highest.
- Further PPE training was required.

Introduction

Personal protective equipment (PPE) compliance is important to reduce the transmission rate of virulent pathogens to health care workers [1]. Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and its clinical syndrome Coronavirus Disease 19 (COVID-19) were first reported to the World Health Organisation by China on December 31st,
2019 with subsequent international spread. The first case in Queensland, Australia was recorded on January 29th, 2020. An audit was undertaken in March 2020 to assess the compliance of medical staff with the Queensland Health PPE guideline for the management of patients with suspected or confirmed COVID-19 (COVID-19 PPE guideline). This guideline was published approximately one month prior to conducting the audit. Posters were in the work environment prior to this audit being undertaken, with all staff members having access to these, but no face-to-face training or compliance evaluation had occurred previously. There was no online module available prior to 2020.

**Methods**

This study audited the PPE donning and doffing practices of medical officers in a large regional teaching hospital in southern Queensland, Australia. 30 medical officers, consisting of: 9 interns, 6 residents, 10 registrars and 5 specialists were assessed. Staff from the emergency department (ED), intensive care unit (ICU), general medicine, and surgical specialties (surgery, obstetrics and gynaecology and orthopaedic) were recruited. Clinicians were approached in person at unplanned times by the primary data collector. Data was collected in the standard work environment separate from patient care areas during working hours from March 9–12, 2020. A standardised script was used when recruiting participants. Written consent for digital recording was obtained. This included both participation in the audit and filming of this, and reassurance that data would be de-identified. Medical officers were video recorded performing donning and doffing PPE by the primary data collector (a medical officer) using a mobile phone for the duration of don and doffing only. This did not occur as part of a clinical or patient care episode but was performed solely for audit purposes and was not covert. Following data collection, each participant was offered written and verbal education in the correct procedure. Data collected was de-identified with only the level of seniority recorded, not names. All recordings were watched and audited independently using the instructions in the current Queensland Health PPE Guideline by two medical officers involved in PPE education, and the data was then averaged to create a percentage of compliance. Clinicians were marked according to their compliance with COVID-19 PPE instructions in this Guideline. This involved donning and doffing non-sterile gloves, gown, protective eyewear, and a surgical mask. N95 masks were only marked as being correct if they were donned by a member of ICU staff, as this was consistent with their workspace at the time of auditing. Hand hygiene was expected to be completed before don and doffing and between each step in doffing. At the time of this audit, both removing gown and gloves in one motion, and removing gloves then gown, with hand hygiene being performed between tasks, were acceptable options in the audited facility and were marked accordingly. Compliance data was stored electronically in a de-identified manner with data only in groups of medical seniority and no names recorded, with all digital recordings deleted. Generalised information around individual don and doffing was made available to participants.

**Results**

30 medical officers were observed donning and doffing PPE. Of these doctors, 13 (43.33%), were women. Only three doctors completed all steps in the correct order following a PPE guideline. Average compliance from all participants was 58.61% with donning and 68.84% with doffing, as seen in Table 1. Combined (donning and doffing) average compliance was 63.73%. The best performing level of seniority were registrars, with a combined average compliance of 72.79%. However, consultant medical officers were the most compliant with donning PPE with 68% compliance. ED was the most compliant department, with a combined average compliance of 72.3%. The lowest performing units were the surgical specialties and medicine, averaging 51.9% overall. The most common PPE item donned and doffed incorrectly, or omitted, was protective eyewear. A 33.3% donning and 60% doffing compliance rate was noted. Gloves were consistently applied and removed appropriately, with 90% and 93% compliance respectively.

**Table 1** Medical officer PPE compliance by seniority and specialty.

| Level/Unit       | Number | % Donning | % Doffing | % Total |
|------------------|--------|-----------|-----------|---------|
| Intern           | 9      | 57.78     | 76.19     | 66.99   |
| Resident         | 6      | 46.67     | 49.17     | 47.92   |
| Registrar        | 10     | 62        | 83.57     | 72.79   |
| Consultant       | 5      | 68        | 66.43     | 67.22   |
| All              | 30     | 58.61     | 68.84     | 63.73   |
| ED               | 15     | 57.33     | 87.26     | 72.3    |
| Medicine         | 6      | 73.33     | 45.83     | 47.83   |
| ICU              | 3      | 73.33     | 69.05     | 71.19   |
| Surgical Specialties | 6 | 40        | 63.79     | 51.9    |

Note: PPE = Personal Protective Equipment.

**Table 2** Medical officer PPE compliance by PPE item.

| PPE Item       | Number of Occasions | % Donning | % Doffing |
|----------------|---------------------|-----------|-----------|
| Hand Hygiene   | 106                 | 83.33     | 55.14     |
| Gown           | 30                  | 50        | 80        |
| Mask           | 30                  | 36.67     | 80        |
| Protective     | 30                  | 33.33     | 60        |
| Eyewear        | 30                  | 90        | 93.33     |

Note: PPE = Personal Protective Equipment.
Discussion

Despite the limitation of the small sample size, the data obtained through our audit was concerning as evidence from the SARS-CoV-1 epidemic emphasised the importance of PPE in preventing nosocomial transmission [1]. Ninety percent of participants in this audit made at least one error in donning or doffing their PPE, increasing their risk of self-contamination and subsequent infection. This is similar to previous findings, with only 13% of participants correctly doffing all PPE during an audit by Zellmer et al. [2] and Mulvey et al. [3]. Errors in doffing are particularly concerning as these could result in health care worker contamination as found in previous studies [4,5] as well as the potential for cross contamination to other patients found by Okamoto et al. [4]. The registrar cohort was found to have the highest overall average compliance within our audit, however the group with highest donning compliance were the consultant group. This compliance from the more senior staff in our audit is encouraging when compared with a study by Van Haren et al. from 2015 [6]. This study found that 66.67% of senior ICU registrars sitting their fellowship examination scored 50% or less on an interactive station assessing understanding and compliance with PPE for the care of patients with a respiratory virus. Phan et al. proposed that PPE training especially including practical experience that improves not just knowledge and skills but also acts to change attitudes was found to be helpful [5].

In response to the data obtained through this audit and the worsening pandemic, face-to-face and online COVID-19 PPE and hand hygiene training was provided to medical staff within the health service. This had the aim of preventing both healthcare worker contamination as well as cross-contamination to other patients. Due to a lack of PPE availability, a follow up audit to assess the impact of this education was unable to be performed. Further research would be beneficial in monitoring the long-term outcomes of similar education programs following this pandemic.

Ethics

This project was submitted to the Darling Downs Health Human Research Ethics Committee who deemed it not requiring ethical review.

Authorship statement

SW was responsible for Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Writing - original draft; Writing - review & editing. SC was responsible for Conceptualization; Methodology; Supervision; Validation; Writing - review & editing.

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Provenance and peer review

Not commissioned; externally peer reviewed.

Conflict of interest

There are no conflicts of interest to be declared.

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