



Major Article

Self-reported behaviors and perceptions of Australian paramedics in relation to hand hygiene and gloving practices in paramedic-led health care



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Key Words:

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Allied health personnel
Paramedic
Hand hygiene

Background: Noncompliance with recommended hand hygiene and gloving practices by workers in the emergency medical services may contribute to the transmission of health care–associated infections and lead to poor patient outcomes. The aim of this study was to explore the self-reported behaviors and perceptions of Australian paramedics in relation to their hand hygiene and gloving practices in paramedic-led health care.

Methods: A national online survey (n = 417; 17% response rate) and 2 semistructured focus groups (6 per group) were conducted with members of Paramedics Australasia.

Results: Although most of the study participants perceived hand hygiene and gloving to be important, the findings suggest poor compliance with both practices, particularly during emergency cases. All participants reported wearing gloves throughout a clinical case, changing them either at the completion of patient care or when visibly soiled or broken. Hand hygiene was missed at defined moments during patient care, possibly from the misuse of gloves.

Conclusions: Paramedic hand hygiene and gloving practices require substantial improvement to lower potential transmission of pathogens and improve patient safety and clinical care. Further research is recommended to explore how to alleviate the barriers to performing in-field hand hygiene and the misuse of gloves during paramedic-led health care.

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BACKGROUND

Hand hygiene through the use of alcohol-based handrubs (ABHR) or washing with soap and water is considered the most effective infection prevention and control (IPC) practice for minimizing the transmission of health care–associated infections (HAIs) in paramedic-led health care.^{1,2} However, 3 studies in North America have identified noncompliance with hand hygiene practices among

emergency medical services (EMS) workers before touching patients, during patient contact, and between patient cases.^{3–5} The noncompliance was attributed to poor access to hand hygiene products³ and fatigue, forgetfulness, operational pressure, and lack of training.^{4,5} In one study, a high bacterial load was found on the hands of the EMS workers after patient care, thereby increasing the risk of transmitting HAIs.³

Gloving is another essential IPC practice for EMS workers because of the increased risk of exposure to blood and other body fluids during patient care.^{6–9} Experience in acute health care services has shown that the failure to change contaminated gloves at appropriate times during patient care results in poor hand hygiene compliance.^{10,11} North American research has found that EMS workers were not changing gloves at appropriate moments during clinical cases.^{4,5} The extent to which this occurs among Australian paramedics remains unclear.

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The Australian health care workforce is provided with detailed advice in the form of national guidelines and standards on recommended IPC practices that are aimed at minimizing the transmission of HAIs.^{1,12} This advice includes the National Hand Hygiene Initiative implemented by Hand Hygiene Australia (HHA) that provides extensive guidance on appropriate hand hygiene practices.¹³ The state and territory ambulance authorities in Australia disseminate advice on IPC practices to their paramedics in the form of operating procedures. Despite this policy rich environment for IPC, there is some evidence that Australian paramedics may be breaching recommended IPC practices when caring for their patients.^{14–17} What is not understood is whether these breaches involve fundamental IPC practices such as hand hygiene and gloving. Therefore, the aim of this study was to explore the self-reported behaviors and perceptions of Australian paramedics in relation to their hand hygiene and gloving practices in paramedic-led health care.

METHODS

Research design

A sequential mixed-methods research design¹⁸ was selected to guide data collection and analysis for the study. Study participants were recruited from Paramedics Australasia (PA), the peak professional organization representing Australian paramedics.¹⁹ Members of PA are employed mostly by Australian state or territory ambulance services, with membership being voluntary.

This study had 2 parts. First, an online self-administered questionnaire was developed to survey PA members in 2013 about their self-reported behaviors and perceptions related to IPC practices in paramedic-led health care. The survey of paramedics on infection control (SoPIC) consisted of 29 constructs and 211 items that targeted the 4 broad IPC areas of hand hygiene and gloving practices, environmental hygiene, aseptic nontouch technique, and clinical governance. Second, 2 semistructured focus groups were conducted with PA members in 2015 to triangulate the participant responses from the SoPIC. This article reports on the findings from the SoPIC and focus groups for hand hygiene and gloving practices.

SoPIC development, piloting, and administration

Development of the questionnaire for the SoPIC was informed by an extensive literature review, content analysis of national IPC guidelines and standards, and IPC operating procedures provided by 4 major Australian ambulance services. In addition, semistructured interviews were conducted with 14 IPC experts drawn from senior ambulance managers ($n = 5$), public health specialists ($n = 3$), infection control practitioners ($n = 4$), and university academics ($n = 2$). The paradigms of predisposing, reinforcing, and enabling factors from social learning theory and the PROCEED-PRECEED (Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development) planning model were used to guide the grouping of themes, constructs, and variables in the SoPIC.^{20–22} The questionnaire contained both open-ended and closed questions that elicited both textual and nontext data. Table 1 shows the themes, constructs, variables, and question details used in the questionnaire for participant attributes and hand hygiene and gloving practices.

The SoPIC was piloted with a small convenience sample from across Australia that included a senior ambulance manager, practicing paramedics ($n = 10$), paramedic educators ($n = 3$), university paramedic academics ($n = 5$), and IPC experts ($n = 2$). This enabled the improvement of construct validity and refinement of the question stems and response choices, and ensured the questionnaire could be completed within 20 minutes. Construct validity was assessed

through discussions with pilot participants, written feedback received, and responses to items. Post pilot changes to the questionnaire functionality were tested online before going live.

The SoPIC was conducted over a 4-week period in September 2013 with PA members being informed about the survey via e-mails through the PA national office.

Semistructured focus group

Two semistructured focus groups (FG1 and FG2) were held prior to PA professional development events in 2015. Participants were self-selected from an e-mail sent from PA administrators to their members. To be eligible for inclusion, participants must have been practicing paramedic members of PA. Participation was voluntary, and data were deidentified. Secondary inclusion criteria were not used because the number of eligible applicants did not exceed the number required for each focus group.

Discussion topics aligned with the 4 broad IPC areas covered in the SoPIC: hand hygiene and gloving practices, environmental hygiene, aseptic nontouch technique, and clinical governance. Three themes were explored for each area: difficulties of maintaining IPC practices in paramedic-led health care, adequacy of IPC practices of Australian paramedics, and what may be required to improve IPC practices in paramedic-led health care. This strategy enabled the interviewer to adapt, modify, and add to the planned themes in response to the focus group discussion.²³

Three short video vignettes of 1–2 minutes that depicted usual paramedic operational events were used to stimulate discussion for each theme.²³ The video vignettes were selected and edited from the Special Broadcasting Service “HELP” documentary (episodes 1 and 6) available for public access on the Special Broadcasting Service Australia YouTube channel.²⁴

Data analysis

The textual data were analyzed through an interactive process of describing, classifying, and connecting information. This process used a combination of initially collating data around a small number of a priori codes followed by thematic analyses,^{25–28} where inductive codes were used to capture emergent themes.^{26,28}

The nontext data (categorical, ordinal, and Likert scales) were summarized using descriptive statistics for variables. Inferential statistics were then used to test for associations between variables using Pearson χ^2 tests and the McNemar test. In addition, logistic regression models were fitted to evaluate the relative importance of multiple predictor variables on dichotomized response variables, allowing adjusted P values to be computed. Confirmatory factor analysis was not undertaken on the survey data because the primary focus was on gaining an understanding of a wide range of specific behaviors and perceptions of Australian paramedics rather than identifying underlying constructs.

Ethical clearance

Ethical clearance was obtained from the University of the Sunshine Coast Human Research and Ethics Committee (S/10/252 and S/14/719).

RESULTS

Demographic attributes of study participants

In 2013 there were 12,500 full-time equivalent paramedics in Australia,²⁹ and the PA had 2,449 financial (active) paramedic members.¹⁹ There were 802 active members of PA¹⁹ who entered

Table 1

Themes, constructs, variables, and question details in the survey of paramedics on infection control* for hand hygiene and gloving practices during paramedic-led health care

Constructs	Variable groups†	Details
Theme 1: demographic attributes—description of study participants		
Universal demographics	Sex	1 question, binary, 2 options
	Age	1 question, ordinal, 7 options
	Ethnicity	1 question, categorical, 9 options plus comments
Paramedic training	Competency	1 question, categorical, 6 options
	Education level	1 question, categorical, 7 options plus comments
	Type of paramedic training	1 question, binary, 2 options
	Time since first qualification	1 question, continuous
Employment	Other clinical qualification(s)	1 question, categorical, 5 options plus comments
	Current clinical practice level	1 question, categorical, 9 options plus comments
	Current paramedic crew structure	1 question, categorical, 3 options plus comments
	Employer type	1 question, categorical, 6 options plus comments
Other	Employer location	1 question, categorical, 9 options plus comments
	Skin irritation from hand hygiene products	1 question, categorical, 5 options plus comments
Theme 2: self-reported behaviors in relation to hand hygiene and gloving practices		
General	Change in general IPC practices while administering care to an infectious patient	1 question, binary, 2 options plus comments
Hand hygiene	Frequency of hand hygiene performed at defined moments during patient care	7 questions, ordinal, 5 options
	Hand and wrist wear	6 questions, ordinal, 5 options
	Length of fingernails	1 question, binary, 2 options
Gloving	Hand hygiene and gloving practices during emergency and nonemergency situations	8 questions, categorical, 3 options plus comments
	Use of ABHR to sanitize gloves	1 question, 5-point Likert scale
	Double gloving	1 question, 3-point-Likert scale
	Triggers for changing gloves during clinical care	1 question, categorical, 8 options plus comments
Frequency of writing on gloves		1 question, 5-point Likert scale
Theme 3: perceptions regarding IPC, hand hygiene, and gloving practices		
General	Confidence with own IPC practices	1 question, categorical, 3 options
	Importance of IPC standard operating procedures	1 question, 3-point Likert scale
	Frequency of observing other paramedic's hand hygiene prior to IV cannula insertion	1 question, 5-point Likert scale
Hand hygiene	Importance of compliance with "bare below the elbows" policies	2 questions, 3-point Likert scale
	Importance of defined moments for performing hand hygiene	7 questions, 3- and 5-point Likert scales
	Barriers to performing hand hygiene during clinical care	1 question, binary, 2 options plus comments
Gloving	Opinion on whether gloving obviates hand hygiene	1 question, 5-point Likert scale

ABHR, alcohol-based handrub; IPC, infection prevention and control; IV, intravenous.

*A copy of the questionnaire, which includes further sections related to environmental hygiene, aseptic nontouch technique, and clinical governance, can be obtained by contacting the authors.

†Variable groupings are shown. More than 1 variable in a group is indicated by multiple questions attached to the group listed, for example "frequency of hand hygiene performed at defined moments during patient care" has 1 question for each variable.

the SoPIC (32% response rate). Of these, 385 participants dropped out early in the survey and prior to completing enough questions to allow analysis, thereby reducing the usable response rate to 17%. Because demographic details were sought at the end of the survey, no demographic data were available for those who did not complete the survey.

Approximately two-thirds ($n = 291$, 69.8%) of the survey participants were men, and most were between 35 and 54 years of age (18–34 years: 20.9%; 35–54 years: 69.1%; ≥ 55 years: 10%). In accordance with the PA definitions for clinical practice, participant scope of practice fell within both the professional stream (paramedic: 49.9%; intensive care paramedic: 28.3%; general care or retrieval paramedic: 12.2%) and the technical stream (patient transport attendant: 6.2%). Most participants worked in a 2-person crew ($n = 277$, 64.0%) or as a single officer ($n = 120$, 28.8%). Highest level of education was reported as Bachelor's degree ($n = 143$, 34.3%), closely followed by postgraduate study ($n = 142$, 34.1%; postgraduate certificate/diploma: 23.3%; Master's degree by course work: 7.4%; higher degree by research: 3.4%), and finally certificate or diploma ($n = 122$, 29.3%). Three main groupings of years of experience post initial qualification as a paramedic were found: <10 years ($n = 194$, 46.5%), 11–20 years ($n = 128$, 30.7%), >20 years ($n = 95$, 22.8%). Most participants reported that their paramedic training was through a postemployment model ($n = 311$, 74.6%). An association ($\chi^2_2 = 45.024$, $P < .001$) was found between an increased length of time post qualification and training pathway. Although most participants did not have another health discipline qualification ($n = 308$, 73.9%), nearly

one-fifth ($n = 79$, 18.9%) of participants reported training in nursing. Participation across the deidentified state and territory jurisdictions ranged from 5.3%–26.1% ($n = 22$ –109).

Both focus groups included 6 participants of differing scope of practice in paramedicine. Using the PA professional role descriptors,³⁰ scope of practice ranged from paramedic to intensive care paramedic. FG1 included 1 man and 5 women, and FG2 included 5 men and 1 woman. The major themes that arose from the focus group discussion for the constructs of hand hygiene and gloving practices are shown in Table 2.

Confidence with IPC practices

Most survey participants were confident with their IPC practices (74.8%). However, the odds of the participants having received competency-based training for IPC was significantly different across individual states and territories ($\chi^2_7 = 47.602$, $P < .001$). The percentage of participants receiving competency-based training for IPC within an Australian state or territory ambulance service ranged from 16.0%–65.4%.

Hand hygiene practices

The SoPIC participants indicated that hand hygiene had been a minor aspect of their training. One SoPIC participant commented that "there should be much better standards of [hand] hygiene across the board, but I don't recall there being much made of it during our

Table 2
Focus group constructs and themes related to hand hygiene and gloving practices

Constructs themes	
Hand hygiene practice	<ul style="list-style-type: none"> ● Compliance with hand hygiene is poor ● Poor access to appropriate products and facilities increases difficulty with hand hygiene ● Paramedics may have a lack of understanding of the importance of hand hygiene
Gloving practice	<ul style="list-style-type: none"> ● Gloves are worn for entire clinical cases ● Gloves are worn for self-protection ● Gloves are perceived as not being clean ● Workarounds have been developed to avoid changing gloves ● There are multiple barriers to changing gloves when needed, including <ul style="list-style-type: none"> ○ Time and patient acuity ○ Unplanned work environment ○ Patient acuity and perceived time (operational) pressure ○ Physical difficulties, including <ul style="list-style-type: none"> ■ Swollen hands ■ Sweaty hands ■ Wet hands after an alcohol hand cleanse

training at all.” The focus group participants also indicated that there had been little or no competency-based training in hand hygiene during their training. An FG2 participant commented that “I got more education as a nurse than I ever did as a paramedic about infection control.”

The perceptions of the SoPIC participants about the importance of performing hand hygiene during patient care (Fig 1) were incongruous with their self-reported behaviors (Fig 2). Self-reported hand hygiene varied with the type of activity being performed during clinical practice, with less than one-third of the participants indicating that they frequently (often or almost always) performed hand hygiene immediately before (32.8%) or shortly after (28.3%) touching a patient or their items, or before inserting an intravenous (IV) cannula (29.5%). The reported frequency of hand hygiene increased with activities at the conclusion of direct patient care, such as before driving and after patient handover. The focus group participants acknowledged that there was a practice gap between the perception of importance of hand hygiene and actually performing it. An FG1 participant commented, “You know you’re supposed to, but in practice it’s not going to happen.”

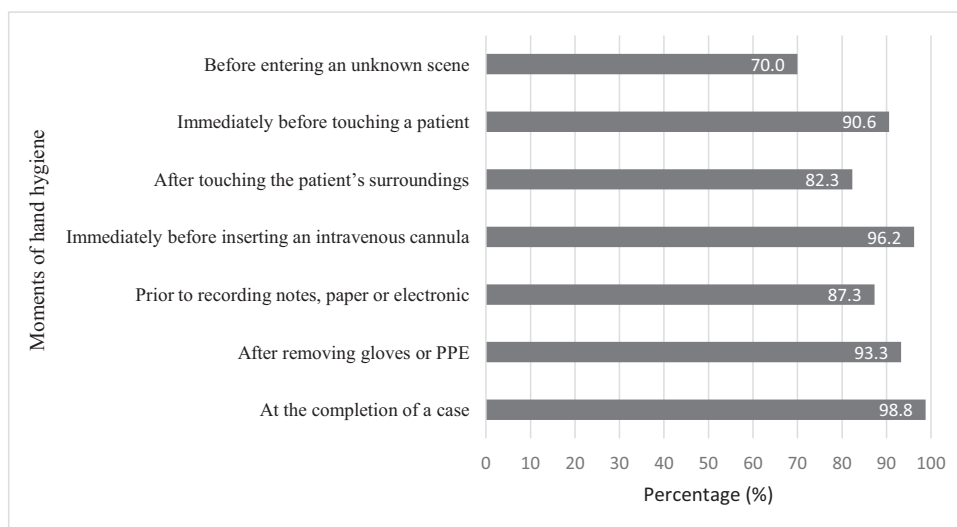


Fig 1. Percentage of survey of paramedics on infection control participants (n = 417) who identified that performing hand hygiene was important during defined moments of a clinical case. PPE, personal protective equipment.

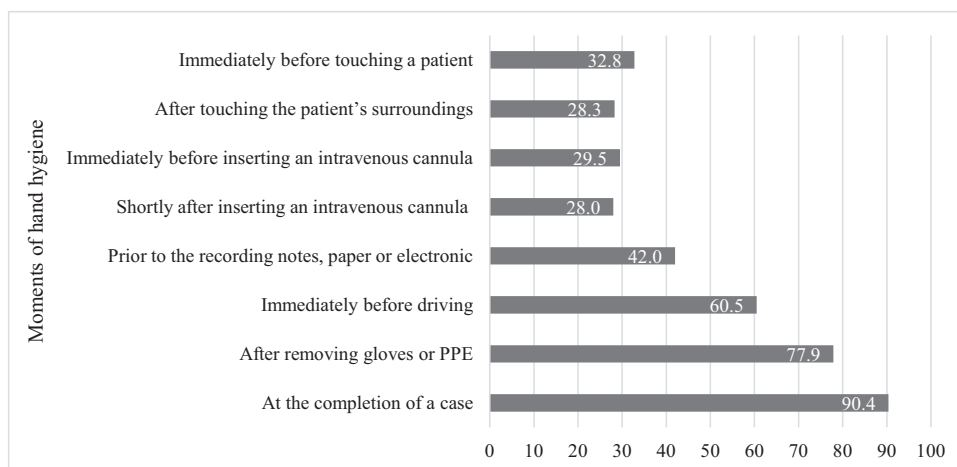


Fig 2. Percentage of survey of paramedics on infection control participants (n = 417) who self-reported that they frequently (often or almost always) perform hand hygiene during defined moments of a clinical case. PPE, personal protective equipment.

The SoPIC participants considered operational pressure to complete each clinical case in a short turnaround time to be the major barrier to effective hand hygiene practice in paramedic-led health care. The FG2 participants agreed that operational pressure was mostly attributed to policies that required “. . . a certain amount of time to get off scene,” such as the “. . . ten and twenty minute artificial time lines at a scene,” and that “If you’re there over twenty minutes, it’s tracked.” One FG1 participant commented that “hand hygiene will go out the window between patients if there’s multiple patients.”

Other barriers to performing hand hygiene during clinical cases reported by SoPIC participants included the following: access to appropriate hand hygiene facilities, including running water and soap; poor availability of hand hygiene products, such as ABHR; lack of resources for drying hands prior to replacing gloves; and skin reactions to alcohol-based products. Three SoPIC participants noted the following: “When hands are wet/sweaty/sticky donning gloves is IMPOSSIBLE!”; “There is no appropriate facility for hand washing in the ambulances here in Australia”; and “Hard to access hand hygiene gear in active situations in remote locations when you have to carry everything on your back.”

The McNemar test was used to assess the changes in self-reported hand hygiene behaviors of the SoPIC participants in both emergency and nonemergency cases prior to undertaking the non-technical skills of using communications equipment (mobile phone and radio handsets), driving, and completing patient care records. In every case, the frequency of reported episodes of hand hygiene during an emergency case was significantly less than during a nonemergency case ($P < .001$). The SoPIC participants reported that their hand hygiene compliance during an emergency case was compromised by operational pressure (47.5%, $n = 85$), the clinical activity being conducted taking precedence (20.8%, $n = 37$), difficulty in performing hand hygiene procedures in the paramedic work setting (19.2%, $n = 34$), and not having access to appropriate hand hygiene supplies (12.5%, $n = 23$).

Hand hygiene during IV cannula insertion

One-third of the SoPIC participants performed hand hygiene when preparing to insert an IV cannula, with 29.5% indicating that this was done frequently (often or almost always) (Table 3). In contrast, the reported frequency of observing other paramedics performing hand hygiene prior to inserting an IV cannula was never (42.4%), rarely (37.2%), sometimes (16.3%), often (2.2%), and almost always (1.9%). Table 3 shows associations using logistic regression between demographic attributes and those who reported that they frequently performed hand hygiene before IV cannula insertion, with P values adjusted for all other demographic attributes in Table 3. The categorical variables with statistically significant associations after adjusting were sex, competency-based training, previous or current registration in nursing, time post qualification, and state or territory of employment.

The perception of having difficulty with hand hygiene was associated with a lower frequency of performing hand hygiene prior to IV cannula insertion ($P = .009$, adjusted for variables in Table 3). Hand hygiene prior to IV cannula insertion was 24.5% for those who reported difficulties ($n = 200$) with in-field hand hygiene and 40.9% for those who reported no difficulties ($n = 117$).

Gloving practices

All SoPIC participants reported they wore disposable gloves for every clinical case and changed gloves when either the glove integrity was broken by being punctured, torn, or ripped (89.2%), or became soiled with either bodily substances (85.9%) or blood (85.6%). If gloves were not soiled or broken, more than half of the participants (57.8%) reported they only changed their gloves at the end of a clinical case. One SoPIC participant commented that “My gloves stay on from the moment I arrive at the scene until I have completed all the case, including paperwork.” The focus group participants corroborated this finding, with 2 FG2 participants

Table 3

Associations determined using logistic regression between the survey of paramedics on infection control demographic attributes and the survey participants who reported frequently performing hand hygiene before inserting an IV cannula

Demographic attribute	Category	Percentage of participants that frequently perform hand hygiene before IV cannula insertion	Raw P value/adjusted P value*
Sex ($n = 417$)	Male ($n = 291$)	29.2	.85/.031
	Female ($n = 126$)	30.2	
Clinical practice level ($n = 377$) [†]	Paramedic ($n = 208$)	26.9	.048/.22
	Intensive care ($n = 118$)	22.9	
	Retrieval and general care ($n = 51$)	41.2	
	Excluded [‡] ($n = 40$)		
Competency-based training for standard precautions ($n = 417$)	Yes ($n = 295$)	34.2	.001/.002
	No ($n = 122$)	18.0	
Training type ($n = 417$)	Pre-employment ($n = 106$)	24.5	.19/.88
	Postemployment ($n = 311$)	31.2	
	Certificate or diploma ($n = 122$)	38.5	
Highest level of education ($n = 417$)	Bachelor degree ($n = 143$)	25.2	.026/.07
	Postgraduate study ($n = 142$)	25.4	
	Paramedic only ($n = 308$)	25.0	
	Paramedic and nursing [§] ($n = 79$)	45.6	
Health discipline training ($n = 387$) [‡]	1–10 y ($n = 194$)	25.8	.001/<.001
	11–20 y ($n = 128$)	25.8	
	≥20 y ($n = 95$)	42.1	
	Range [¶]	8.0–46.8	
State or territory			.002/.008

IV, intravenous.

*Adjusted for all other demographic attributes in the table. Adjusted P values were calculated by fitting a logistic regression model.

[†]Forty participants were not included in the statistical analysis because of low numbers in a category or roles that do not perform IV cannulation.

[‡]Health disciplines other than paramedicine and nursing were excluded because of low numbers ($n = 30$).

[§]Sex of nurses were men 53.2% ($n = 42$) and women 46.8% ($n = 37$).

[¶]A range has been provided to avoid identifying individual state and territory ambulance services.

commenting that “When people are in...that moment with that patient, I don’t think swapping gloves and hand hygiene is part of that flow mechanism” and “[I] have the same gloves on for pretty much the entire job because you’re just been too busy to think about it.”

The SoPIC participants reported the frequency of writing case notes on their gloves as never (8.9%), rarely (16.1%), sometimes (23.0%), often (25.7%), or almost always (26.3%). One SoPIC participant commented, “I write on my glove so never remove it.” Both SoPIC and focus group participants indicated workarounds to avoid changing gloves, including the application of ABHR to sanitize gloves being worn instead of changing gloves and performing hand hygiene; adding a glove over a soiled glove; double-gloving prior to clinical work to enable the quick removal of the top glove if it became contaminated or broken; and wearing of a glove on one hand for patient care, and using the nongloved hand for touching other surfaces. An FG2 participant noted that when gloves were contaminated with blood after bandaging or IV cannula insertion, “You should take them off, but I think people look, wipe and go again.”

When focus group participants were asked why paramedics were so reliant on wearing gloves during clinical cases, there was consensus that paramedics perceived gloving as being important in protecting themselves from infectious patients, and that the practice of gloving had been driven by the HIV epidemic. An FG2 participant also commented, “We are protecting the patient from our own germs.” Most of the focus group participants acknowledged that they usually wore gloves throughout each clinical case and did not perform patient care without them. However, one FG2 participant commented, “...people with gloves on touch the radio, the keyboard, the patient, the keyboard, the radio and then the bag. Then they take them off and touch the same things again,” highlighting the potential issue of the transmission of pathogens by paramedics.

DISCUSSION

This study has found that Australian paramedics feel confident with their IPC practices and perceive hand hygiene and gloving as being essential in paramedic-led health care. However, this study also identified a level of noncompliance by Australian paramedics with recommended hand hygiene and gloving practices, and that compliance varied with the nature of the clinical activity being undertaken and worsened during perceived emergency events. Noncompliance with hand hygiene immediately before touching a patient and before invasive clinical procedures was also identified. These findings are consistent with 3 North American studies that have reported noncompliance with IPC practices, such as hand hygiene and gloving, among EMS workers.^{3–5}

Four major barriers to hand hygiene compliance in paramedic-led health care were reported by the study participants. They were (1) insufficient time to perform hand hygiene because of operational pressure during clinical cases, (2) the physical difficulty of changing gloves in some of the operational environments, (3) poor access to hand hygiene products in the field, and (4) lack of IPC education and training. Similar barriers to IPC practices have been identified in previous studies with EMS workers^{3,5} and with health care professionals in hospital settings.³¹ Each of these barriers will be dealt with in turn.

Some of the participants in this study reported that a target on-scene turnaround time of <20 minutes affected their ability to comply with recommended hand hygiene practices. The Council of Ambulance Authorities in Australia suggests that reducing the time taken to deliver critical patients to definitive care will improve their clinical outcome.³² Evidence for this comes from research that demonstrated an association between shorter on-scene turn-

around times and lower patient mortality for penetrating trauma.³³ Although data for response times to a clinical case are a key performance indicator for EMS in Australia,³⁴ the time paramedics are expected to spend on-scene is driven by individual ambulance service policy. Further exploration of the impact that on-scene turnaround time and operational pressure has on paramedic IPC practices is warranted.

Inappropriate gloving is known to interfere with hand hygiene compliance^{10,11,35–37} and contributes to the transmission of HAIs.¹¹ The findings of this study suggest an overreliance on gloving by Australian paramedics in some clinical cases. As with hand hygiene, the study participants reported operational pressure and patient acuity to be key barriers to changing gloves. They also reported difficulties in changing gloves because of sweaty and swollen hands when hot. Because the hands of health care workers are progressively inoculated with pathogens during patient care,^{38,39} poor hand hygiene practice by paramedics is likely to cause cross contamination of key sites on the same patient and between patients.

The study participants reported that access to appropriate hand hygiene products was problematic during some clinical cases. Similar to recommendations from other research,^{3,40} consideration should be given to improved visibility and accessibility of ABHR dispensers, and the development of products for use in paramedic-led health care, that minimize skin reactions and do not impede the changing of gloves. A recent study³ has shown that when hand hygiene is poor, the hands of up to 77% of paramedics are heavily contaminated with pathogens on arrival at hospital, and up to 47% remained heavily contaminated after hand hygiene.

Participants reported that little emphasis had been placed on hand hygiene practices during their paramedic training. The outcomes of occupational health and safety research across multiple industries has demonstrated that training facilitates workplace culture.^{41–43} It is also known that workplace culture can cause substantial differences between knowledge, attitudes, and practices.^{44,45} The entry-to-practice pathway in Australia has migrated over the last 15 years to university-based training. Although the longer-serving paramedics were mostly trained in an apprenticeship model, those with <10 years of experience were mostly university trained. An association was found between better compliance with hand hygiene prior to IV insertion and length of time post qualification. In addition, survey participants with either a nursing background or who had received competency-based training in IPC, were also more likely to report better compliance with hand hygiene in paramedic-led health care. Some of the participants with a nursing background commented that a greater emphasis on IPC and hand hygiene was made in their nursing training and workplace than in their paramedic training program or workplace. Workplace culture and training may be contributing to the overreliance of gloving by Australian paramedics because their training curriculum has been criticized for being too focused on the management of critical medical emergencies and the control of dangers to paramedics.⁴⁶ An emphasis on self-protection has been reported in hospital-based studies to increase gloving time and decrease hand hygiene compliance.⁴⁷ An exploration of the differences between paramedic and nursing entry-to-practice IPC curriculum in Australia is warranted, particularly when many studies have found that nurses have better hand hygiene compliance than members of other health disciplines.^{48–50}

The study participants described several workarounds to avoid changing gloves and obviate the need for hand hygiene during clinical cases. Double gloving is not recommended because of potential pathogen contamination through microporations and during donning and doffing.³¹ Although double gloving reduces the risk of percutaneous sharps injury and blood and body fluid contamination,⁵¹ it does not obviate hand hygiene. Also, the appli-

cation of ABHR to sanitize contaminated gloves during patient care instead of doffing and performing hand hygiene is problematic. HHA advises against this practice because the effect of ABHR products on the integrity of disposable gloves is unknown.³¹

Encouraging paramedics to remove gloves and perform hand hygiene at appropriate times during clinical cases is a key challenge for EMS. Improved compliance with correct gloving practices has been achieved in hospital settings through collaborative and comprehensive interventions that involved clinicians, educators, and management.^{52–54} EMS organizations, paramedics, and training institutions also need to work together to address gloving noncompliance because knowledge and attitudes do not always transfer into practice.^{5,55,56}

Although the My 5 Moments for Hand Hygiene is a recommended IPC practice for all health care facilities,^{57,58} there is some debate about its suitability in medical areas, such as in anesthetics and recovery.⁵⁹ This study suggests that the My 5 Moments for Hand Hygiene needs to be reviewed for paramedic-led health care because of the challenges to performing hand hygiene in a mobile out-of-hospital environment with short on-scene turnaround times. Reported compliance with hand hygiene worsened with perceived increased acuity of a case. It is not clear, however, as to what constitutes an emergency case in paramedicine that would preclude recommended hand hygiene practice to ensure patient safety. For instance, it is possible that the workaround of decontamination of disposable gloves with ABHR, although not being recommended by HHA, could be a more effective IPC practice in emergency cases with a short on-scene time than changing gloves at specific moments. Research is required to establish critical control points⁶⁰ in which hand hygiene and gloving should occur in paramedic-led health care at different levels of patient acuity. This in turn could lead to a rigorous infield observational audit process to assist with improving IPC compliance by paramedics. HHA provides an audit tool for compliance with hand hygiene moments, but it is not recommended for use outside of Australian acute health care facilities.^{31,61} A similar audit tool for hand hygiene and gloving practices in Australian paramedicine needs to be developed.

Limitations

The study findings should be viewed in the context of 3 limitations. First, social desirability and identity may have led to the intentional misreporting of IPC behaviors in favor of better compliance by the participants.^{62–64} Evidence for this is that participants reported much higher levels of compliance for themselves than their colleagues. The anonymous responses to the SOPIC may have helped to limit this bias.⁶⁴ Second, the survey participants were self-selected, and a large dropout occurred. This may bias the study outcomes because the participants may have been more likely to comply with hand hygiene and gloving advice. Third, it is not known whether the attributes, behaviors, and perceptions of the PA members who participated in this study reflect those of all Australian paramedics. In addition, the attributes of the participants who did not complete the survey are also unknown. These limitations affect the generalizability of the study findings, which may overstate compliance with recommended IPC practices.

CONCLUSIONS

This study has found that the perceptions of Australian paramedics in relation to the importance of hand hygiene and gloving during paramedic-led health care may not be transferring into clinical practice. Future research into hand hygiene and gloving practices in paramedic-led health care should be targeted at 2 areas. The first is alleviation of the physical difficulties with performing in-field hand

hygiene, including how to decrease the time required to decontaminate hands and replace gloves given the perceived operational pressures on-scene and overall patient acuity. The second is cultural issues and misconceptions concerning overuse of gloves during clinical cases to address perceived barriers. Strong leadership will be required to develop paramedic-specific hand hygiene and gloving procedures at different levels of patient acuity, establish competency-based education packages, and encourage champions to challenge established social norms toward these IPC practices.

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