

# BMJ Open New Zealand Emergency Department COVID-19 Preparedness: a cross-sectional survey and narrative view

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## ABSTRACT

**Objective** Our objective was to assess the level of COVID-19 preparedness of emergency departments (EDs) in Aotearoa New Zealand (NZ) through the views of emergency medicine specialists working in district health boards around the country. Given the limited experience NZ hospitals have had with SARS-CoV-2, a comparison of current local practice with recent literature from other countries identifying known weaknesses may help prevent future healthcare worker infections in NZ.

**Methods** We conducted a cross-sectional survey of NZ emergency specialists in November 2020 to evaluate preparedness of engineering, administrative policy and personal protective equipment (PPE) use.

**Results** A total of 137 surveys were completed (32% response rate). More than 12% of emergency specialists surveyed reported no access to negative pressure rooms. N95 fit testing had not been performed in 15 (12%) of respondents. Most specialists (77%) work in EDs that cohort patients with COVID-19, about one-third (34%) do not use spotters during PPE doffing, and most (87%) do not have required space for physical distancing in non-patient areas. Initial PPE training, simulations and segregating patients were widespread but appear to be waning with persistent low SARS-CoV-2 prevalence. PPE shortages were not identified in NZ EDs, yet 13% of consultants do not plan to use respirators during aerosol-generating procedures on patients with COVID-19.

**Conclusions** NZ emergency specialists identified significant gaps in COVID-19 preparedness, and they have a unique opportunity to translate lessons from other locations into local action. These data provide insight into weaknesses in hospital engineering, policy and PPE practice in advance of future SARS-CoV-2 endemic transmission.

## INTRODUCTION

The Aotearoa New Zealand (NZ) healthcare system was as unprepared for the COVID-19 pandemic as many nations, yet NZ successfully eliminated SARS-CoV-2.<sup>1 2</sup> The decision to implement aggressive public health infection elimination practices hinged on NZ's ability to rapidly and effectively close its borders thus limiting COVID-19 impact to approximately 2600 cases and 26 deaths.<sup>3 4</sup> As a result, NZ's emergency departments (EDs) have had little experience caring for patients

## Strengths and limitations of this study

- Survey responses specifically identified existing breakdowns in engineering, administrative policy and personal protective equipment in New Zealand (NZ) emergency departments (EDs), potentially increasing healthcare worker nosocomial infection risk upon reintroduction of SARS-CoV-2.
- Respondents included emergency specialists from all 20 of NZ's district health boards but the electronic convenience sample may not be representative of all ED consultants in NZ.
- Some survey questions asked respondents to recall experiences or project how they would practise if they were caring for a patient with COVID-19.
- Those motivated to respond may feel they have more or less access to protective policies and equipment than non-respondents.

with COVID-19 and disparate efforts towards infection control preparedness may leave healthcare workers (HCWs) vulnerable to nosocomial SARS-CoV-2 transmission.<sup>5–8</sup>

The Hierarchy of Control offers an algorithm to assess preparedness of a health system, scalable to departmental, hospital and nationwide recommendations.<sup>8–10</sup> Once elimination is established but eradication remains impossible, there must be appropriate resources to institute and sustain substitution of the threat (typically by vaccination or other therapies). Even as vaccine-based immune protection expands, there are still uncertainties requiring multiple controls to prevent transmission of SARS-CoV-2. Questions about viral variants that evade host immune responses, vaccine safety and efficacy in vulnerable groups (ie, young children, immunocompromised, elderly), and the impact of vaccine hesitancy indicate we will need to maintain layers of protection for some time into the future.<sup>11</sup> In addition to vaccination, pandemic ED response should continue to focus on proven non-pharmaceutical interventions such as engineering (often through changes in ED physical layout, ventilation

and bed allocation), administrative policy (infection prevention and control (IPC), workflow changes, training resources) and transmission-based personal protective equipment (PPE). These practices demand equity, and the failure has resulted in HCW infections, disability and death.<sup>8 12–14</sup>

The July–August 2020 outbreak in Melbourne, Victoria, Australia revealed deficiencies in hospital-level IPC in a health system comparable with that of NZ.<sup>15 16</sup> Unfortunately, this outbreak in long-term care facilities and subsequent nosocomial spread in tertiary hospitals resulted in significant SARS-CoV-2 infections in HCWs. The Australian response affords insight into improvements to adopt in other health systems.<sup>8 17 18</sup> The New Zealand Emergency Department COVID-19 Preparedness Survey of emergency consultants was designed to identify and address weaknesses in local NZ ED policy, engineering and PPE to provide proactive recommendations for system improvement.

## METHODS

This study was a cross-sectional web-based assessment of COVID-19 pandemic preparedness of EDs in NZ via survey of ED senior medical officers (ED SMOs) from the EDs of all NZ District Health Boards (DHBs). In order to encourage anonymous participation, only DHB of employment was requested; respondent characteristics (sex, age, years of practice, ED location) were not gathered for the study sample.

### Questionnaire design

A 27-item questionnaire was framed around the Hierarchy of Control model with questions on engineering (negative flow isolation rooms, shared/cohorted patient areas, segregated patient flow, physical distancing), administrative controls (policies for rostering, training, simulations, treatments and breaches) and PPE (supply, fit testing, use and reuse).<sup>8 10 19</sup> Likert scale questions evaluated consultant ability to physically distance and respond to a future surge. Questions were adapted for the ED from a published survey of preparedness in intensive care units (ICUs) of Australasia and the prospective COVID Evaluation of Risk in Emergency Departments Project in the USA.<sup>20 21</sup> These questions were previously validated by those investigators using established survey methodology.<sup>22</sup> ED-specific modifications of our survey were checked for clarity and vernacular specific to NZ with at least two test surveys of ED, microbiology and infectious disease specialists, and of a primary investigator from each of the studies mentioned above.

### Survey distribution

The survey was distributed by email to 422 members of the Association of Salaried Medical Specialists (ASMS) identified as having emergency medicine as their designated department of work using Survey Monkey (San Mateo, California, USA) between 26 October 2020 and 23

November 2020. Two email reminders were sent. Participation was voluntary.

### Data analysis

Raw data were summarised in Excel and basic descriptive statistics were reported as percentages of valid responses. Diverging stacked Likert scales are used to display emergency specialist opinion results. The survey is included as an online supplemental file 1 although not all question responses were resulted here due to length limitations.

### Patient and public involvement

Patients or members of the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

## RESULTS

One-hundred thirty-seven surveys were completed (32% response rate). All (100%) of 20 NZ DHBs were represented by at least two individual SMO surveys. Surveys were returned from 24 EDs representing smaller regional to major urban tertiary hospitals. Nine (6.6%) respondents did not identify a DHB.

### Engineering

The majority of respondents have access to negative flow or negative pressure patient care rooms (table 1). Most (115, 83%) report four or fewer such rooms in their ED, but 14 (12%) ED specialists reported no access to negative flow rooms for COVID-19 patient care. Most respondents (99, 77%) worked in EDs that have some beds separated only by curtains with shared air circulation where patients may be cohorted. Most (101, 74%) surveyed emergency consultants work in EDs which can create physical separation of care areas for high index of suspicion (HIS) patients segregated from those for presumed low index of suspicion (LIS) patients. Emergency consultants from multiple DHBs commented that ED segregated flow or 'streaming' can be changed with COVID-19 prevalence and alert level.

Most respondents (118, 87%) did not feel they could meet minimum physical distancing requirements in their workplace and disagree or strongly disagree that physical distancing is possible (figure 1).

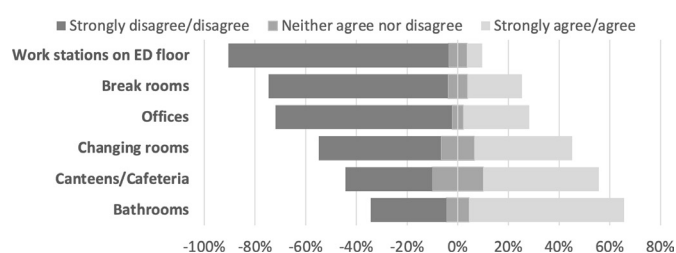
### Administrative controls

Policy rostering ED consultants into either strictly 'COVID-19' or 'non-COVID-19' teams is not common and the majority (n=70, 60%) see these patient populations during shifts. Almost all (98%) of NZ ED consultants report having training for proper transmission-based PPE use with 60% having had in-person sessions being observed donning and doffing by the instructor. In practice, NZ emergency specialists report donning observation is rarely (18%) mandatory and about one-third (30%) do not have an observer present. Only 16% report mandatory observation during removal while one-third (34%) are not usually observed doffing PPE. Greater than half of

**Table 1** Summary table of select NZEDC19 Preparedness Survey answers

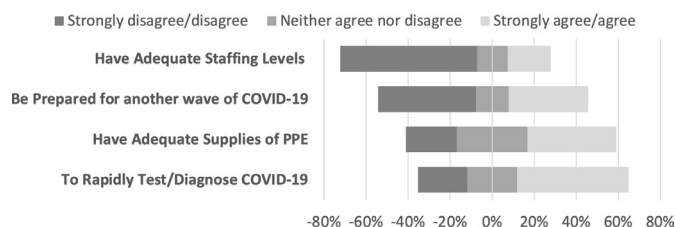
Control	Specific hierarchy of control question	N	%
Engineering	Have negative flow/pressure rooms in ED	123	88
	Have cohorted beds in ED	99	77
	Segregated patients with and without COVID-19 in ED	101	74
	Rostered to see both COVID-19/non-COVID-19 as needed	70	60
	Unable to meet physical distance requirements at office	94	70
	Unable to meet physical distance requirements at workstation	118	87
	Unable to meet physical distance requirements at break rooms	92	71
Policy	Intubate LIS patient in negative pressure	6	4
	Intubate HIS patient in negative pressure	88	64
	Dedicated intubation teams ICU/anaesthesia	57	47
	Intubation of HIS/COVID-19 with video laryngoscopy	98	71
	Use HFNC for hypoxic patients with COVID-19	53	50
	Use NIV for hypoxic patients with COVID-19	101	86
	Use NIV with in-line expiration viral filter	19	16
	No PPE training	3	2
	PPE group training in-person with observed practice	66	37
	PPE individual training in-person with observed practice	40	23
	Simulation training of intubation in patients with COVID-19	93	70
	Simulation training of NIV in patients with COVID-19	61	46
	Simulation training of self-proning in patients with COVID-19	17	13
	Not monitored during donning PPE	39	30
	Not monitored during doffing PPE	44	34
PPE	Not N95 fit tested by time of this survey	15	12
	Fit tested by qualitative method (odour or taste)	82	60
	Fit tested by quantitative method (machine sampling)	41	30
	Wear N95 for patient with HIS/COVID-19 not receiving AGP	61	48
	Wear N95 or PAPR for AGP of patient with HIS/COVID-19	110	87
	N95 masks unavailable	6	6
	Re-use N95 masks without sterilisation	12	11
	Re-use N95 masks after sterilisation	3	3
	Elastomeric respirators unavailable	63	66
	PAPRs unavailable	79	82

AGP, aerosol-generating procedure; ED, emergency department; HFNC, high flow nasal cannula; HIS, high index of suspicion; ICU, intensive care unit; LIS, low index of suspicion; NIV, non-invasive ventilation; NZEDC19, New Zealand Emergency Department COVID-19; PAPR, powered air-purifying respirator; PPE, personal protective equipment.



**Figure 1** Are you able to meet minimum physical distancing requirements in certain non-clinical areas of the ED? ED, emergency department.

the NZ emergency consultant workforce surveyed is not aware of an official breach-of-PPE policy in their hospital ED or breach criteria.<sup>23</sup> Simulation training is common in NZ for patient intubation (93, 70%). Less common simulations are performed for non-invasive ventilation (NIV) (61, 46%) and are rare for patient self-proning (17, 13%). Only half (54%) of specialists report high flow nasal cannula (HFNC) availability, but 14% would not use this technology at all. Half (55%) of ED specialists say they can use non-invasive ventilation (NIV) but only 16% report using viral expiration filters, a low-cost recommended infection control. NIV is not used outside



**Figure 2** If there were another wave of COVID-19 in NZ, what are your views regarding your ability to do the following? NZ, New Zealand; PPE, personal protective equipment.

negative pressure rooms and only 4% transfer to ICU for this modality. The majority of specialists report wide discretion in their ability to apply NIV to patients with COVID-19 and just 15% reserve it only for patients with comorbidities (chronic obstructive pulmonary disease, congestive heart failure, etc) known to benefit. Sixty-four per cent of consultants would intubate patients with HIS/COVID-19 in a negative pressure room. Very few (4%) would intubate patients screened as LIS/non-COVID-19 under negative pressure. The lack of adequate staffing levels during the pandemic is cited as the greatest concern for two-thirds of respondents. Having adequate PPE and adequate testing capacity if a future wave of COVID-19 occurred in NZ were less concerning for respondents (figure 2).

### Personal protective equipment

NZ emergency consultants report few shortages of consumable PPE and have had little experience with reusing PPE, except washable face shields and goggles (table 1). Low reuse of N95 masks either without sterilisation (9%) and after sterilisation (2%) further supports

that respondents felt PPE supplies were adequate. Few respondents reported use of elastomeric respirators (2%) and powered air-purifying respirators (PAPRs) (2%).<sup>24 25</sup> Only 89% of respondents had been fit tested for N95 masks at the time of this survey, leaving approximately 11% of ED consultants surveyed having not been fit tested by November 2020. Half of these (7 of 15) were from one hospital.

Best practice for ED consultant use of transmission-based PPE was assessed in different clinical scenarios as shown in table 2. Only 83% of respondents reported they would use N95 respirators in the context of aerosol-generating procedures (AGPs), with an additional 4% protected with elastomeric mask or PAPR. Thirteen per cent of respondents would not use a respirator (N95 mask, elastomeric mask or PAPR) for a patient with HIS/COVID-19 receiving an AGP.

PPE practice preferences vary when caring for either a HIS or LIS patient while not performing an AGP. For a patient with HIS/COVID-19 without an AGP, consultants report N95 use of 48%, the rest using surgical mask alone or over N95. When seeing a LIS patient and no AGP, 6% report using an N95 respirator. Two-thirds (69%) wear some type of mask seeing LIS patients and one-third of emergency consultants surveyed see LIS patients in their ED without a mask. While working outside of direct patient care but still in the hospital, one-third of ED SMOs wear a surgical or reusable fabric mask. Toilets may present a unique risk for droplet and possibly faecal-airborne transmission yet only 10% report using masks in toilets.<sup>26 27</sup>

A summary rank-ordered list by ED consultants' assessment of their most likely source of exposure to COVID-19

**Table 2** PPE chosen by ED SMOs ED consultants for various clinical scenarios

PPE	Non-patient care	Tea room	Toilet	LIS	HIS	HIS+AGP
Face shield	1%	0%	2%	4%	71%	75%
Safety glasses/goggles	1%	0%	1%	12%	79%	76%
Surgical masks	31%	9%	10%	61%	71%	34%
Reusable fabric masks	2%	1%	1%	2%	6%	5%
N95 masks/respirators	0%	0%	1%	6%	48%	83%
Elastomeric respirators	0%	0%	0%	0%	3%	2%
PAPR	0%	0%	0%	0%	1%	2%
Disposable surgical hat	0%	0%	1%	2%	25%	29%
Reusable surgical hat	0%	0%	1%	4%	7%	7%
Disposable gown	0%	0%	1%	13%	87%	84%
Impermeable suit	0%	0%	0%	2%	6%	7%
Gloves	2%	0%	1%	52%	90%	83%
Double gloves	0%	0%	0%	1%	21%	25%
Foot coverings	0%	0%	0%	1%	16%	13%

Non-patient care areas include areas in ED for charting, making telephone calls, etc.

AGP, aerosol-generating procedure; ED, emergency department; HIS, high index of suspicion; LIS, low index of suspicion; PAPR, powered air-purifying respirator; PPE, personal protective equipment; SMOs, senior medical officers.

**Table 3** Rank the most likely reason that you think puts you at risk of exposure to COVID-19 at work (1 for most likely, 8 for least likely)

Rank	Risk	Mean	95% CI
1	Wearing inadequate PPE for patient(s) not suspected of COVID-19	2.9	2.6 to 3.3
2	Contracting it from a fellow staff member in the ED	3.1	2.7 to 3.4
3	Accidental PPE doffing exposure	3.5	3.1 to 3.9
4	Wearing inadequate PPE for patient(s) suspected of COVID-19 infection	3.7	3.3 to 4.0
5	Not being able to access adequate PPE	4.4	4.0 to 4.9
6	Inadequate mask fit testing for staff	5.6	5.2 to 6.0
7	Cleaners have been provided inadequate training and/or inadequate PPE	5.7	5.3 to 6.0
8	Not applicable: I do not fear risk of COVID-19 exposure at work	6.6	6.0 to 7.1

ED, emergency department; PPE, personal protective equipment.

identified 'wearing inadequate PPE for patients not suspected of COVID-19 infection', followed by 'contracting it from fellow staff members' or 'accidental doffing exposure' as the top three most likely routes of nosocomial infection. Consultants were less concerned about inadequate N95 mask fit testing or the lack of appropriate training or PPE for coworkers such as house-keeping staff (table 3).

## DISCUSSION

This study assesses the preparedness of EDs around Aotearoa NZ for the eventual reintroduction of SARS-CoV-2.<sup>28</sup> Survey results identify weaknesses in local NZ hospital infection control practices which have been cited as risks in prior outbreaks in other countries.<sup>5 8 13</sup> Eight months following declaration of the pandemic in March 2020, these responses from NZ ED specialists reveal incomplete ED engineering upgrades to provide them negative flow rooms or portable high efficiency particulate air (HEPA) filtration, the continued use of curtained patient bed bays with shared circulation and crowded work environments inconsistent with recommendations for physical distancing. Results also indicate variations in pandemic-specific administrative policy, adherence and practice; in particular, inconsistent monitoring of donning and doffing of PPE as well as limited adoption of recommended treatments such as HFNC and NIV. Although reported N95 mask shortages were rare, not all respondents would use a respirator in the high-risk setting of a patient with HIS/COVID-19 receiving an AGP. Finally, infection control through PPE may be compromised by the finding that about one-tenth of ED consultants reported not being fit tested for N95 masks as late as November 2020. NZ guidelines for PPE were slow to accept airborne transmission stating: 'The route of transmission of SARS-CoV-2 continues to be an area of debate in the medical and scientific community' as recently as August 2020. When elimination of SARS-CoV-2 fails and adequate community-wide immunity has not been established, it is these proven layers of inhalation dose

reduction that are needed to curb nosocomial spread and prevent healthcare capacity compromise.

Engineering controls should provide enough adequately ventilated negative pressure rooms, or at least negative directional airflow, to allow for treatment of multiple respiratory isolation patients. Negative flow dilutes contaminated air breathed by HCWs caring for patients with airborne-transmissible infections. DHBs should prioritise ED patient areas with a greater number of room air changes per hour (ideally 6–12), and greater proportion of fresh (vs recycled) air or consider portable HEPA filter units if airflow is inadequate.<sup>7 18</sup> The finding that 12% of consultants report no access to at least one negative flow room, mostly in smaller peripheral hospitals, suggests NZ DHBs have not equitably upgraded all EDs.

Control of bed allocation during a COVID-19 surge reiterates issues common to emergency systems chronically plagued by overcrowding and limited resources.<sup>29</sup> Somewhat unique to a respiratory pandemic, patients with suspected COVID-19 may compromise the capacity to protect other patients from exposure. Because of this, single rooms to isolate suspected cases or protect vulnerable non-infected patients become a premium. The delay between clinical suspicion and confirmatory test results can further prolong lengths of stay such that available, rapid SARS-CoV-2 testing must be a priority.<sup>30</sup> Our results show most NZ patients with suspected COVID-19 are streamed to separate ED areas or wards away from others where possible. Although recommended as an important IPC, placing patients in LIS or HIS streams relying only on an unvalidated pre-triage screening set of questions and not rapid antigen or nucleic testing ignores the lessons learnt from asymptomatic spread in this pandemic. In some instances, there may be pressure to cohort patients in multiple bed bays with shared air circulation. In this study, three-quarters of NZ specialists report having ED patients cohorted with shared ventilation and only curtains separating beds. Based on overseas experience, large numbers of patients with COVID-19

in confined spaces may create a high density of aerosols and cause HCWs to stay longer as they attend each patient increasing their risk. Best practice reduces patient density to one per room (even if in a two or four bed bay) and mandates airborne PPE for staff in these situations.<sup>8 31 32</sup> Conversely, use of multibed bays to cohort presumed patients without COVID-19 risks misidentifying the asymptomatic or presymptomatic patients as safe to collocate with other uninfected individuals.<sup>30</sup> This has resulted in verified nosocomial infections in 39% of uninfected roommates by whole-genome sequencing confirmation of cluster association.<sup>33 34</sup> Masking of patients and well-ventilated or HEPA-filtered areas may decrease this risk but evidence is limited.<sup>35</sup>

Although much attention is directed toward patient-to-HCW transmission, literature has identified HCW transmission to patients and to other HCWs, and many of these nurses or doctors had no symptoms reiterating the importance of maintaining physical distancing and mask wearing in non-clinical areas when SARS-CoV-2 is circulating.<sup>36 37</sup> Ranking this risk second in [table 2](#) suggests most NZ ED specialists may be aware of this concern. Despite recommendations to maintain physical distancing in non-clinical work areas, most (86%) of NZ specialists disagreed that their ED workstations were engineered for adequate room ([figure 1](#)). This illustrates how the lack of resources, physical space or personnel can undermine administrative efforts to protect staff and patients from exposures.

Administrative policy involves institution of rules that change how HCWs behave, it alters work flow and implements infection control protocols. Success may depend on dissemination of guidelines, staff confidence in recommendations or practice. This can be undermined by poor messaging, mistrust or when case counts are low and the risk no longer justifies the effort. Vaccination may also create a sense that these other controls are not needed.

Initial training for PPE use was universal (97%) but ongoing interval training was not common nor was mandatory observation during donning or doffing as recommended in the literature.<sup>16</sup> Training (baseline and refreshers) and monitoring policy for PPE use (spotters) for all clinical and non-clinical staff is not standardised across DHBs ([table 1](#)). Simulations to practice skills (such as intubation and NIV use) and accommodate for PPE are variably applied in NZ.<sup>16</sup>

Experience in other countries has shown HCW PPE breaches, exposures and infections cause large numbers of staff furloughs, worsening nurse to patient ratios and causing the remaining staff to experience high workloads.<sup>8 38 39</sup> Maintaining a healthy skilled workforce is paramount to offset predicted inadequate staffing. A proactive approach should be used to support infected and furloughed staff well-being, with dedicated nursing and medical staff monitoring physical and mental health and providing support. Given the gravity of HCW infection and the system failure it implies, every suspected

healthcare-associated infection should trigger a bundle of immediate infection control measures.<sup>40</sup>

Among the strongest recommendations in the literature regarding prevention of HCW nosocomial infection is to 'decant' or decrease overcrowding of patients with COVID-19 in EDs and wards.<sup>8</sup> Ensuring a manageable workload through adequate staffing ratios by anticipating the increased care required for these patients with infectious respiratory failure is paramount. This may also prevent the added fatigue HCWs face secondary to PPE compliance, doffing observation, and decontamination of providers and work environment. These additional tasks are not being calculated into traditional bedside severity scores and underestimate nursing ratios.

PPE places a barrier between the HCW and the infectious agent (the principal example being respirators and other masks) and is considered the final and least effective control measure because it relies on consistent individual action at the point of care.<sup>10</sup> PPE should be implemented through clear guidelines and be current with peer-reviewed literature and expert recommendations.<sup>20 34 41 42</sup> The NZ Ministry of Health last updated PPE recommendations August 2021 and these do not promote use of N95 respirators outside of patients with HIS/COVID-19 receiving AGPs or during lockdowns but still allow surgical masks to be used caring for patients with HIS/COVID-19 at lower community prevalence.<sup>42</sup>

The scientific community has acknowledged transmission through inhalation of small airborne particles as a significant mode of SARS-CoV-2 virus transmission.<sup>34 40 43 44</sup> These studies demonstrate aerosols produced through breathing, talking, coughing and yelling can remain in air and viable for long periods of time, travel long distances within a room and sometimes farther depending on ventilation. The experience in the Royal Melbourne Hospital City Campus outbreak noted that 'aerosol-generating behaviour' in infected patients appeared to be linked to transmission events.<sup>8</sup> Patients shouting, vigorous coughing, cognitive impairment and combative behaviour, actions common in ED patients, should mandate airborne precautions equivalent to AGPs.<sup>34 38</sup> Yet, fit testing of N95 respirators, in line with other nations' health and safety legislation, was late to be initiated in NZ, and for at least 15 consultants (11%) was still not available at the time of this survey.<sup>16 20</sup> Small peripheral facilities, as was the case for negative flow rooms, appear to be less prepared.

In the scenario-based PPE questions ([table 2](#)), the finding that up to 13% of NZ ED consultants would not choose an N95 respirator, elastomeric or PAPR in the context of an AGP for a patient with HIS/COVID-19 was unexpected and raises concern. Given the low prevalence of SARS-CoV-2 in NZ, the probability of an HIS patient being infected is low, but not zero. Some ED consultants may argue N95s are not necessary due to elimination efforts or may believe they are still in short supply. But the omission of this recommended PPE could be interpreted as a purposeful disregard of evidence-based pandemic

IPC practice or a deliberate ignorance of why these policies exist. In a pandemic, an individual's choice to forgo personal protection does not just take the risk for themselves, but for the community of others on their health-care team, the other patients they care for, and their families and close contacts. Instituting and maintaining a standardised observer system and breach protocols should remedy this issue and may help promote a culture of staff safety, risk and adverse event reporting and staff support. NZ has enjoyed near SARS-CoV-2-free medical practice but sporadic reintroduction has occurred with HCW infection and risking transmission during AGPs is an unconscionable breach of IPC even if vaccinated.<sup>14</sup> This will have to change as SARS-CoV-2 is reintroduced.

Our survey has several limitations. It was a cross-sectional study and relied on voluntary, self-reported data from ED consultants only. Email addresses were obtained from ASMS (n=422) and were not verified as still active. Although the rate of returned surveys from 137 ED consultants was 32%, all 20 DHBs representing 25 EDs returned surveys increasing the representativeness of the sample. Respondent characteristics were not collected to protect individual anonymity and promote candour. COVID-19 NZ ED presentations were variable by hospital location and respondent experience with direct patient care was not included in survey design. COVID-19 IPC policies and practices may vary significantly among different types of facilities and/or those in different DHBs. Despite these limitations, this study may be useful to EDs or other acute care settings throughout the Australasian-Pacific region where elimination was successful but now need to examine their preparedness as endemic Delta variant spread becomes imminent.

## CONCLUSION

These survey results from NZ ED consultants identify potential risks of failure in the hierarchy of infection controls currently in place to prevent nosocomial spread of SARS-CoV-2 or future emerging infections. Our findings show that engineering upgrades to respiratory pandemic standards are not prevalent, administrative COVID-19 policy has not adapted to scientific advances seen in policy from other healthcare systems (ie, Australia), and PPE current practice reveals high variability suggesting poor dissemination of guidelines, low confidence in recommendations or little practice because of low prevalence. NZ's public health success in SARS-CoV-2 elimination and the promise of protective immunity through vaccines have allowed for a relaxation of other layers of inhalation dose reduction even as evidence-based practice supporting them has evolved. As NZ borders reopen and crowded and under-resourced EDs face endemic COVID-19, it would be prudent to use lessons learnt elsewhere to identify local ED weaknesses and better prepare them to protect their patients and caregivers in this approaching phase of the pandemic.

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**Data availability statement** All data relevant to the study are included in the article or uploaded as supplemental information.

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