









BMJ Open 'Like building a plane and flying it all in one go': an interview study of infection prevention and control in Australian general practice during the first 2 years of the SARS-CoV-2 pandemic

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ABSTRACT

Objectives General practitioners (GPs) and their staff have been at the frontline of the SARS-CoV-2 pandemic in Australia. However, their experiences of responding to and managing the risks of viral transmission within their facilities are poorly described. The aim of this study was to describe the experiences, and infection prevention and control (IPC) strategies adopted by general practices, including enablers of and challenges to implementation, to contribute to our understanding of the pandemic response in this critical sector.

Design Semistructured interviews were conducted in person, by telephone or online video conferencing software, between November 2020 and August 2021.

Participants Twenty general practice personnel working in New South Wales, Australia, including nine GPs, one general practice registrar, four registered nurses, one nurse practitioner, two practice managers and two receptionists.

Results Participants described implementing wide-ranging repertoires of IPC strategies—including telehealth, screening of patients and staff, altered clinic layouts and portable outdoor shelters, in addition to appropriate use of personal protective equipment (PPE)—to manage the demands of the SARS-CoV-2 pandemic. Strategies were proactive, influenced by the varied contexts of different practices and the needs and preferences of individual GPs as well as responsive to local, state and national requirements, which changed frequently as the pandemic evolved.

Conclusions Using the 'hierarchy of controls' as a framework for analysis, we found that the different strategies adopted in general practice often functioned in concert with one another. Most strategies, particularly administrative and PPE controls, were subjected to human variability and so were less reliable from a human factors perspective. However, our findings highlight the creativity, resilience and resourcefulness of general practice staff in developing, implementing and adapting their IPC strategies amidst constantly changing pandemic conditions.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This qualitative study used a combined inductive/deductive approach to explore the experience of a variety of personnel in different general practice settings, gaining a rich understanding of the unique infection prevention and control (IPC) challenges posed by the SARS-CoV-2 pandemic.
- ⇒ We drew on the hierarchy of controls framework in our analysis, to examine how it can be applied to IPC guidance in general practice.
- ⇒ We analysed the enablers and challenges faced by participants in implementing IPC strategies in general practice.
- ⇒ The research team comprised a range of expertise, including clinician-researchers in general practice, IPC and pharmacy and social scientists.
- ⇒ Study findings are limited to a small sample size and to only one state in Australia.

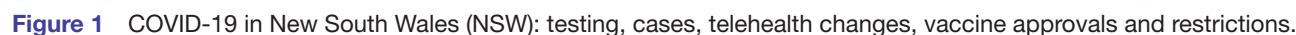
INTRODUCTION

The SARS-CoV-2 pandemic has burdened health systems worldwide,¹ including general practice (family medicine), at the frontline of community access to healthcare.² Reports and reflections on the role of general practice in well-resourced countries describe shifts to remote consultations, practice reorganisation and contributions to public health messaging and education. They also describe anxieties around resources, income, information, public access to care and risks of infection.^{2–5}

In Australia, general practitioners (GPs) and primary health networks have played a pivotal part in the national health pandemic strategy, responding with agility and ingenuity during a difficult and changing crisis.⁶ Two key aspects of the national primary care response were the expansion of Medicare-subsidised telehealth⁷ and the establishment

Although national and state guidelines were provided to support risk management of COVID-19 in healthcare workplaces,^{12 13} IPC standards and guidance must also be adapted for local conditions, in order to be effective.¹⁴ In order to reflect on and learn from the rapid implementation of pandemic IPC in general practice, we need to understand not only what kinds of strategies were adopted but also *how* they were adapted to diverse general practice

Our study design draws on the tradition of interpretivism in qualitative health research.³¹ We treated interview transcripts as accounts of participants' interpretation



and meanings attributed to their experiences, coconstructed through the interview process with the interviewer (SH).

The research team represents a broad range of research and clinical experience, comprising: clinician-researchers with expertise in IPC and biopreparedness (GLG, RB, MW), sociologists and social scientists (SH, CD, LWV), a general practice clinician-researcher (PB) and a pharmacist-researcher (FY).

Sampling and recruitment

To be included in this study, participants had to have worked in a general practice setting in NSW since January 2020. Sampling was purposive and aimed to include participants from a variety of general practice settings in NSW (e.g., independent, corporate, rural and metropolitan), incorporating a spectrum of seniority and roles (e.g., GPs, GP registrars, registered nurses (RNs), nurse practitioners, practice managers and receptionists) working during the SARS-CoV-2 pandemic in NSW.

Potential participants were informed about the research and invited to participate, through existing professional contacts of a member of the research team (PB) and through a snowball approach from previous participants. Those who expressed interest in participating were then contacted by a separate member of the research team (SH), who arranged written consent and scheduled and conducted the interviews.

Patient and public involvement

No patients were involved.

Data collection and analysis

A member of the research team, an experienced qualitative health researcher and social scientist (SH), conducted semistructured one-on-one interviews remotely, via phone, or video-conferencing (Zoom V.5.7.6) or face-to-face at the GP surgery when community transmission risk was low. Interviews varied between 30 min and 60 min and were audio-recorded and transcribed by an external third party who had signed a confidentiality agreement. Transcripts were reviewed iteratively by SH and FY for data saturation. PB continued recruitment until data saturation was achieved.

Interview questions were designed to investigate IPC as a multidimensional concept, including practical strategies and controls, and the sociocultural, technical and ethical issues arising during a constantly evolving pandemic situation. The interview guide is available as a supplementary file. Questions focused on participants' experiences of the pandemic, in relation to: changes implemented at their workplaces, how they balanced risks and responsibilities as healthcare workers and their views on sources of support that were available during the pandemic.

Data analysis combined both inductive and deductive approaches.³² The process began with an initial familiarisation phase, where researchers (SH and FY) reviewed the transcripts and applied inductive coding to identify

analytical categories and build an overall picture of the data. Coding was carried out in NVivo V.12 (QSR International) by FY and SH. During this familiarisation process, we identified that a key topic described by participants in detail was the variety and novelty of IPC strategies implemented to manage transmission risks in their workplaces. A decision was made to take a deductive framework approach³³ with this subset of codes, mapping participants' accounts of these strategies to the risk-mitigation framework known as the Hierarchy of Controls (first developed by the US National Safety Council³⁴). The framework matrix also included codes relating to 'enablers' and 'challenges' for each level of the hierarchy, to identify the sociocultural, technical and ethical factors that either helped or hindered participants in implementing each kind of IPC strategy. See [table 1](#) for a summary of the strategies, enablers and challenges mapped to this matrix.

This stage involved four members of the research team (PB, GLG, SH, FY) who were involved in charting data to the hierarchy, cross-checking and developing overall interpretations. Divergent cases were sought and discussed among the team to promote analytical rigour. Differences in interpretation were handled through iterative discussion until consensus was reached among all parties.

The hierarchy of controls

The hierarchy of controls represents a human factors approach to safety that classifies a range of risk-reduction strategies by their effectiveness and reliability, with more reliable strategies considered less likely to fail due to variability in human behaviour.³⁴ See [figure 2](#), for examples, of the hierarchy applied to general practice IPC, drawing on our analysis. At the top of the hierarchy are actions taken to either *eliminate* the risk completely through removal of the risk from the workplace or workflow, or, if that is not possible, to *substitute* the risk (whether it is an unsafe material, process or procedure) with a less risky alternative. Next in the hierarchy are actions taken to physically separate workers from the risk through *engineering* of the work environment, followed by *administrative* controls (such as protocols, training, supervision, scheduling) designed to modify work practices, which depend on workers' compliance. Finally, the use of PPE is often seen as the most obvious strategy, but it is relatively unreliable, as its effectiveness depends on multiple unstable factors (e.g., adequate supplies of appropriate equipment, regular training and workers' competence in using it safely).³⁵ In the patient safety literature, the hierarchy has been used to highlight a tendency towards over-reliance on weaker risk-mitigation strategies (such as administrative measures or PPE).³⁶

Prior to the SARS-CoV-2 pandemic, the hierarchy was used by the US Centers for Disease Control and Prevention in the 1990s to control a resurgence of tuberculosis³⁷ and to manage care for patients with Ebola virus disease.³⁸ Since 2020, however, the hierarchy has become widely

Table 1 IPC strategies, enablers and challenges, by type of control (see figure 2)

Control type	Strategies	Enablers	Challenges
Elimination (Remove the risk of exposure)	<ul style="list-style-type: none"> ▶ All staff working separately from home. ▶ No physical attendance at the practice for patients or staff. 	<ul style="list-style-type: none"> ▶ Medicare subsidies for telehealth (from March 2020) ▶ Dedicated general practice respiratory clinics (GPRCs) (first opened March 21, 2020) ▶ Ability to privately bill for telehealth consults ▶ Having the appropriate (and sufficient) technology for telehealth (e.g., phones in clinics). 	<ul style="list-style-type: none"> ▶ Restrictions and changes to Medicare funding for telehealth significantly affected margins for practices that did not usually bulk bill most patients. ▶ Protecting the privacy and confidentiality—of patient information, and of clinician contact information, in telehealth consults. ▶ Patients facing long waits for telehealth calls; receptionists having to manage delays. ▶ Lack of face-to-face consultation impractical for some conditions (e.g. mental health), physical examinations, vaccinations)
Substitution (Replace a relatively high risk with a lower risk)	<ul style="list-style-type: none"> ▶ Vaccination 	<ul style="list-style-type: none"> ▶ Access to vaccines 	<ul style="list-style-type: none"> ▶ Difficult access to vaccines (early in the vaccine rollout)
Engineering controls (Separate people from, or mitigate impact of, the exposure risk)	<ul style="list-style-type: none"> ▶ Relocating consults and waiting areas outdoors (including GPRCs). ▶ Creating separate 'respiratory rooms'. ▶ Physically dividing the clinic. ▶ Changing clinic layout to: redirect patient flow, restrict the number of patients in waiting room, enable physical distancing. ▶ Moving/installing objects (e.g. screens, chairs) to separate or maintain distance between reception staff and patients. ▶ Access to hand sanitiser 	<ul style="list-style-type: none"> ▶ Available outdoors areas (e.g., backyard, carpark, balcony, foyer). ▶ Available physical space – for example, separate, large rooms. ▶ Knowledge/experience shared from other clinics. ▶ Having an usher outside to screen and direct patients. ▶ Allowing patients to make appointments. ▶ Previous pandemic planning. ▶ (GPRCs) One staff member allocated to swab the patients (nurse or lab swabber). ▶ (GPRCs) Patients not lingering (wanted to be out of there). 	<ul style="list-style-type: none"> ▶ Inclement weather (cold and rain). ▶ Connecting up IT systems. ▶ Difficult to determine logistics of where potentially infectious patients can safely wait, indoors, to be seen or swabbed. ▶ Difficulty managing high patient numbers/demand. ▶ Existing layout of clinic (e.g., small terrace house, small, cramped consulting rooms). ▶ (GPRCs) Location in community—for example, as part of an apartment block sharing lobby space.
Administrative controls (Change the way work is done)	<ul style="list-style-type: none"> ▶ Screening of patients and staff. ▶ Regularly updating clinic policies and protocols. ▶ Allowing/requiring patients to make appointments. ▶ Avoiding use of nebulisers, spirometry. ▶ Limiting time spent with patients. ▶ 'Telephone-only' communication with receptionists. ▶ Cohorting staff—those who would see respiratory patients and those that would not. ▶ Enhanced environmental cleaning (closely linked with hand hygiene and PPE). ▶ Ensuring supply of resources (PPE, hand sanitiser and cleaning supplies). ▶ PPE training. ▶ Removing objects (e.g., kids' toys, chairs). 	<ul style="list-style-type: none"> ▶ Communicating with patients ahead of appointments. ▶ Clear processes in place for staff to follow where there were breaches. ▶ Sense of seriousness (e.g., during an outbreak, high community transmission). ▶ Well-informed and organised practice leadership (managers/owners/senior GPs). ▶ Cohorting patients by appointment time. ▶ Regular meetings, communication among staff within clinic. ▶ Consistency. ▶ Keeping 'an eye' on one another. ▶ Habituation of hand hygiene, due to the frequency of practice. 	<ul style="list-style-type: none"> ▶ Patients who breached screening—inadvertently or intentionally ▶ Inconsistent quality of screening (at individual sites, as well as across different sites). ▶ Varied application of screening by different doctors. ▶ Justifying screening to patients when there was low community transmission. ▶ Reduced access to routine medical care and continuity of care for patients. ▶ Dealing with patient anger & frustration. ▶ Forgetting to maintain protocols when busy, or when urgency has died down. ▶ Clutter (difficult to clean). ▶ Not sure of efficacy of intensive cleaning. ▶ Difficulty sourcing PPE/hand sanitiser early in the pandemic. ▶ Skin irritation and dermatitis from use of hand sanitiser.
PPE (Personal protective equipment)	<ul style="list-style-type: none"> ▶ Use of PPE: <ul style="list-style-type: none"> – Masks (surgical and/or N95) for staff – Requiring masks for patients – Gloves, gowns, eye protection for staff ▶ Scrubs (staff purchased their own). ▶ PPE logistics (policies, protocols and guidelines on how, when and where to don and doff). 	<ul style="list-style-type: none"> ▶ Good supply (e.g., GPRC—govt supplied, or manager/owners who ordered early, able to source). ▶ PPE provided a sense of safety (even if not prescribed). ▶ PPE protected staff from other viruses too (e.g., common colds). ▶ Education from clinician colleagues (doctors and nurses). 	<ul style="list-style-type: none"> ▶ Uncertain (and/or poor quality) PPE supply (early in the pandemic). ▶ Discomfort. ▶ Masks make it difficult to communicate with patients (leading to increased risk, because people remove their masks or lean in closer). ▶ Confusion about appropriate use, and logistics of safe doffing and disposal. ▶ Inconsistent use (from person to person) within the clinic, between clinics. ▶ Lack of training and follow-up, particularly for non-clinical staff. ▶ Possible overuse (impacting on supply; increased discomfort).

Hierarchy of controls in general practice:

Examples of strategies for respiratory infectious disease outbreaks

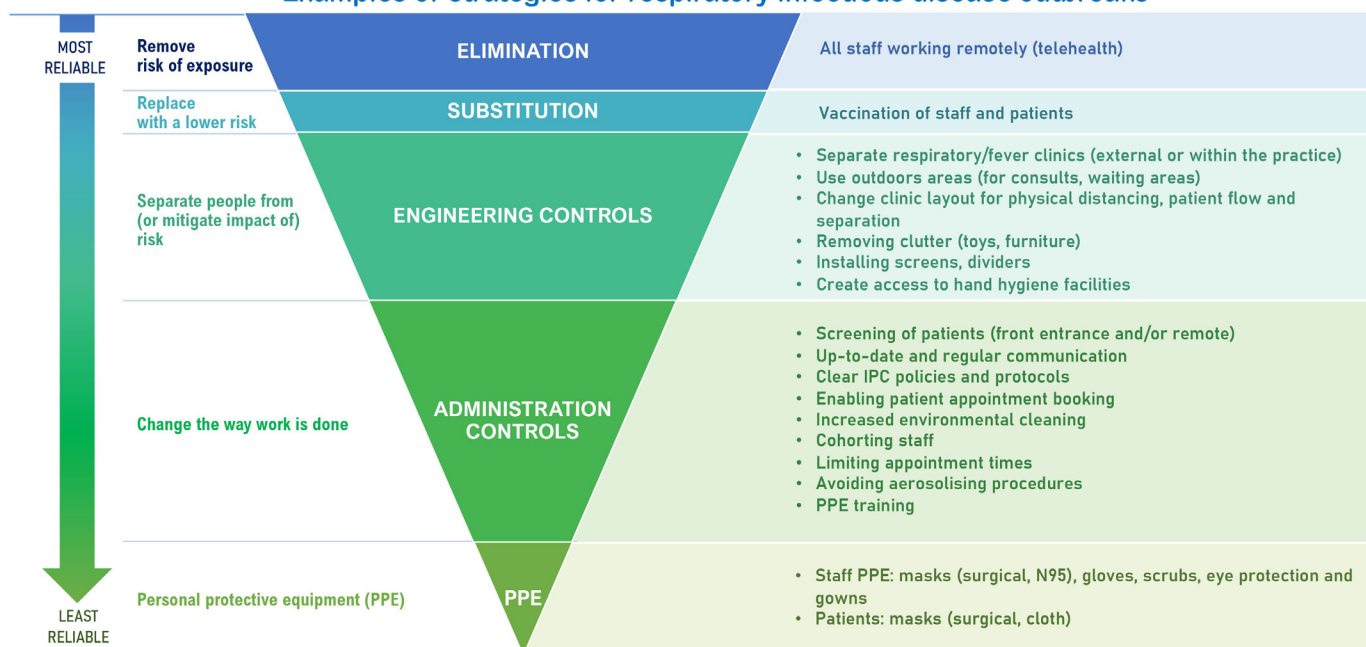


Figure 2 Hierarchy of controls in general practice. IPC, infection prevention and control.

adopted in international and national guidance for SARS-CoV-2 management, including key resources developed to inform general practice IPC in Australia.^{12 13 39}

We adopted the hierarchy in our analysis to examine its application to general practice IPC. Below, we organise the IPC strategies described by participants using the hierarchy and identify the enablers and challenges associated with their implementation and sustainability. In doing so, we aim to inform the use of the hierarchy of controls in current and future IPC guidance for pandemic preparedness and response in general practice settings.

RESULTS

Interviews were conducted with 20 participants in NSW: GPs (n=10), one GP registrar, RNs (n=4), practice managers (n=2), receptionists (n=2) and one nurse practitioner. Most GPs and RNs worked across two or three different sites, including hospitals, GPRCs and vaccination hubs. Four GPs worked at rural sites; all other sites were metropolitan. Illustrative quotes from participants are included below.

Overall, participants reported being motivated to avoid the risks of infection to themselves and others but were also mindful of the impact of a confirmed COVID-19 case on the practice. Depending on local public health guidelines⁴⁰ and level of exposure, this could involve a temporary closure of the practice for 2 weeks, with significant consequences for staff, patients and the business.

I mean, when the outbreak happened, we also knew that if we got a positive case of COVID in our rooms here, then it would shut us down, and I think you're

conscious of that. So [...] for us on a Monday, that could be 99 [patients] that wouldn't be seen (P02, practice manager).

Participants reported adopting a wide range of workplace IPC strategies to reduce the risk of SARS-CoV-2 exposure and illness. Some IPC strategies were reported by all participants, but there was also variation between, and sometimes within, practices. As the pandemic evolved, these IPC strategies were modified.

Rules were changing every week. I couldn't keep up. [...] there was times when we were wearing masks and then we weren't wearing masks. [...] So, everything was changing. There's been a million changes. And with triaging as well, who's let in, who's not let in. Just because I feel like no one has all the information, we're just winging it as we go (P05, receptionist).

Importantly, despite the variation and uncertainty, many participants—especially those who worked in the GPRCs—reported feeling protected by the precautions.

Family and friends would say to me, 'We cannot believe you are doing this job on the frontline [in a GPRC] because [...] they thought I was putting myself in danger. However, I would say I feel much safer where I am, than going to Woolworths and standing next to 60 people all trying to get toilet paper [...] I never felt unsafe because I knew that I was very well protected (P07, GP).

In the following sections, we present descriptions of these strategies within the hierarchy of controls

framework. For each strategy, we also describe the enablers and difficulties reported by participants and provide illustrative quotes. See [table 1](#) for a summary of these strategies, enablers and challenges.

Elimination strategies

The most effective type of control is elimination, which refers to the complete removal of the risk of exposure. For our participants, the only plausible elimination strategy was *practice closure* with no other consultations except telehealth, as any face-to-face interaction between staff or between staff and patients risked exposure. This could involve entire practices closing their doors to patient attendance, with staff working remotely, and conducting telehealth consultations. Mainly, this was applied at individual GP level, with some choosing to work from home doing telehealth-only consults.

GPs considered telehealth extremely useful for certain kinds of consult (e.g., brief encounters, sharing results or providing repeat prescriptions) but unsuitable for others (e.g., those involving mental health issues or physical examination). Other difficulties included technical (poor connectivity, insufficient telephone equipment or lines), financial (restrictions and changes to Medicare funding) and logistical issues (e.g., patients waiting a long time for telehealth calls or having difficulty describing clinical signs).

People would send in photos of rashes. They'd have a spot, for instance, and they'd do a nice close-up photo of this spot. Well, you've got no idea, unless there's a ruler next to it, whether it's a three millimetre spot or a six centimetre spot because you've got nothing to compare it with (P19, GP).

We had to get some extra phones and phone lines because all the phone lines were busy and then you couldn't get a phone line in or out. So they ended up purchasing some mobile phones for the doctors to use (P11, RN).

Another strategy that was mentioned by all participants and is often included under the category of elimination,³²⁰ is screening/risk assessment of patients and staff—either remotely (eg, by phone or online) or in person (most commonly by an usher or receptionist at the entrance to the surgery). However, we categorised screening as an administrative control (see below), as our participants described it being highly dependent on patient and staff compliance with protocols and awareness of possible infectiousness. Following the human factors principles underlying the hierarchy,¹⁵ this means that the reliability of screening is uncertain, so it is more accurately classified as a strategy that reduces, but does not eliminate, transmission risk, by changing work practices.

Substitution strategies

Vaccination was mentioned by several participants as an important protective strategy. We suggest that vaccination could be considered a valid example of substitution

in this situation, in that it can reduce the risk of severe illness and death, resulting instead in mild or no illness.

I remember I got my AstraZeneca needle three weeks ago and I felt this great sense of relief. Afterwards, it's like, 'Oh, my ventilator risk has just dropped by 90%.' Because I know that's what it means (P13, GP).

Engineering controls

Engineering controls are strategies to separate people—any of whom could be unwittingly infectious—from one another, or reduce the effect of contact, through physical means, involving the built environment. Many of these strategies also involve *administrative* changes. Participants reported a wide variety of novel and creative strategies, varying by general practice, and over time. For instance, some practices installed portable shelters in car parks or backyards, or set up waiting and consultation areas in foyers and balconies, to provide better ventilation. Outdoors, the main challenges were inclement weather (cold and rain) and information technology (IT) connections.

We had an elderly GP and [...] a staff member that was immune-compromised, and so they didn't want to let anybody into the practice [...] So we had a big tent for patients to wait 1.5 metres away, and we had a tent that the doctor and the nurse could sit in. And it took a while to get all that set up because we had to get IT support to get the laptop out there, to print inside, to work out all our processes (P07, GP).

Indoors, surgery layouts were rearranged to redirect patient flow—to separate (suspected) infectious from non-infectious patients, minimise numbers in the waiting room and increase physical distancing. For example, chairs were moved to separate waiting patients; signs and floor markings employed to direct patients; Perspex screens were installed around reception desks and, in one practice, artificial walls were built (to cohort staff and minimise disruption in the event of a COVID-19 exposure).

When we did start bringing patients back into the practice, they actually built a couple of artificial walls inside the practice [...] with clear plastic and a door in it. And the idea was, because it is such a big practice, there's like 10 doctors, [...] hopefully the door was always to remain shut, and [...] if there was a patient with COVID, hopefully [only] one half of the practice would have to shut down and the other half would remain open and stay operational (P15, GP).

Some practices allocated specific rooms (and entrances and corridors) for patients with respiratory symptoms such as those who had returned a negative COVID-19 test, or bypassed screening (deliberately or unwittingly). As noted above, there were also GPRCs, which saw *only* patients with respiratory symptoms.

So, if we had anyone that had any signs and symptoms of COVID, and then they'd been tested and it was negative, but still needed to see a GP, I would put them into a respiratory room. So I made a respiratory room. So, outside that respiratory room I had [PPE available], and then they could be reviewed by a GP (P03, RN).

Physical layout made these strategies easier for some practices (e.g., having outdoor areas or spare rooms) than others (e.g., older style cottages, single entrance, small rooms). Participants also reported difficulty managing the logistics of seeing *both* respiratory and non-respiratory patients indoors. One GPRC had to manage patient flow within a residential apartment building, where the residents were uneasy about sharing an entrance with patients.

So [clinic 1] I felt was much better organised. So they had a line marked the 1.5 metre distance in the room, they had PPE that was plentiful and adequate. Whereas [at clinic 2], [...] the consultation rooms were a lot smaller. There was no way you could socially distance. You couldn't have a 1.5 metre barrier. And I think the screening of patients wasn't as great (P17, GP).

So there were initial issues [...] trying to separate the space of the clinic with the residential block. [...] What became a problem was the common area and the common entry and exit to the building. And so, it was reassuring people that [...] the clinic was actually a very safe clinic. [...] But we had to set up barriers and a certain flow in and out of the clinic so that this will separate the public (P07, GP).

Finally, engineering controls (requiring administrative support) include physical access to and replenishment of appropriate PPE and hand sanitiser, supplies of which were uncertain at the start of the pandemic, with some practices better prepared than others.

We had one GP that was really onto it, that was really worried about what was going to happen. And she was really keeping an eye on everything [...] So we purchased extra masks. We already had a whole lot of stock of PPE because of accreditation with the pandemic influenza plan. Part of that is that you have to have three months' worth of PPE (P11, RN).

[The supply of masks] are occasionally just terrible. So, the batch we have at the moment, the ones that loop behind each ear, the bottom left loop breaks off, so I have to staple that back on (P08, GP).

Administrative controls

One administrative control described by all participants was screening of patients. Patients were questioned about symptoms of respiratory illness, COVID-19 test results and potential COVID-19 exposure (through known contact,

recent travel overseas or local hotspots), to prevent people most at risk of being infectious from entering the facility.

Screening can occur in person (e.g., by an usher or receptionist at the entrance to the surgery) or remotely (e.g., by phone or online) or in combination. Patients assessed as potentially infectious were offered telehealth appointments, or advised on alternative access to care as appropriate, including referral to a GPRC or hospital emergency department for assessment and management.

Participants reported that screening depended heavily on public cooperation and was most easily justified during increased community transmission. It also depended on clear communication to patients about what to expect prior to appointments; and clear, consistent protocols for staff.

Yeah, just making sure that we had the right processes in place. And that was making sure we were calling patients, every single patient, before they came into the clinic, telling them what we were doing, explaining to them if they had any symptoms that they needed to be going to a respiratory clinic or getting a swab, and triaging every patient that came in, making sure that we had that proper signage on the doors, making sure that every patient, at certain times in the last 12 to 18 months, was wearing a mask as they came into the practice (P16, GP).

All participants reported involvement in screening patients; however, strategies varied between individual practices and GPs. For instance, some restricted in-person consults to patients without respiratory symptoms, others were willing to see patients with respiratory symptoms if they had a negative COVID-19 PCR test, and others made judgements on a case-by-case basis. One medical centre decided, for a period of time, to see children under 5 years of age with a respiratory illness, as they were not able to easily access healthcare services at that time in the local community.

In the end, we probably saw about 10% of people in real life. So they would ring up and we'd talk on the phone and then we would realise that we really needed to see them and so we would get them in generally later in the day and see them in real life (P19, GP).

We were very concerned because there was [...] no other private-practising GPs who were seeing children with COVID symptoms. [...] And it was very infuriating for us because we'd even have little ones who had a negative COVID test, whose GPs would not see them (P02, Practice manager).

Participants consistently described variations in the perceived quality and effectiveness of screening, with questions sometimes not asked or answered incorrectly or inaccurately. Another common difficulty was dealing with the anger and frustrations of patients who were denied appointments in person, including parents of young children. Patients' frustrations with screening were

exacerbated during periods of low community transmission, and by variation in screening criteria between general practices.

Very occasionally someone would come in, deny that they had anything wrong at all to the staff at the front desk, and then sit down in your room and tell you they'd come in for their terrible cough. So, in those situations I just tended to do the swabs there and then and see them and hope for the best (P19, GP).

I think probably the most stressful part of it was probably dealing with mums of young kids, to be honest, more than anything else. Because I think life was so stressful for them because their children were unwell, a lot of them being in childcare [and] they couldn't just get to see a GP to have someone listen to their chest or look at their child's ears or things like that (P09, RN).

Participants regarded screening as an administrative, risk-assessment strategy that complemented (and necessitated) other strategies, to manage potentially infectious patients presenting in person. For instance, staff who performed screening *in-person* remained exposed to potentially infectious patients, relying on other strategies (such as outdoor ventilation and PPE) for protection.

Participants often described how *administrative* controls were useful when other measures were difficult to implement. For instance, protocols for screening, patient flow, distancing and cleaning were frequently mentioned in conjunction with efforts to engineer separation between people. Logistical administrative strategies included appointment scheduling (minimising waiting time), limiting consultations to 15 min and asking patients to wait in their cars. In some practices, receptionists interacted with patients only by telephone, but this was impractical if patients needed to deliver or collect items or make payments in person.

In another [GPRC] that I've worked in, there is a separate entrance that the patients come into, then there's a certain flow, and they'll see the doctor, see the nurse, get swabbed, out a separate exit. This one was, come in, see people, come out same exit/entrance. So then we had to look at staggering the appointments so that patients wouldn't bump into each other [...] this was a learning, as time went on, but it was challenging (P07, GP).

Participants described the value of practice-wide communication processes such as regular meetings, and clear, consistent IPC protocols. In general, the success of these strategies was attributed to staff (such as practice managers, practice owners or senior GPs) who were well organised and well-informed.

I remember driving to work going, 'What's today going to be like? What's going to happen today?' And you'd walk in the door and everyone would be huddled together [...] The manager was really

the critical person because she was receiving all the bulletins from local health districts and Health Department advice and item numbers and telehealth updates (P13, GP)

Some of these strategies reduced in intensity over time, such as the frequency of meetings and comprehensive cleaning, when the level of risk was felt to be lower.

So we wiped down everything [...] for a short period, maybe a month or two [...] but then when we weren't getting many cases, that's when we slowed things down a bit and we didn't (P10, RN).

Administrative measures are considered less reliable according to the hierarchy but provided a sense of order and played a valuable role in helping staff feel safe, when consistently applied.

The pandemic is a state of chaos, and I think everyone needs some sort of sense of order [...] to go into a clinic where you know exactly what's going to happen, you are guaranteed that, nothing is ever 100%, but you know that it's going to be run in a certain way and it has a formula, then there's a certain sense of comfort there, right? (P07, GP)

Personal protective equipment

PPE is considered the least reliable in the hierarchy of controls. Nevertheless, it is a very important strategy. Participants valued and felt protected by their PPE from common viruses as well as SARS-CoV-2, particularly with use of masks by staff and patients.

People would say, 'Look, I'll [see patients with respiratory symptoms] if I've got PPE. But if I haven't got PPE that's too much of an ask' (P13, GP).

P2/N95 respirators were described by some participants as offering more protection for the wearer than surgical masks, although perspectives varied on their use, except for aerosol-generating procedures. Participants described problems associated with mask-use, including discomfort and difficulty communicating with patients.

I have a lot of older, deaf patients and it was just hard for them and they struggled. So when I didn't have to wear a mask, for certain patients I would actually just take it off because I was like, 'It's not worth the effort to try [communicating with masks on].' But that was in the time that we didn't have to. Whereas, now we have to (P15, GP).

In addition to masks, participants wore gloves, eye protection and gowns when seeing patients with suspected COVID-19 symptoms. Scrubs were also purchased by several participants as additional protection. Again, this differed by practitioner, and over time, with some wearing only masks when seeing suspected patients with COVID-19, and others donning more PPE (including gloves, a gown and eye protection) when seeing all patients.

In my other practice, there were five opinions and you had to adhere to those five opinions. So, depending on what doctor was working that day, I'd have to be alert of what they liked to have done for their PPE or everything else. Some didn't want to do any, some wanted the whole lot plus (P03, RN)

Finally, there was confusion around the logistics of PPE use, particularly doffing protocols, in combination with hand hygiene moments and cleaning. Some participants also described protocols to remove their scrubs/clothing when returning home, similar to PPE doffing protocols. Some questioned the adequacy of training provided, particularly for non-clinical staff. Much like the tasks of ensuring supply and access, protocols and training are also administrative strategies that support the appropriate use of PPE.

I would leave my scrubs and a separate pair of running shoes at work and get changed, and then at the end of the day, I was like, 'Now, where do I put the scrubs? In which bag? And then do I wash my hands? Do I put gloves on?' (P80, GP)

I think you get a basic training, and [...] it's probably a good training, but, of course, a lot of the basic training was via a video conference because no one could do them in person. And then people, I think, have one training and then it's never followed up on (P82, RN).

DISCUSSION

We found that healthcare workers in general practice implemented varied and flexible repertoires of IPC strategies, either proactively or in response to complex and evolving circumstances. These circumstances included: emerging scientific and clinical knowledge about the virus (SARS-CoV-2) and the disease (COVID-19); varying levels of 'lockdown' based on community transmission; changes to Medicare telehealth funding; the establishment of respiratory clinics; differing national, state and professional IPC guidelines, and strategies employed by other practices in the area. In individual practices, factors that hindered or helped the implementation of IPC strategies included: the locations and layouts of practice facilities; PPE supplies, and knowledge and confidence of staff about its use; clear and timely communication of information and guidance; individual differences in preferences, fears or risk tolerance; IT systems and patient populations.

We found that the pandemic was experienced as highly novel and constantly changing, such that participants spoke of continually reinventing their IPC strategies—'building a plane and flying it all in one go', as one GP described. Nevertheless, participants also saw benefits in maintaining some strategies into the future, such as increased hand hygiene, wearing of masks by both staff and patients and the use of telehealth, where appropriate.

Our findings provide empirical support for our application of the hierarchy of controls in general practice settings. Our classification is aligned with some official guidance³⁹ and provides support for amending others.^{12 13} In particular, our study demonstrates how screening strategies are more accurately described as administrative, as they are unreliable in practice. Our findings demonstrate how the hierarchy of controls can be usefully applied to guide pandemic IPC in general practice, but with some caveats.

First, although the hazard to be controlled here is the risk of exposure to, and subsequent illness caused by SARS-CoV-2, the virus is harboured and transmitted by *members of the public*—patients, carers, family members and staff—and it is impossible to reliably distinguish those who are infectious, but presymptomatic or asymptomatic, from those who are not infected. The 'strongest' control in the safety hierarchy—*elimination*—is difficult to apply in a general practice setting, as many clinical presentations benefit from a face to face visit, patients with chronic conditions require physical assessment and examination at regular intervals, and preventative care activities such as vaccinations and cervical screening require face to face contact.

Second, during a pandemic, the hazard is not limited to the workplace. Strategies applied at work may minimise the risk for workers there, but they remain vulnerable to exposure in the community—such as on public transport while commuting to work, or from household members, while working from home. This means that strategies applied at the societal level (e.g., statewide restrictions on movement of people, vaccination, establishment of respiratory clinics, and federal subsidies for telehealth) necessarily impact on and function *in concert with* practice-level strategies.

For instance, federal funding of telehealth and GPRCs addressed some of the risks of reduced access to care, due to screening protocols adopted in general practice, and patients' reluctance to seek healthcare (as observed in previous epidemics).⁴¹ Within practices, as described above, engineering and administrative controls were often described by participants as functioning *interdependently* to manage logistics, communication, information and the provision and use of PPE.

The hierarchy of controls promotes a strategic preference for strategies that rely less on human behaviour and variability.³⁴ Our findings suggest that, in a general practice context during a pandemic, ranking strategies by these criteria is only one approach but an important one, as it highlights the need to avoid relying solely on PPE. IPC advice however should also attend to how strategies from different levels of the hierarchy can be *combined* in general practices, adapted to meet the circumstances and needs of different general practices, at different points during the pandemic.³⁶ Our findings demonstrate the creativity and innovation of general practice personnel in devising, trialling, adapting, and adapting to, the many strategies described to us in this study. The 'human factor'

here has been a critical resource, necessary to meet the challenges of responding to highly variable and changing pandemic circumstances.

Our findings are limited by our small number of participants, in only one state, and the restricted time periods in which interviews were conducted, recognising that other Australian states and territories, and other countries have had different pandemic experiences. This study, however, contributes to the limited available evidence on General Practice IPC during pandemics, providing valuable insights into inform future pandemic planning and preparedness.

Conclusion

General practice has been at the frontline of the health-care system for Australians throughout the SARS-CoV-2 pandemic, playing critical roles in primary care and public health. During this period, general practice staff have striven to understand and respond, creatively, to the changing pandemic environment, by implementing modifications to practice management and healthcare delivery processes. The varied contexts and circumstances for different practices and practitioners have been matched by variations in IPC strategies, across the hierarchy of controls. Overall, these findings provide valuable insights into the pandemic activities of general practice professionals, who are an under-researched but critical group of frontline healthcare workers in any pandemic response.

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REFERENCES

- 1 Chang AY, Cullen MR, Harrington RA, *et al*. The impact of novel coronavirus COVID-19 on noncommunicable disease patients and health systems: a review. *J Intern Med* 2021;289:450–62.
- 2 Huston P, Campbell J, Russell G, *et al*. COVID-19 and primary care in six countries. *BJGP Open* 2020;4:bjgpopen20X101128.
- 3 Khan Y, O'Sullivan T, Brown A, *et al*. Public health emergency preparedness: a framework to promote resilience. *BMC Public Health* 2018;18:1344.
- 4 Li DKT ZS. Contributions and challenges of general practitioners in China fighting against the novel coronavirus crisis. *Fam Med Com Health* 2020;8.
- 5 Marshall M, Howe A, Howsam G, *et al*. COVID-19: a danger and an opportunity for the future of general practice. *Br J Gen Pract* 2020;70:270–1.
- 6 Wright M, Versteeg R, Hall J. General practice's early response to the COVID-19 pandemic. *Aust Health Rev* 2020;44:733–6.
- 7 Snoswell CL, Caffery LJ, Haydon HM, *et al*. Telehealth uptake in general practice as a result of the coronavirus (COVID-19) pandemic. *Aust Health Rev* 2020;44:737–40.
- 8 Hunt G, Coulton M. GP-led respiratory clinics continue to serve Australians 2020.
- 9 Kippen R, O'Sullivan B, Hickson H, *et al*. A national survey of COVID-19 challenges, responses and effects in Australian general practice. *Aust J Gen Pract* 2020;49:745–51.

- 10 Sotomayor-Castillo C, Nahidi S, Li C, *et al.* General practitioners' knowledge, preparedness, and experiences of managing COVID-19 in Australia. *Infect Dis Health* 2021;26:166–72.
- 11 Australian Government. Review of Australia's Health Sector Response to Pandemic (H1N1) 2009: Lessons identified 2011.
- 12 The Australian Government. Minimising the risk of infectious respiratory disease transmission in the context of COVID-19: the hierarchy of controls. *Be CovidSafe* 2021.
- 13 Royal Australasian College of Physicians. COVID-19: guidance on workplace risk management 2020.
- 14 Iedema R, Jorm C, Hooker C, *et al.* To follow a rule? On frontline clinicians' understandings and embodiments of hospital-acquired infection prevention and control rules. *Health* 2020;24:132–51.
- 15 O'Brien BC, Harris IB, Beckman TJ, *et al.* Standards for reporting qualitative research: a synthesis of recommendations. *Acad Med* 2014;89:1245–51.
- 16 Broom J, Broom A, Williams Veazey L, *et al.* "One minute it's an airborne virus, then it's a droplet virus, and then it's like nobody really knows...": Experiences of pandemic PPE amongst Australian healthcare workers. *Infect Dis Health* 2022;27:71–80.
- 17 Broom J, Williams Veazey L, Broom A, *et al.* Experiences of the SARS-CoV-2 pandemic amongst Australian healthcare workers: from stressors to protective factors. *J Hosp Infect* 2022;121:75–81.
- 18 Veazey LW, Broom A, Kenny K. Entanglements of affect, space, and evidence in pandemic healthcare: An analysis of Australian healthcare workers' experiences of COVID-19. *Health & Place* 2021;102693.
- 19 Pearce C, Phillips C, Hall S, *et al.* Following the funding TRAIL: financing, nurses and teamwork in Australian general practice. *BMC Health Serv Res* 2011;11:38.
- 20 NSW Health. 2020 media releases from NSW Health - News, 2020. Available: <https://www.health.nsw.gov.au/news/Pages/2020-nsw-health.aspx> [Accessed 13 Oct 2021].
- 21 NSW Health. 2021 media releases from NSW health, 2021. Available: <https://www.health.nsw.gov.au/news/Pages/2021-nsw-health.aspx> [Accessed 13 Oct 2021].
- 22 Parliament of Australia. COVID-19- a chronology of Australian Government announcements (up until 30 June 2020), 2021. Available: https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp2021/Chronologies/COVID-19AustralianGovernmentAnnouncements [Accessed 13 Oct 2021].
- 23 Australian Government. TGA approves Pfizer COVID-19 vaccine for 12 to 15-year-olds 2021.
- 24 Australian Government. TGA grants provisional determination for the Moderna COVID-19 vaccine, Elasmoran 2021.
- 25 Australian Government. TGA provisionally approves AstraZeneca COVID-19 vaccine for use in Australia 2021.
- 26 Australian Government. TGA provisionally approves Pfizer/BioNTech COVID-19 vaccine for use in Australia 2021.
- 27 Australian Bureau of Statistics. COVID-19 2021. Available: <https://www.abs.gov.au/covid-19> [Accessed 13 Oct 2021].
- 28 NSW Ministry of Health. COVID-19 tests by date and postcode, local health district, and local government area. Available: <https://data.nsw.gov.au/data/dataset/nsw-covid-19-tests-by-location/resource/fb95de01-ad82-4716-ab9a-e15cf2c78556> [Accessed 25 Jan 2022].
- 29 NSW Ministry of Health. COVID-19 cases by notification date and age range. Available: <https://data.nsw.gov.au/search/dataset/ds-nsw-ckan-3dc5dc39-40b4-4ee9-8ec6-2d862a916dcf/details?q=> [Accessed 25 Jan 2022].
- 30 Royal Australian College of General Practitioners (RACGP). COVID-19 telehealth MBS items. Telehealth available through a patient's regular GP/practice: Frequently asked questions 2021.
- 31 Pope C, van Royen P, Baker R. Qualitative methods in research on healthcare quality. *Qual Saf Health Care* 2002;11:148–52.
- 32 Pope C, Zieband S, Mays N. Analysing qualitative data. *BMJ* 2000;320:114–6.
- 33 Gale NK, Heath G, Cameron E, *et al.* Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Med Res Methodol* 2013;13:117.
- 34 Manuele FA. Risk assessment & hierarchies of control. *Professional Safety* 2005;50:33–9.
- 35 Spigarelli C. Understanding the hierarchy of controls through a pandemic. *Professional Safety* 2020;65:20–1.
- 36 Liberati EG, Peeraly MF, Dixon-Woods M. Learning from high risk industries may not be straightforward: a qualitative study of the hierarchy of risk controls approach in healthcare. *Int J Qual Health Care* 2018;30:39–43.
- 37 Thorne CD, Khozin S, McDiarmid MA. Using the hierarchy of control technologies to improve healthcare facility infection control: lessons from severe acute respiratory syndrome. *J Occup Environ Med* 2004;46:613–22.
- 38 Cummings KJ, Choi MJ, Esswein EJ, *et al.* Addressing infection prevention and control in the first U.S. community hospital to care for patients with Ebola virus disease: context for national recommendations and future strategies. *Ann Intern Med* 2016;165:41–9.
- 39 World Health Organization. COVID-19: occupational health and safety for health workers, 2 February 2021.
- 40 Department of Health. CDNA national guidelines for public health units (version 6.1). *Coronavirus disease 2019 (COVID-19)*. Department of Health, 2021.
- 41 Kidd MR. Five principles for pandemic preparedness: lessons from the Australian COVID-19 primary care response. *Br J Gen Pract* 2020;70:316–7.