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Personal protective equipment training & lived experience for healthcare staff during COVID-19

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ABSTRACT

Objectives: To describe the lived experience of healthcare staff during the Coronavirus Disease 2019 (COVID-19) pandemic relating to the use of personal protective equipment (PPE) and investigate risks associated with PPE use, error mitigation and acceptability of mindfulness incorporation into PPE practice.
Methods: A qualitative human factors' study at two Irish hospitals occurred in late 2020. Data was collected by semi-structured interview and included role description, pre-COVID-19 PPE experience, the impact of COVID-19 on lived experience, risks associated with PPE use, contributory factors to errors, error mitigation strategies and acceptability of incorporating mindfulness into PPE practice.
Results: Of 45 participants, 23 of whom were nursing staff (51%), 34 (76%) had previously worn PPE and 25 (56%) used a buddy system. COVID-19 lived experience impacted most on social life/home-work interface (n = 36, 80%). Nineteen staff (42%) described mental health impacts. The most cited risk concerned 'knowledge of procedures' (n = 18, 40%). Contributory factors to PPE errors included time (n = 15, 43%) and staffing pressures (n = 10, 29%). Mitigation interventions included training/education (n = 12, 40%). The majority (n = 35, 78%) supported mindfulness integration into PPE practice.
Conclusions: PPE training should address healthcare staff lived experiences and consider incorporation of mindfulness and key organisational factors contributing to safety.

Introduction

Protecting healthcare staff wellbeing is a key safety priority. A person's wellbeing consists of a combination of physical, psychological, and social factors (including working conditions) (Engel, 1977). Reduced healthcare staff wellbeing has been associated with poor patient safety outcomes (Hall et al., 2016). The Coronavirus Disease 2019 (COVID-19) pandemic had a significant impact on the health and wellbeing of healthcare staff (Sim, 2020; Li et al., 2021 Mar 10). Infection prevention and control (IPC) training and safe personal protective equipment (PPE) practice play a key role in staff safety and wellbeing. This is particularly important when staff are redeployed and/or new staff are recruited for frontline work, as occurred during the pandemic.

Donning and doffing PPE can be stressful with fears regarding personal safety. During the pandemic, staff concerns included the risk of disease transmission, fears of infecting family members, and the impact of increased workload on mental health (Smith, 2020; Smith et al., 2020). Recent studies have highlighted the prevalence of stress, anxiety, and burnout (Li et al., 2021 Mar 10).

A person's 'lived experience' refers to how a person makes sense of their life events. This includes how they perceive, feel or remember it, and how they talk about it to others (Lindseth and Norberg, 2004). Research has recently addressed the 'lived experience' of work describing how staff experience their work situation including levels of

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work-related stress, and how it impacts on wellbeing, performance, and safety (Cahill et al., 2021).

The human factors literature addressing PPE primarily investigates risks associated with donning and doffing (Gurses et al., 2019). Human factors methodologies can identify error-prone steps in PPE practice, delineate the relationship between errors and self-contamination, and suggest remediation strategies (Mumma et al., 20182018). Issues associated with PPE availability and PPE fit, comfort, and design have been highlighted (Liu et al., 2020; Hignett et al., 2021). A recent study identified working in full PPE, fear, burnout and working in new contexts as the major challenges during the pandemic (Villar et al., 2021). Similarly, navigating new occupational challenges, maintaining mental health and wellbeing under unprecedented circumstances, and managing feelings of being misunderstood and undervalued, have been described (McGlinchey et al., 2021). The key role of the PPE 'buddy' has been highlighted for safe PPE use (Frost et al., 2020). A systematic review of interventions indicates that mindfulness positively impacts staff stress, anxiety, and resilience (Gilmartin et al., 2017). Mindfulness interventions have been proposed for hand hygiene (Gilmartin, 2016) and catheter-associated urinary tract infection prevention (Kiyoshi-Teo et al., 2013; Apisarnthanarak et al., 2014).

Documenting the lived experience of staff in relation to PPE use and factors that impact safe PPE use, is critical to the specification of PPE training. This supports staff competency development and wellbeing, along with identifying the need for interventions to promote and protects health and safety.

In this prospective qualitative human factors' study, we describe the lived experience of staff and PPE use during the COVID-19 pandemic at two Irish hospitals. We also investigated risks associated with safe PPE use, error mitigation and the acceptability of incorporating brief mindfulness in PPE practice.

Methods

This human factors' (HF) study was conducted at two Irish hospitals between September and November 2020. Beaumont Hospital Dublin (site 1) is an 820-bed tertiary referral adult public hospital, with national referral centres for neurosurgery and neurology, renal transplantation, and cochlear implantation. It also provides adult emergency and acute care services to 290,000 people. The Bon Secours Health System Cork (site 2) is Ireland's largest private hospital, with over 300 beds. It is a general hospital for adults and children with an Acute Medical Assessment Unit.

PPE training is led by the IPC team, and is mandatory at both sites, consisting of both theoretical and practical components. Each hospital's virtual learning environment provides access to theory-based information, supplemented by a mobile phone app on one site. The key focus of training is on procedural learning for specific tasks including PPE donning and doffing, hand hygiene and glove use.

Staff over 18 years on both sites were eligible for inclusion if they were working in patient-facing roles during the COVID-19 pandemic. This included doctors, nurses, care assistants, porters, radiographers, and other frontline staff. Participants were recruited directly by a lead nurse at each site and provided with briefing information and consent forms.

Once consent was established, a semi-structured interview of approximately 30 min was conducted onsite by the lead nurse, at the participant's convenience. Participant feedback was recorded in deidentified interview transcripts. Data included demographics, role description and duration, pre-COVID-19 PPE training and experience and current use of a PPE 'buddy'. A PPE 'buddy' was defined as a second staff member who monitored their buddy's donning /doffing progress as they are donning/ doffing PPE and assisted them with ensuring the correct order of steps. The buddy also reminded the staff member about regular hand hygiene, and may also have assisted with sample receipt and/or passed any equipment to that staff member. In addition, participants were asked open-ended questions on the impact of COVID-19 on their lives, contributory factors to errors, typical risks when donning & doffing PPE and the prevention of such risks. Impacts were discussed relating to the self, job role and work (i.e., teamwork, care delivery). Lastly, participants were asked if it would be helpful to incorporate a mindfulness aspect into PPE practice, to address staff wellbeing.

Interview feedback was analysed by three human factors' (HF) researchers. This involved three sequential phases of analysis. In the first phase, HF researcher 1 and HF researcher 2 reviewed and transcribed the paper notes obtained from the nurse-led interviews at each site. HF researcher 1 was assigned to Site 1, and HF researcher 2 was assigned to Site 2. The individual interview notes were transcribed into MS Word Documents. The researchers clarified any anomalies and/or missing data for specific questions, with the lead nurses. Following this, the collective participant feedback for each site was recorded in one excel spreadsheet (i.e., separate worksheets for each site). The second and third phase of analysis involved HF researcher 3 only. In phase 2 analysis, the third HF researcher collated the feedback from both sites into one master spreadsheet and cleaned the data. The researcher defined a high-level coding frame, linking to the main themes of the analysis. The researcher then collated feedback from both sites and reviewed it in detail. This review was used to refine the initial coding framework. Following this, the researcher coded the data in Excel, using the revised data frame (i.e., framework which emerged from the evidence/review of data). This task was undertaken twice, to ensure intra-observer reliability. The spread sheets were compared, and the same codes were applied in all cases (100%). In the third phase of analysis, the researcher performed frequency counts in relation to the different themes of the analysis, using functions in MS Excel.

Participants were classified into one of four occupational groups – namely, 'nursing' (i.e., ward-based nursing staff), 'nursing senior/management' (nurses in management roles both ward and non-ward based), 'non-nursing clinical', and 'non-clinical' staff (e.g., cleaners, kitchen staff, porters). Each of these group interacts with patients (with different levels of frequency and personal interaction) and require PPE. However, the frequency of interaction was not elicited during the interviews. Participant feedback on the impact of COVID-19 on staff lived experience was organised into seven categories, namely care delivery, teamwork/communication, physical factors impacting on PPE use / physical impact of PPE use, working conditions/role, mental health, physical health, and social life/home-work interface. Data pertaining to the top three impacts on lived experience were further analysed in terms of a subset of staff profile factors. Data on risks when donning & doffing PPE were classified into eleven categories. Data pertaining to contributory factors to errors and risk mitigation were categorised into organisational and individual levels.

The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the School of Psychology, Trinity College Dublin. All field research was conducted in accordance with COVID 19 health and safety guidelines.

Results

In total, 45 interviews (Site 1: 25; site 2: 20) were conducted. Most participants were female (n = 39, 87%) with 19 (42%) in the 25 to 35 age range group, seven (15%) under 25 years, six (13%) 36–45 years and 13 (28.8%) over 45 years. Half were nursing staff (n = 23, 51%) and the majority were primarily ward/unit based (n = 39, 55%). Six staff covered more than one ward. A third (n = 15) had less than five years' experience, with 14 (31.1%) over 20 years' experience. (Table 1) All participants had received PPE training, 21 (46%) in the previous six months. All had previous experience of wearing PPE before COVID-19, with 34 (76%) having previously worn the full range of PPE including FFP-2 respirators, 11 (86.6%) had not. Twenty-five (56%) participants were currently using a buddy system for PPE donning and doffing.

Table 1
The top three effects of the COVID-19 pandemic on the lived experience of 45 Irish healthcare staff at two clinical sites in relation to staff profile.

Impact of COVID-19 on staff lived experience[1]				
	N (%)	Social Life & Home/Work Interface	Mental Health (Anxiety/ Stress/Fear)	Physical Factors[2]
Total Participants	45 (100%)	36 (80%)	19 (42%)	15 (33%)
Nursing	9 (20%)	9	3	4
Nursing – Senior / Management	14 (31%)	14	8	4
Non-nursing clinical	12 (27%)	12	4	4
Non-clinical	10 (22%)	10	4	3
Time in Occupation				
• 0–5 years	15 (33.3%)	11	4	3
• 5–10 years	11 (24.4%)	11	4	7
• 10–20 year	5 (11.1%)	5	2	0
• >20 years	14 (31.1%)	9	9	5

1 Participants were asked an open-ended question on the impact of COVID-19 on their lived experience. Some participants referred to one impact area, while others referred to multiple areas, hence the % is > 100%.
2 Physical factors impacting on use of PPE & physical impact of using PPE.

The lived experience of COVID-19 impacted most on social life/ home-work interface (80%) and mental health (42%). (Table 1). Other aspects included physical factors impacting on use and physical impact of PPE use (n = 15, 33%), effects on care delivery (n = 13, 28%), teamwork and communication (n = 10, 22%), working conditions and/ or role (n = 9, 20%) and physical health impacts (n = 2, 4%). The impacts on social life and the home/work interface were frequently cited by all staff groups, although more so in staff without experience of full PPE pre COVID-19 (10/11 91%, vs 26/34 76%). Almost half (48%) of nurses reported mental health impacts. Senior/management nurses (8/ 14, 57%) and staff with over 20 years' experience (9/14, 64%) reported more mental health issues (8/14, 57%) than other groups. (Table 2) Prior PPE experience made little difference to reported mental health (5/11, 45% without PPE experience vs 14/34, 41% with prior experience).

Examples of quotes from participants included:

"I used to get headaches from being stressful. Was so exhausted. Stressful because I have vulnerable people at home."
"Hugely terrifying. I was fearful if I bring it to my home. Fear regarding causing harm to immediate family and huge risks involved. Get very upset when patients are dying - they have no visitors."
"At the start I was very nervous - as time went on, it became normal. Worried about bringing it home."

Of the 15 (33%) participants who reported physical factors affecting PPE use and/or physical impacts of using PPE, those without experience of the full range of PPE made more reference to physical issues (6/11, 55%) than those with experience (9/34, 28%).

Risks when donning & doffing PPE spanned both organisational and individual factors. (Table 2). The most cited risk concerned 'knowledge of procedures' (40%), with participants providing examples of incorrect PPE use of and/or typical mistakes. Stress and not being prepared were among the joint lowest cited factors. Contributory factors to PPE errors were organisational (referred to by 35 staff, 78%) and individual (30 staff, 67%), with many staff citing more than one factor. Time pressure was the most cited factor overall (n = 15, 43%), followed by staffing pressures (n = 10, 29%), equipment design and quality (n = 6, 13%) and training/education (n = 5, 11%). Two staff cited patient volumes, with one staff citing lack of PPE a buddy and no anteroom respectively. Being rushed and competency were the most frequently cited (both n = 9, 30%), followed by stress (n = 5, 17%), anxiety/fear and not being prepared (both n = 3, 10%). Two staff cited distraction, with one person citing each of the following -; exhaustion/fatigue, morale, complacency, taking chances and discomfort.

Table 2
Donning and doffing personal protective equipment (PPE) risks reported in interviews with 45 Irish healthcare staff at two clinical sites.

Category/Type	Number (%)	Examples
Knowledge of procedures & competency	18 (40%)	Not aware of procedure. Forgetting procedure. Not following procedure/using incorrect technique: not using correct sequence of steps, not tying apron or sealing mask properly, accidental touching of objects in environment, touching face, contamination of hands, contaminating environment with PPE, other STAFF popping head into room and not wearing PPE
PPE quality and availability	14 (31%)	PPE quality & breaks. Availability of PPE. Equipment and fit (gloves/apron not fitting). Googles/mask steaming up
Time availability	4 (8%)	Staff rushing/speed, time availability and pressure
Physical side-effects	4 (8%)	Dehydration, general discomfort, sores, heat, redness, headaches
Infrastructure	3 (6%)	No anteroom
Task difficulty	3 (6%)	Steps hard to understand, complex task
Distraction	3 (6%)	Distraction (general, patient interaction, patient demands)
Risk of contamination from environment	2 (4%)	PPE becoming contaminated from environment (not clean), risks from environment
Not being prepared	1 (2%)	
Stress	1 (2%)	
Difficulties in communication/ coordination	1 (2%)	Interaction with colleague made difficult with PPE

Regarding reducing risks, 30 (66%) staff cited interventions that were organisational/ system-level and 16 (35%) individual-level interventions. At an organisational level, the most frequently cited interventions were training and education (n = 12, 40%), followed by equipment availability/design/quality (n = 8, 27%) with increased staffing levels and buddy system cited by six staff each (20%). Provision of checklists and task aids were cited by three with infrastructure/ anteroom improvements and patient education cited by one person. At an individual level, the practice of self-awareness and being prepared (n = 5, 31%) were the most frequently cited. Three staff stated that nothing could be done at an individual level, two cited 'keeping focus', 'taking time', 'asking for help', 'hand hygiene' and 'patient education' were each cited by one staff member. The majority (n = 35, 78%) believed it would be helpful to incorporate a mindfulness aspect into PPE practice though five were mixed or not sure, three said no and two staff made no response.

Discussion

The description of the lived experience of COVID-19 of healthcare staff provides insights into the areas most impacted by the pandemic. The initial surge in COVID-19 cases followed by the influx of non-COVID-19 related admissions, coupled with staffing demands and redeployment, IPC training requirements, and the management of a disease where new evidence emerged at an exponential rate, contributed to staff stress, fear, and fatigue. Our findings are consistent with the lived experience of staff in other centres (Villar et al., 2021; McGlinchey et al., 2021). In our study, the predominant lived experience themes (or impact

areas) pertained to the person; namely social life/the management of the home-work interface and mental health. Mental health impacts can have a ripple effect on other areas (e.g., social life and physical heath), and so the cumulative impact of mental health issues may be greater. Ward nurses have more frequent and direct interaction with patients than others, hence, it was not surprising that mental health impacts were more frequently cited by them. Nurse managers have additional responsibilities which include IPC, staffing and management of staff wellbeing, which potentially contributes to more stress, and may account for the greatest number of mental health references reported from senior/management nurses. It should be noted that most participants (39/45) were female. However, as participant numbers are small, no conclusions could be drawn regarding COVID wellbeing impacts and gender differences nor comments regarding representativeness of the workforce.

A third of participants reported physical factors impacting on PPE use, consistent with other reports (Liu et al., 2020). Wearing PPE limits social connections with patients and colleagues, which are an important part of job satisfaction and outlets for stress relief. Although most participants had prior experience of the full range of PPE use, only half used a buddy system. The most common contributory factors to PPE practice errors were reflective of a stretched workforce - namely time and staffing pressures. The majority stated that risk reduction lay principally at organisational/system-level with training and education most frequently cited. At individual level, the most frequent mitigation lay with the practice of self-awareness and being prepared. Importantly, most participants were open to the incorporation of a mindfulness aspect into PPE practice.

The design and implementation of appropriate PPE training underpins safe operational practice, protecting staff and patients from workplace-acquired COVID-19. The COVID-19 pandemic brought an intense focus on PPE training and competencies. From the outset, transmission and transmissibility of SARS-CoV-2 was much debated with resultant ever-changing IPC guidelines (Humphreys and Fitzpatrick, 2020). Updates to PPE training had to occur rapidly, so staff may not have had adequate time to learn and remember new steps, generating stress and leading to errors and a lack of confidence. When answering questions relating to risks associated with PPE use and contributing factors to errors, participants consistently reported issues pertaining to IPC training, knowledge of PPE procedures, staffing, time availability and PPE quality/availability/design. Risks spanned both organisational and individual factors, hence mitigation needs to be addressed at both levels. Participant feedback on systems contributing factors included the relationship between staffing and time availability/rushing. The most cited PPE risk was knowledge of procedures, supporting a case for ongoing enhanced IPC education and training.

PPE training alone is not sufficient. Staffing issues to manage the additional workload coupled with fatigue associated with care delivery remain a real challenge. The use of a buddy system which is also highlighted in other studies as important for IPC (Frost et al., 2020), has staffing implications. Additional resourcing is also required to support adequate breaks which could reduce the physical and psychosocial impacts of PPE use, and additional work stressors associated with caring for COVID-19 positive patients.

Being prepared and the importance of self-awareness was the joint highest cited individual level intervention to address PPE-related errors. The acceleration of PPE training and the changing practices denied staff the time needed to commit the all the steps to memory and develop confidence in their practice. This relates well to mindfulness practices and could be addressed in relation to the design of new PPE practice procedures, the advancement of PPE practice checklists and training content. The incorporation of mindfulness into operational practice is one mechanism to integrate staff health, wellbeing, and safety, and follows recommendations proposed in other studies (Gilmartin, 2016; Kiyoshi-Teo et al., 2013; Apisarnthanarak et al., 2014). In relation to PPE practice, the incorporation of a 'stop' moment before donning and doffing, and/or the incorporation of a brief mindfulness 'be prepared - do not rush' step into checklists, to support safe practice and wellbeing might be considered. Future research is required to validate this approach from an IPC and occupational health and safety perspective.

A multidisciplinary response addressing staff fears, stresses, and the risk of burnout is required (McGlinchey et al., 2021). As highlighted in our study, there are gaps in existing training from a human factors' perspective. Nearly 19% of participants felt that they could do nothing to reduce risks, indicating an opportunity to incorporate the themes of mindfulness, COVID-19 lived experience, and risk reduction at an individual level, in PPE training. Critically, training needs to address mental health impacts and the role of self-care to include coping mechanisms. This might include simple self-care practice which can be used in different contexts (i.e., in work and/or in home). Training must also signpost staff to supports and services if further help is needed.

Limitations of our study include the relatively short duration of the interviews (approx. 30 min). This was preferred to maximise participation. Potential biases in relation to recruitment are likely to include differing motivations for participation for staff experiencing varying COVID-19 impacts, biases in relation to self-reporting, potential reluctance to disclose information regarding errors and risks, and the lack of observations of actual practice (i.e., which might be used to corroborate evidence on PPE risks and errors). Strengths of this study include its prospective design, interdisciplinary staff participation which is reflective of hospital staffing mixes, and documentation of COVID-19 lived experience incorporating PPE experience using a human factors approach.

An organisational culture that promotes staff wellbeing and safe practice is key for IPC. The World Health Organisation refers to the concept of a 'healthy workplace' where both physical and psychosocial risks are managed (WHO, 2010). 'Total Worker Health' brings together all aspects of work in integrated interventions that collectively address worker safety, health, and well-being (Tamers, 2020). PPE training should address healthcare staff lived experiences and consider the incorporation of mindfulness and key organisational factors contributing to safety. Accordingly, the next phase of research will investigate (1) training in relation to the role of mindfulness in safe PPE performance, (2) human factors and risk mitigation in safe PPE performance, and (3), the design, implementation, and evaluation of a mindfulness protocol integrated in the hand hygiene task. In relation to (3), pre and post measures of wellbeing and work-related stress would be obtained (i.e., assessing effects).

Performance auditing and staff feedback should be used to identify gaps in practice. This aligns well with safety-II concepts (Hollnagel et al., 2015). Staff wellness needs to be viewed as a 'protective' factor for safe IPC. The COVID-19 pandemic has had profound impacts on staff wellbeing; in particular, social wellness, the management of the home-work interface and mental health. This in turn has implications for IPC training and practices.

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CRediT authorship contribution statement

J. Cahill: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Supervision, Project administration, Funding acquisition. **A. Kay:** Conceptualization, Methodology, Writing – review & editing, Investigation. **V. Howard:** Conceptualization, Methodology, Investigation. **B. Mulcahy:** Supervision, Project administration, Conceptualization, Methodology. **M. Forde:** Supervision, Writing – review & editing. **S. George:** Investigation, Writing – review & editing. **E. Ziampra:** Investigation. **F. Duffy:** Writing – review & editing.

G. Lacey: Writing – review & editing, Funding acquisition. **F. Fitzpatrick:** Conceptualization, Methodology, Writing – review & editing, Supervision, Project administration, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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