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TOTAL WORKER HEALTH AMONG HEALTHCARE WORKERS: THE ADVANCEMENT OF A MINDFUL HAND HYGIENE (MHH) PROTOCOL TO PROTECT AND PROMOTE WELLBEING & SAFETY

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Abstract

This paper reports on a qualitative human factors study pertaining to the specification of a new mindful hand hygiene (MHH) protocol to support safe donning and doffing of personal protective equipment (PPE) and staff wellbeing. Wellness is a protective factor for safe performance. Further, safe PPE practice starts with being prepared. A new MHH protocol for use as part of PPE donning and doffing is proposed. Further, provisional recommendations for the design of new PPE training checklists, incorporating preparedness, mindfulness, and information about potential risks are proposed. Safe practice is contingent on addressing both the individual and organisational factors which contribute to both staff wellbeing, and PPE practice errors. Healthcare organizations need to look at how health protection and promotion might be properly integrated, to support health care worker health and safety, along with patient safety.

Introduction

Human factors (HF) knowledge is applied to wherever humans work, to enhance both wellbeing and safety. As espoused in human reliability theory (Swain, 1983), it is important to understand the 'performance shaping factors' that influence the probability of human error. These include personal factors (i.e., training, fitness for work and stress), task-oriented factors, and environmental factors. The underlying causes of human error are often traced to features of the 'system design' (Reason,

1990). Accordingly, HF researchers seek to understand the systemic factors which contribute to both positive and negative performance outcomes.

Wellbeing consists of a combination of physical, psychological, and social factors - including working conditions (Engel, 1977). The Word Health Organisation (WHO) emphasise the importance of fostering and maintaining positive wellbeing and reaching ones potential, as opposed to simply preventing and managing illness (2011). In addition, functional models of health define health from a positive perspective in relation to 'unimpaired flourishing' (Misselbrook, 2014).

Work is part of our wellbeing and a key driver of health. Mental wellbeing at work is determined by the interaction between the working environment, the nature of the work and the individual. Work has an important role in promoting psychological wellbeing (NICE, 2009). However, it can also have negative effects on mental wellbeing, leading to stress.

Staying in good physical and mental health is essential to the response and management of Coronavirus Disease (COVID-19 (Smith, 2020). The COVID-19 pandemic has had a significant and disproportionate impact on the health and wellbeing of healthcare workers (HCWs) (Sim, 2020; Li et al, 2021). Up to 30% infections can be attributed to healthcare workers (HCW), with up to 1% of the whole work force affected (Barycka et al, 2020).

Infection prevention and control training along with safe PPE practice plays a key role in preventing disease transmission in healthcare settings. Hand hygiene (HH) is a key part of PPE donning/doffing (Allegranzi & Pittet, 2009). The World Health Organisation (2009) provide guidance in relation to the appropriate hand hygiene (HH) technique for use of an alcohol-based hand rub (ABHR), and/or handwashing at a sink. Donning and doffing of PPE can be stressful for HCWs with considerable fear regarding personal safety. Recent studies have highlighted the prevalence of stress, anxiety, and burnout for HCWs (Li et al, 2021). The risk of disease transmission, HCW fears of infecting family and household members, and increased workload is likely to be associated with poorer mental health (Smith, 2020; Smith, Oudyk, Potter, Mustard, 2020). A small number of qualitative studies focus on the lived experience of using PPE (McGlinchey et al., 2021; Hignett et al, 2021). Hignett et al (2021) highlighted issues associated with availability of PPE equipment, PPE fit and comfort, and PPE design. McGlinchey et al (2021) identified specific challenges associated with the lived experience of PPE. These include, navigating new occupational challenges, maintaining mental health and wellbeing under unprecedented circumstances, and managing feelings of being misunderstood and undervalued.

Brief mindfulness techniques have been proposed in healthcare to manage stress pertaining to the impact of work stressors on HCW wellbeing and performance (Gilmartin et al, 2017). Potentially, self-care (brief mindfulness step) might be included in PPE practice, to support HCW wellbeing and mental health. From a behaviour change perspective, the least burdensome way to introduce a new behaviour, is to attach it to another behaviour (Wood & Neal, 2016). Accordingly, mindfulness might be attached to HH.

This paper reports on a qualitative HF study pertaining to the lived experience of HCWs using PPE during the COVID-19 pandemic, contributory factors to PPE practice errors, hazards associated with PPE usage and associated mitigations, and the specification of a mindful HH protocol to support safe performance of the PPE task and HCW wellbeing. This research was undertaken as part of the PPE Safe project funded by the Science Foundation Ireland (SFI).

Background

PPE & Infection Prevention & Control

The use of PPE is a primary strategy to prevent transmission of infectious agents in healthcare settings. The purpose of PPE is to protect the wearers from infection, keeping both staff and patients healthy and safe. Infection prevention and control guidance applies to all settings where healthcare is delivered. The Centre for Disease Control and Prevention (CDC) distinguish standard precautions and

transmission-based precautions (Siegel et al, 2007). Transmission-based precautions are used in addition to standard precautions when caring for patients who may be infected or colonised with certain infectious agents for which additional precautions are needed to prevent infection transmission. PPE is usually used as part of transmission-based precautions and depending on the infectious agent can consist of combinations of glove, gown and mask use. Given the potential risk of pathogens being transferred from the PPE to the bodies of healthcare workers (HCWs) during the doffing process, there is a large focus on the doffing task (Mumma et al, 2018; Phan et al, 2019). A 2019 CDC study found that 90% of observed doffing was incorrect, with respect to the doffing sequence, doffing technique, or use of appropriate PPE, resulting in an increased risk of infection (Phan et al, 2019). Common errors were doffing gown from the front, removing face shield of the mask, and touching potentially contaminated surfaces and PPE during doffing.

Fitness for Work & Operational Readiness

'Fitness for Work' refers to a state of physical and psychological health and wellbeing, which enables a worker to perform assigned tasks, reliably, safely, and effectively, and in a manner, which does not affect their safety and/or the safety of others.

COVID & HCW Wellbeing & Mental Health

The COVID-19 pandemic is having profound impacts on the health and wellbeing of HCWs (Sim, 2020). Recent studies have found that strengthening employer-based infection prevention and control strategies is likely to have important implications for mental health symptoms among healthcare workers (Smith, Oudyk, Potter, Mustard, 2020). As argued by Smith (2020), it is important to identify workplace factors linked to mental health that can be changed. While PPE and infection prevention and control procedures are often discussed as measures to reduce virus transmission, we also need to understand their importance in the context of HCW mental health. This is especially important, given that the mental health impacts of COVID-19 may continue beyond the pandemic (Smith, 2020).

Mindfulness & Compassion

Mindfulness is described as a "systematic approach to developing new kinds of control and wisdom in our lives, based on our inner capacities for relaxation, paying attention, awareness, and insight" (Kabat-Zinn, 2011). Mindfulness has been established as a useful preventative strategy in relation to the management of work-related stress (WRS), burnout, trauma, and PTSD (Gilmartin et al, 2017).

Mindfulness training is an evidence-based approach to increase situational awareness and positive responses to stressful situations and has been used for stress reduction and building resilience for HCW (Mulcahy, 2019). Mindfulness has a lot to offer HCW in relation to their personal and professional lives. It can be used to reduce stress and build resilience to avoid vocational fatigue and burnout.

Although the practice of nursing is grounded in clinical competence, it is also deeply embedded in the experience of compassion-based relationships (Halifax, 2013). According to Halifax, a deficit of compassion impacts nurse well-being, patient and family satisfaction, and the frequency of nursing errors (2013). To this end, Halifax proposes the 'G.R.A.C.E.' model of mindfulness (2013). The G.R.A.C.E. model has five elements:

1. Gathering attention: focus, grounding, balance.
2. Recalling intention: the resource of motivation.
3. Attuning to self/other: affective resonance.
4. Considering: what will serve.
5. Engaging: ethical enactment, then ending.

Accordingly, the 'G.R.A.C.E.' mnemonic invites the caregiver to slow down and be more mindful and aware in the process of interacting with the patient, so that compassion can arise. The objective is twofold; to support nurses working in stressful situations and to prime compassion (Halifax, 2013).

Recently, the 'G.R.A.C.E.' model has been adapted to support stress management for nurses in cardiac care (Mulchay, 2019).

Healthy Workplace & Total Worker Health

Health care settings need to be a healthy and safe space for employees. Employers have a duty of care to ensure that staff are adequately trained to perform their duties and that the working environment is safe. In explaining this, the World Health Organisation (WHO) refer to the concept of a 'healthy workplace', which is defined as a workplace in which both physical and psychosocial risks are managed (WHO, 2010). Total Worker Health is defined as policies, programmes, and practices that integrate protection from work-related safety and health hazards with promotion of injury and illness-prevention efforts, to advance worker well-being (Tamers, 2020). Overall, the objective is to protect the safety and health of workers and advance their well-being by creating safer and healthier work.

Methods

Introduction

This HF study involved the participation of HCWs at three clinical sites, and a panel of experts. The three hospital sites included Bon Secours Hospital (Cork, Ireland), Beaumont Hospital (Dublin, Ireland), and Tallaght University Hospital (Dublin, Ireland). The Bon Secours Health System Cork (site 1) 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. Beaumont Hospital (site 2) is an 820-bed tertiary referral adult public hospital in Dublin, Ireland, with the National Referral Centre for Neurosurgery and Neurology, Renal Transplantation, and Cochlear Implantation. It also provides emergency and acute care services to the local adult catchment area of 290,000 people. Tallaght University Hospital (site 3) is one of Ireland's largest acute teaching hospitals, providing child-health, adult, psychiatric and age-related healthcare.

The HF approach has involved building an evidence map in relation to the lived experience of HCW during COVID, the contributory factors to PPE practice errors and their mitigations, the case for mindfulness and the preliminary requirements for a mindful HH protocol. A combination of HF action research methods was used – including stakeholder interviews (Cooke, 1999) and participatory co-design and evaluation with stakeholders (Bødker, Kensing & Simonsen, (2004).

Table 1 provides an overview of these methods and the numbers of participants involved in each phase across the three clinical sites and expert panel. The study was conducted in accordance with the Declaration of Helsinki, and the study 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.

Participants were eligible for inclusion if they were (1) over 18 and (2) HCWs currently working at one of the three clinical sites during the COVID-19 pandemic. This included, but was not limited to, doctors, nurses, health care assistants, porters, radiographers, and other frontline health care staff. Participants were recruited directly by the lead nurse at each hospital site. In addition, participants were recruited outside the 3 sites. These other participants were recruited directly by the human factors team at Trinity College Dublin (TCD). Participants who expressed an interest in taking part were provided with a participant information leaflet (PIL) and consent form. Once consent was established, an interview was arranged and conducted on site, at the participant's convenience. Interviews were conducted by one member of the research team (nurse lead). The interviews were analysed by a HF researcher.

Table 1: Summary of research phases & research across different clinical sites.

Phase	Method	Total # Participants	Clinical Sites (Project)			Expert Panel
			1	2	3	
1	Problem space interviews	45	21	24	0	0
2	Scoping preliminary mindfulness technique	2	2	0	0	0
3	Co-design & evaluation of mindful HH technique (via poster)	43	2	11	17	13
Total		**90**				

Phase 1

Interviews were undertaken with N=45 HCWs from site 1 and site 2. A semi-structured interview approach was used. Interviews were undertaken during September to November 2020. All raw data obtained from participant interviews at both sites was transcribed and cleaned. Participants were classified into one of four occupational groups. These are: clinical nurse, clinician nurse/senior, other clinical, non-clinical. A subset of participant survey feedback was analysed in more detail using a coding framework/data frame that emerged from the evidence (Saldana, 2015). This included data pertaining to the following themes: lived experience and impacts, hazards, contributory factors to errors, hazard prevention, use of buddy system and acceptability of embedding mindfulness in the HH protocol. In relation to participants lived experience, the raw data was coded in relation to different impacts – including role, physical, mental health, social life and home/work interface, teamwork, and care delivery. Hazard data was classified in relation to 8 types (see Appendix 1). Data pertaining to contributory factors to errors were classified according to different levels (i.e., organisational and/or individual level), and then further classified according to type. Data pertaining to error prevention were similarly classified. In addition, data pertaining to the three top impacts on lived experience - namely (1) impact on social life and home/work interface, (2) impact on MH and (3) physical impacts of using PPE/physical issues impacting on use of PPE were further analysed in terms of a subset of HCW profile factors. These were occupational group, overall time in occupation, and prior experience of full PPE.

Phase 2

The high-level concept for the technique was scoped with 2 HCWs and mindfulness experts from Site 1 (Bon Secours Hospital). This took the form of two participatory workshops. The workshops were attended by two HCW/mindfulness experts from Site 1, the lead nurse researcher from Site 1, and three human factors researchers (i.e., human factors research team at TCD) As part of this, the emerging protocol was specified, documented, and refined. In the first workshop, a provisional protocol was defined for both handwashing at sink, and HH with gel. After the first workshop, the human factors research team produced posters which outlined the steps for both mindful handwashing at a sink, and mindful hand hygiene using gel (i.e., MHH). The posters used a combination of text and graphics, and in particular, the WHO imagery for the handwashing and hand hygiene techniques. These were reviewed by the HCW at Site 1, in advance of workshop 2. Workshop 2

focussed on the procedure for mindful hand hygiene using gel (i.e., MHH) in more detail. The poster was reviewed and refined further.

Phase 3

The specific mindful HH protocol was evaluated with 43 participants (Table 2), comprising participants from Site 1, 2 and 3 and an additional panel of mindfulness experts and HCWs (N=11). The protocol was evaluated via a poster which outlined the mindful HH steps. Three stages of co-design/evaluation were undertaken, involving the iterative refinement of the mindful HH protocol and associated poster. In the first stage, a series of co-design evaluations with HCW and mindfulness experts was undertaken (n=11). The protocol was then refined considering participant feedback. In the second stage, the protocol and associated poster presentation was evaluated with HCWs and mindfulness experts from Site 1 (n=2), and HCW from an expert panel (n=2). Participants were asked to evaluate the protocol itself, and the communication of the protocol (i.e., graphical poster). Following feedback, the protocol and poster design was further refined. In the third, the emerging protocol was evaluated with HCWs from site 2 (n=11) and site 3 (n=17).

Table 2: Breakdown of Phase 3 research across different clinical sites and expert panel

Phase	**Method**	**Total # Participants**	**Clinical Sites (Project)**			**Expert Panel**
			1	**2**	**3**	
1	Codesign phase 1/ poster review	11	0	0	0	11
2	Codesign phase 2/ poster review	4	2	0	0	2
3	Codesign phase 3/ poster review	28	0	11	17	0
Total		**43**				

Results

Phase 1: Problem Space Interviews

In total, 45 interviews (Site 1: 25; site 2: 20) were conducted. Most participants were female (n=39, 87%), in the 25 to 35 age range (n=19, 42%), from nursing staff (n=23, 51%) and working on the ward (n=25, 55%) (Table 1). A third of HCWs had less than five years' experience with another third over 20 years. All had received PPE training. All had previous experience of wearing PPE prior to COVID-19 with 34 (76%) having previously worn the full range of PPE and 11 (24%) had not. Twenty-five (56%) participants were currently using a buddy system for PPE donning and doffing.

Participants were asked an open-ended question as to impact of COVID-19 on their lived experience. Some referred to one impact area, while others referred to multiple areas. As indicated in Figure 1, participant feedback was organised in relation to seven high level impact areas. These are: social life and home/work interface, mental health, physical factors impacting on PPE use and/or physical impacts of using PPE, care delivery, teamwork and communications, physical health, and working day/conditions. Each impact area was further classified in relation to either self/personal or

person in work/work. The most frequently cited impact was 'impact on social life and home/work interface' – with 80% of participants referring to this. The three most frequently cited impact areas pertain to the person - namely impact on social life and home/work interface (80%), impact on mental health (42%) and physical impacts of using PPE/physical factors impacting on use (33%). Nearly half of those interviewed (42%) referred to MH impacts.

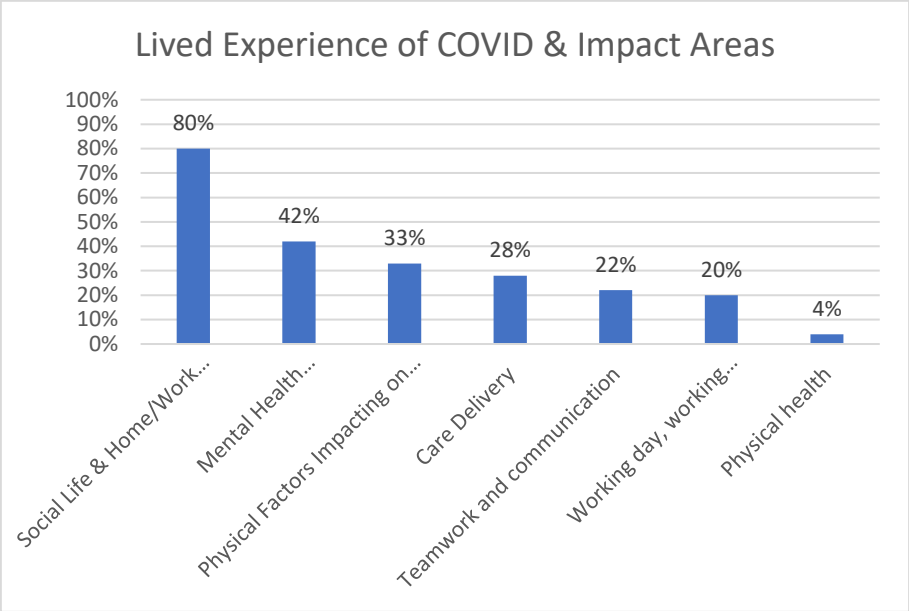

Figure 1: Lived Experience of COVID & Impact Areas

As demonstrated in Figure 2, impacts on social life and the home/work interface were frequently cited by all groups, with the most citations by junior nurses (100%). Of the three high level roles categories (i.e., nurses all, clinical other, non-clinical), nurses made most references to impact on social life and home/work interface (82%), with similar frequency levels.

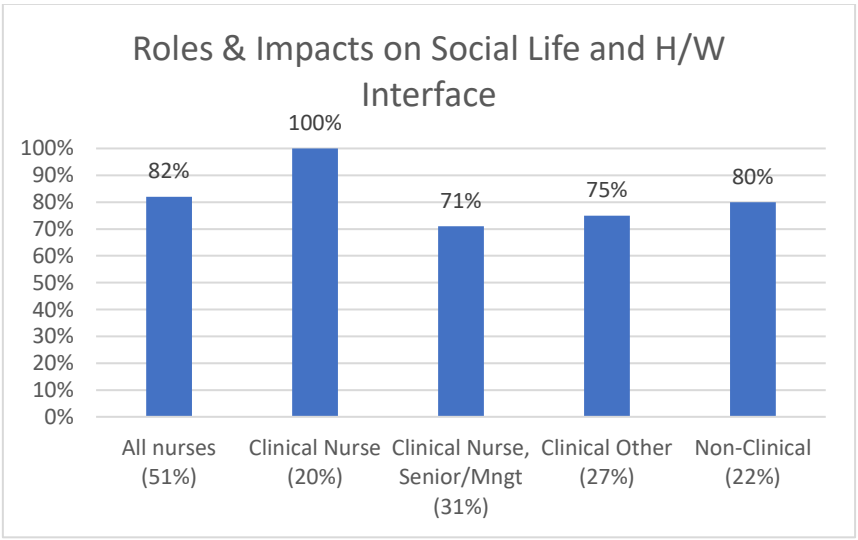

Figure 2: Role & Social Impacts

Those with '5 to 10' and '10 to 20' years of experience referenced this impact area more than others (both at 100%). Those with 'over 20 years' experience made the least number of references (64%). Those who did not have experience of full PPE prior to COVID (N=11) made more references to impact on social life and H/W interface (91%), than those that had (N=34) (76%). As indicated in Figure 3, 45% of participants (N=19) referred to impact on MH – referring to the experience of anxiety and stress.

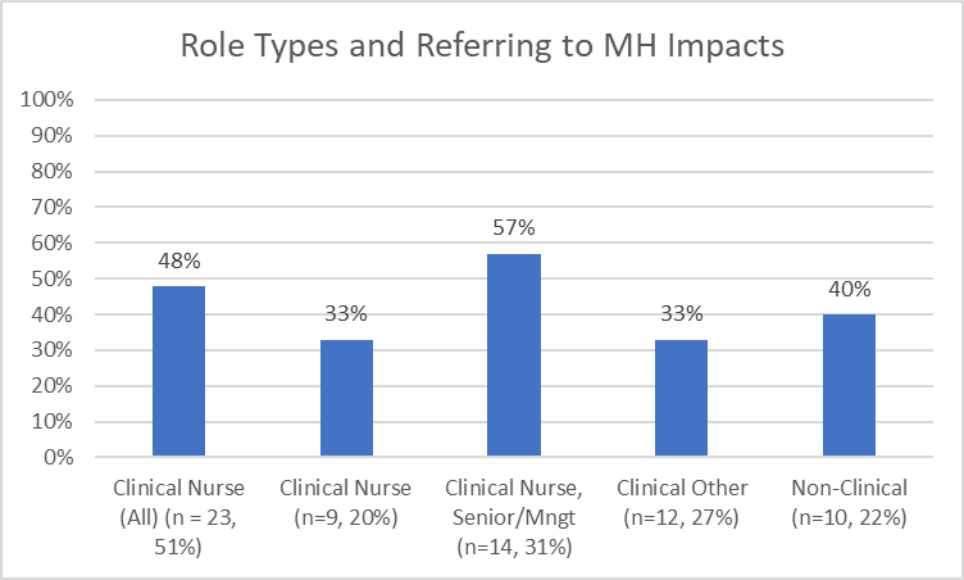

Figure 3: Role & MH Impacts

HCWs with 'over 20 years' experience referred to MH impacts more frequently (n=14, 64%) than those with 0 to 5 years' experience (n=15, 27%), 5 to 10 years' experience (n=11, 44%), and 10 to 20 years (n=14, 40%). Lastly, those who did not have experience of full PPE prior to COVID – made marginally more references to MH impacts (45% compared to 41%). 33% (n=15) of participants reported physical factors impacting on PPE use and/or physical impacts of using PPE. Participant feedback in relation to physical factors impacting on PPE use and/or physical impacts of using PPE, was further analysed in relation to role, time in occupation and prior experience of full PPE. Not all HCWs were impacted equally. The Clinical Nurse group (i.e., junior nurses) reported the highest proportion of references to physical impacts (44%). However, the combined nursing group (i.e., clinical nurse and senior nurses/nurse managers) was within a similar range to the two other groups – with all (35%), clinical other (33%) and non-clinical (30%).

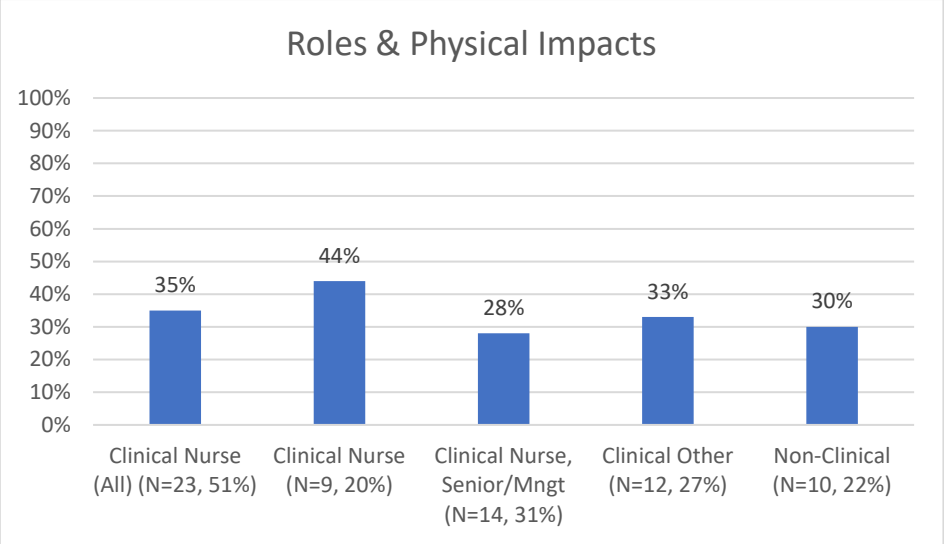

Figure 4: Role & Physical Impacts

Those with '5 to 10 years' experience reported the highest number of references to physical factors. There was no obvious trend with age and physical factors impacting on use and/or physical impacts of PPE. Physical factors impacting on PPE use and/or impacting on PPE use were not referenced more frequently by either younger or older cohorts. Those who did not have experience of PPE prior to COVID-19, made more reference to physical impacts than those who had prior experience (55% versus 28%). However, the numbers were small here, and it is hard to generalize.

Many participants referred to one or more hazards. Hazards were classified in relation to eleven high level categories (see Appendix 1). As indicated in Figure 5, the top three reported hazards were: knowledge of procedures (40%), PPE quality and availability (31%), and rushing/time availability and physical impacts (both at 8%). Stress and not being prepared were less frequently cited.

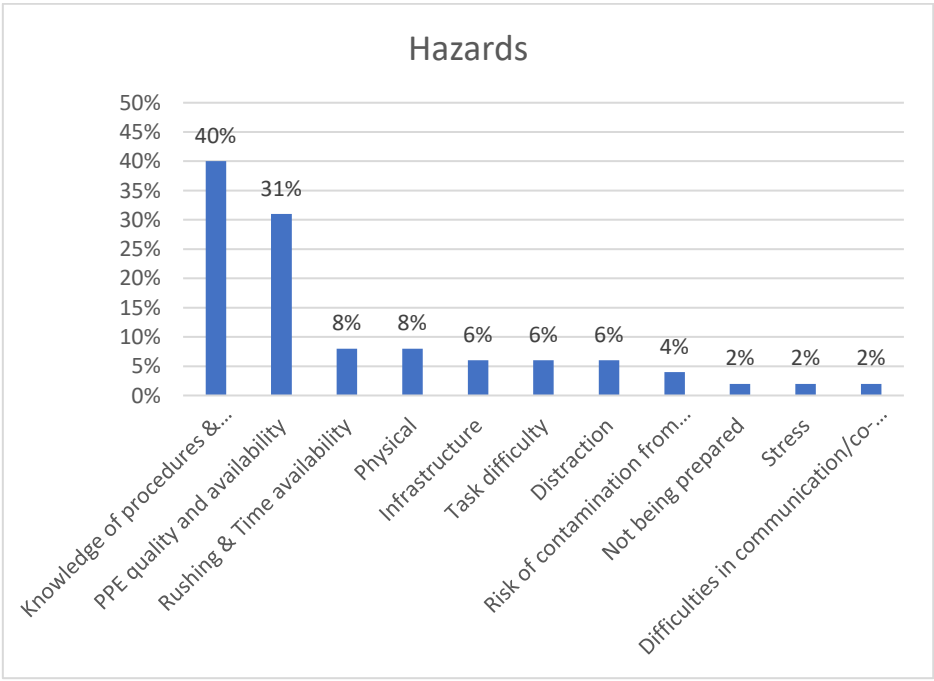

Figure 5: Hazards

Contributory factors (CF) were classified into one of two high level types - organisational and individual CF. Overall, 78% participants (N=35) referred to one or more CF that were classified as organisational, while 67% participants (N=30) referred to one or more factors that were classified as individual. In relation to organisational factors, the most cited was time pressure (43%), followed by staffing (29%) and then equipment design and quality (13%). In relation to the individual level, rushing and competency were the most frequently cited (both 30%), then stress (17%), and then anxiety/fear and not being prepared (both 10%).

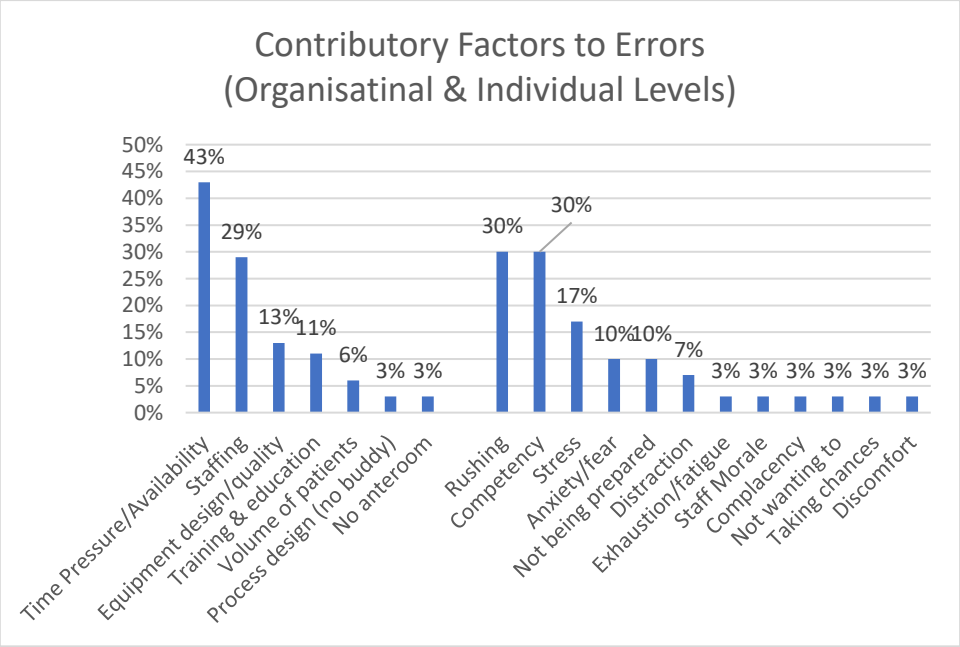

Figure 6: Contributory Factors to Errors – Organisational and Individual Levels

Participants were also asked open question about how hazards might be prevented. Some participants referred to interventions classified as organisational or individual, while others referred to examples of both. 66% referred to interventions at an organisational level, while 35% referred to interventions at an individual level. Systems level interventions featured more than individual level (65% versus 35%). Interventions pertaining to training and education featured as the most cited intervention across both levels (referred to by 40% of participants). The most frequently cited organisational intervention was training and education (40%), then equipment (27%) and then both staffing (20%) and process design/buddy system (20%). 10% referred to the use of checklists and task aids. At individual level, the practice of self-awareness (31%) and being prepared (31%) were most frequently cited. Of concern, 19% of participants reported that they did not think they could do anything to prevent hazards.

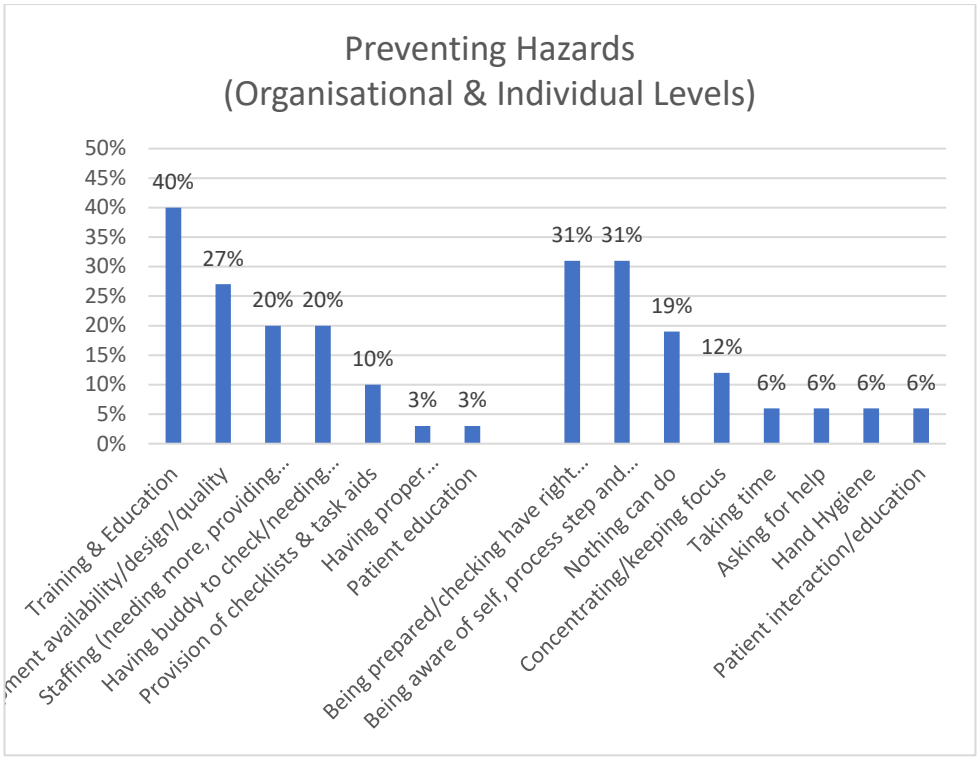

Figure 7: Preventing Hazards

Participants were asked if they thought that it would be helpful to incorporate a mindfulness aspect into the PPE practice, to address HCW wellbeing. 78% (N=35) said yes, 11% (N=5) were mixed or not sure, 7% (N=3) said no and 4% (N=2) made no response.

Phase 2: Specification Mindful Hand Hygiene (MHH) Technique

Both participants were female, working in senior nursing roles and were mindfulness experts.

It was agreed that mindfulness training would features as part of a broader training package supporting HCW self-care. The training would be underpinned by a 'storytelling' approach which places an emphasis on compassion for oneself and for the patient. Such an approach is in keeping with the GRACE model (Halifax, 2014). Given the differences in both handwashing (HW) and hand hygiene (HH) procedures, it was suggested that each method would require a specific mindfulness protocol. On some occasions, HCWs may be able to choose between using gel or handwashing at a sink. Participants noted that there are greater opportunities for mindfulness with handwashing. As such, HCWs might be encouraged to consider mindful hand hygiene (MHH), where possible.

Participants noted that MHH might be integrated with the PPE donning and doffing task. MHH would help with HCW preparedness. As reported by one participant, it would serve to 'ground the person'. This in turn would contribute to improved safety. Further, MHH would be useful to ground the person if a mistake/error was made. In this case, the HCW might perform MHH as opposed to HH. Further, it was noted that this mindfulness approach might be used at other times during the day. For example, at the two golden moments (i.e., start and end of the day) and the WHO 5 moments for HH. Participants noted that not all HCW would be familiar with mindfulness and its benefits. It was suggested that the poster itself might include background information about the purpose and benefits of mindfulness. In this case, mindfulness should be characterized as a 'preventative self-care approach'.

Participants agreed that the technique should commence with 'STOP'. This encourages the HCW to move out of 'auto-pilot', to take a break and bring awareness back to the present moment. It was

agreed that the mindfulness protocol should be integrated with the WHO HH steps. This might be achieved by the inclusion of a simple visual which demonstrates the WHO step and mindfulness as part of it.

Participants highlighted the need to adapt mindfulness concepts for the hand hygiene task. It was suggested that this combine both a breathing approach (i.e., bringing attention to the breath) and body scanning (i.e., focus on sensations in hands and fingers). The protocol was defined and reported as a series of steps linked to WHO HH steps. The initial iteration of the MHH technique involved a focus on breathing and body scanning and was based on a prior mindfulness protocol developed by the team from Site 2.

Phase 3: Feedback on Mindfulness Protocol & Implementation

Phase 3 research was structured in terms of three phases of research/co-design with stakeholders spanning sites 1, 2 & 3, and the expert panel (see Table 2). Most participants were female (n=32, 74%), working in healthcare (n=38, 88%), in a nursing role (n=29, 67%) and had some experience of mindfulness (n=28, 65%). Most participants had a positive attitude to mindfulness (37, 86%). 7 of the 43 participants (16%) were characterised as mindfulness experts.

The first stage involved an evaluation of the first iteration of the MHH technique and allied poster, with 11 HCW and mindfulness experts, recruited outside sites 1, 2 & 3 (see Table 2). All participants were positive about the potential application of mindfulness as part of the HH task (n=11, 100%), and the need to promote self-awareness (n=7, 64%). Most were concerned about the complexity of the mindful HH technique (n=9, 82%). Participants perceived the body scan as a useful tool for mindfulness, enabling HCW to focus on their task (i.e., HH). As reported by participants, the combination of body-scanning and breathing might be too complex and potentially, interfere with the HH task. To this end, participants recommended a simplification of the technique to focus on the sensations in hands and fingers only (i.e., body scanning) – that is, adapt the mindfulness technique to the actual task. Most participants (n=8, 73%) emphasized the importance of the STOP step. That is, the need to pause and ground oneself, before commencing the mindful HH. Over half (n=7, 64%) highlighted that the poster was text heavy and required simplification, to enable HCW to simultaneously (and easily) read the instructions and practice the technique. Following the first phase of evaluation, the protocol was simplified to focus on the sensations in the hand and fingers only. The WHO Steps description was removed, but the MHH protocol description was retained.

A second round of co-design was then undertaken with two participants from Site 2 and two participants from the expert panel (see Table 2). All participants felt that the body scanning protocol was suitable for the HH task (n=4, 100%), and felt that breathing was not required (n=4, 100%). It was agreed that the mindful HH technique should focus on self-awareness (n=4, 100%). This should also be communicated in the text information provided in the poster. Participants agreed that the focus should be on the hands (n=4, 100%). It was agreed that the images depicting the WHO steps were sufficient, and that an additional text description was not required (n=4, 100%). All participants agreed that the text description should outline the MHH step only (n=4, 100%). All participants agreed that it is important to integrate the MHH protocol with the WHO HH steps (n=4, 100%). As reported by one participant, 'this brings your attention to 'what you are doing'. All participants liked the STOP moment (n=4, 100%) and felt that the poster should give visual priority to this message.

The protocol and poster were further refined, and a third stage of co-design/evaluation was undertaken with HCW at two hospital sites (site 2 and 3). Overall, there was high levels of acceptance for the MHH protocol. Most participants responded very positively to incorporation of mindfulness in HH task (n=24, 86%). Participants agreed that the practice of self-care through MHH promotes safety. Being present in the moment/focused attention, introduces a sense of calm and contributes to safe performance. Feedback from participants included the following:

- "It is great to focus on the start of the day".
- "It's a good idea to find some time for own wellbeing."

- "It's a great idea to let all your stress go out."
- "Good. I feel more confident to start on another patient."
- "This is great to prepare for my journey home".

The majority felt that it was appropriate to integrate the MHH with the WHO HH steps (n=23, 82%). Specifically, it was agreed that the graphic would display the WHO step, while the text who describe the mindfulness step in relation to the WHO step (i.e. integration of WHO step and mindfulness task). Over half felt that it was a good idea to show the actual WHO steps (either text or graphic) – (n=18, 64%). In relation to the poster design, over half (n= 17, 61%) felt that that there was a lot of text information on the poster. Over half of the participants reported that HCW might not have time to read the text while working (n= 17, 61%). However, from a training perspective, the poster was viewed as very effective by all but one participant (n=26, 93%). Nearly a third of participants rated the mindfulness steps as the most useful section of the poster (n=9, 32%). A quarter of the participants rated the STOP section as most useful (n=7, 25%). Overall, participants expressed a strong interest in learning the MHH technique (n=25, 89%), with 24 participants (86%) stating that they would personally learn the MHH technique. Most suggested that the poster should be displayed at HH facilities and/or over sinks (n=23, 82%). Approximately a quarter referred to time as a key barrier to HCW adoption/use of the MMH technique (n=7, 25%). A small number suggested that IPC procedures might be a barrier (n=4, 14%). It was noted that the training information should be appropriate for a full range of users (i.e., from novices and experts). Training information should include the proven impact of mindfulness in other healthcare settings. Further, participants observed that successful implementation would depend on organisational commitment to worker wellness, staff safety and patient safety. Following the evaluation, the poster was further simplified to exclude any background information about the purpose and benefits of mindfulness. An example of the final protocol and poster is shown in Appendix 2.

Embedding Mindfulness in Operational Practice to Promote HCW Health, Wellbeing & Safety

Proposed MHH Protocol

MHH is conceived as an integrated stress management and safety intervention. Mindfulness is used to focus HCWs on the correct procedure for HH, along with addressing psychosocial dimensions (i.e., stress and anxiety). The objective of the MHH task is to perform the HH task 'mindfully'. This is characterized as an 'awareness of the sensations of hand hygiene'. The proposed technique attempts to operationalize values in relation to self-care. In keeping with the GRACE model (Halifax, 2014), the emphasis is on compassion for oneself and for the patient. There are different opportunities for MHH. MHH can be integrated with the WHO 5 moments for HH and/or the golden moments. In addition, MHH can be used as part of PPE donning and doffing, and if errors arise (i.e., to reset).

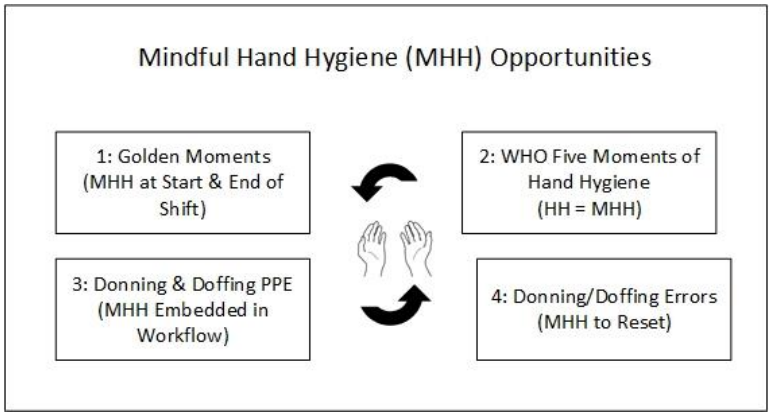

Figure 8: Opportunities for MHH

The WHO HH technique becomes the fundamental flow structure for the meditation/mindfulness exercise - bringing the HCW attention to the moment. It is expected to take 20 to 30 seconds. The practice commences with the STOP moment. HCW are invited to

- S: Stop
- T: Take a Deep Breath
- O: Observe and Acknowledge what is Here Right Now (feelings & emotions)
- P: Proceed with the task of Hand Hygiene - allowing this 20-30 second to be an opportunity to step away from autopilot and allow for a moment of self-care and self-awareness

The eight MHH steps are designed to focus HCW attention on sensations in the hands and fingers – linking to body scanning techniques.

1. Noticing the feel and texture of the gel as it touches the Palms
2. Bringing awareness to the feeling of the Palms as they touch one another
3. Noticing the sensation in the Fingers as they intertwine
4. Bringing awareness to the feeling of the intertwined fingers
5. Allowing the awareness to come to the Clasped Hands, rotating from side to side
6. Feeling the touch of the Hands and the Thumbs together
7. Noticing the feeling in the Fingers and Palms as they rub against each other
8. Allowing the awareness return to the body as a whole. Feel your Feet rooted to the floor. Noticing what is Here Right Now

Appendix 2 provides an example of the final poster – communicating the protocol. The poster draws the HCW's attention to the fact that it is normal for the mind to wander. "The Mind may wander – that's ok… that is what minds do. Noticing the mind wandering is the moment of mindfulness".

Proposed PPE Checklists (Incorporating Preparedness, Self-care & Hazard Information)

Mindfulness might be incorporated in wider PPE performance checklists to support safe PPE practice. It is recommended that HCW wellbeing, mental health and 'operational readiness' be addressed in routine PPE practice, through the inclusion of (1) a being prepared and (2) a brief mindfulness step, at the start of both the donning and doffing task. Further, information about Performance Shaping Factors and/or hazard mitigation strategies should be embedded in the PPE checklist task steps. Critically, data obtained about hazards and PSF would be integrated in checklist design – for example, the need to not rush, the need to be prepared. Appendix 3 & 4 provides examples of donning and doffing checklists. Future research might investigate the validation of such checklists with HCW.

Discussion

Lived Experience, Impacts & Case for Mindfulness

Participant feedback concerning the lived experience of COVID-19 provides a strong case for a stress management intervention. The most reported impact areas (i.e., reflecting HCW priorities) pertain to the person – namely social life and management of the home/work interface, and mental health. It is worth noting that MH impacts have a ripple effect on other areas (for example, social life and physical heath), and so the cumulative impact of MH issues must be considered.

Hazards, Contributory Factors to Errors, Addressing Hazards & Systemic Issues

This research paints a consistent picture in relation to contributory factors to errors and hazard prevention. As indicated, errors are not simply the fault of individuals. Hazard mitigation/risk mitigation needs to be addressed at a systems level.

When answering questions relating to hazards, CF to errors and hazard prevention, participants consistently reported issues pertaining to HCW training and knowledge of procedures, staffing, time availability and PPE quality/availability/design.

More participants cited organisational factors as CF to errors, than individual factors. Further, feedback pertaining to systems level CF was consistent with that pertaining to individual level CF (for example, relationship between staffing and time availability/rushing). The most cited hazard pertains to knowledge of procedures (40%), supporting a case for enhancing education and training. Stress/MH issues was the second most frequently cited CF to errors (at individual level). Participants cited systems level interventions to address hazards, more frequently than individual level interventions. Being prepared and the importance of self-awareness was the joint highest cited individual level intervention. This relates well to mindfulness practices (i.e., calm state and readiness) and can be addressed in relation to the design of new MHH practices, the integration of MHH in PPE donning/doffing, the advancement of PPE practice checklists, and the design of general PPE training.

Addressing Stress Management & Safety

Wellness is a 'protective' factor for safe performance. Further, self-care is an important feature of wellness in work. Being prepared and the importance of self-awareness was the joint highest cited individual level intervention. Stress/MH issues was the second most frequently cited CF to errors (at individual level). HCW's have a role in term of fostering self-care and healthy work and protecting their safety. Further, healthcare organisations need to look at how health protection and health promotion might be properly integrated, to support both employee wellness and safe work.

As part of the response to the COVID-19 pandemic, resources have been put in place throughout many countries to support HCW well-being and mental health. However, many of these are still in their infancy and not all HCWs will have access to confidential listening, referral, and counselling services. This research proposes one possible avenue of integrating both stress management/wellness and safety interventions. As proposed in this research, mindfulness might be integrated in actual operational practice (i.e., performance of the hand hygiene task), to support both HCW wellbeing and safety. This approach provides an opportunity for HCWs to take time out and to pause and prepare themselves for the next task. Overall, the objective is to bolster resilience in the face of great trauma and to promote well-being and self-compassion. This is not intended to be a substitute for professional counselling services.

MHH can be characterized as an integrated approach to the management of health, wellbeing, and safety. From a stress management perspective, it is a preventative self-care approach, which enables HCW to take small periods of 'time out' for their own self-care, and to build and maintain resilience. In relation to task performance and safety, MHH helps HCW focus on the task. Further, it addresses key contributory factors to errors (i.e., not being prepared, rushing and stress), as highlighted in participant interviews. This can be conceptualized as the 'operationalization of

wellbeing' and is in line with the 'Total Worker Health' approach, which integrates health, wellbeing, and safety.

Study Limitations & Areas for Further Research

The interviews with HCWs were short (approx. 30 minutes). Potential biases in relation to recruitment must be considered. HCWs experiencing varying impacts may have varying motivations for participating in this research. Also, biases in relation to self-reporting must be considered. In relation to each site, the interviews were conducted by nurses from that hospital. In one hospital, the nurse conducting the interview was a member of the IPC team. Accordingly, staff may have been reluctant to disclose information regarding hazards and CF to errors. The numbers of HCWs participating in this research were low, with approximately half representing a nursing role. There were no observations of actual practice, to corroborate evidence on hazards and/or CF to errors. Further research is required to substantiate this picture. In addition, it is recommended that the proposals identified in this research around a new PPE checklist design be validated with HCWs. This would involve participatory co-design research with HCWs across both clinical and non-clinical functions.

This research has demonstrated the potential efficacy and acceptability of integrating mindfulness in the HH task, for the purpose of protecting HCW wellbeing (i.e., addressing HCW stress, burnout, and trauma) and promoting safety (i.e., staff and patient safety). HCWs are a heavily burdened population (i.e., high workload) and time constraints are currently an issue in relation to the performance of HH. As such, future research must address the appropriate dosing of MHH. That is, the time allocated to MHH, and how frequently this might be performed. In addition, research is required to measure the efficacy of this protocol and effect sizes. The specific application of mindfulness as part of the broader PPE donning and doffing task (i.e., hand hygiene within broader task) must also be further investigated. Lastly, HH represents just one opportunity for mindfulness. Other mindfulness opportunities should be considered too.

Conclusions

This research has demonstrated the potential efficacy and acceptability of integrating mindfulness in the HH task, to support, promote and protect HCW wellbeing and staff and patient safety. As demonstrated in this research, mindfulness complements the hand hygiene task and might be used in combination with the WHO HH technique, to bring attention to the moment. Mindfulness enables HCW to focus on the correct procedure for HH, along with addressing the need for self-care. In this way, it demonstrates a path to integrating and embedding both occupational health and safety practices in daily operations. Mindfulness is increasingly important in COVID-19 context. It provides an opportunity for self-care along with protection (staff and patient safety). Mindfulness is an inexpensive strategy to reduce stress and improve the quality of the working lives of healthcare workers. However, it is not a substitute for professional counselling services. Further research will address the validation of this protocol with healthcare workers. Healthcare organizations have responsibilities in relation to supporting healthy and safe work, supporting self-care for HCW, and ensuring a culture that promotes wellbeing. Wellness is a protective factor for effective and safe performance. Healthcare organizations need to investigate how best to integrate existing health promotion and health protection functions and activities, to optimize both staff wellbeing and safety.

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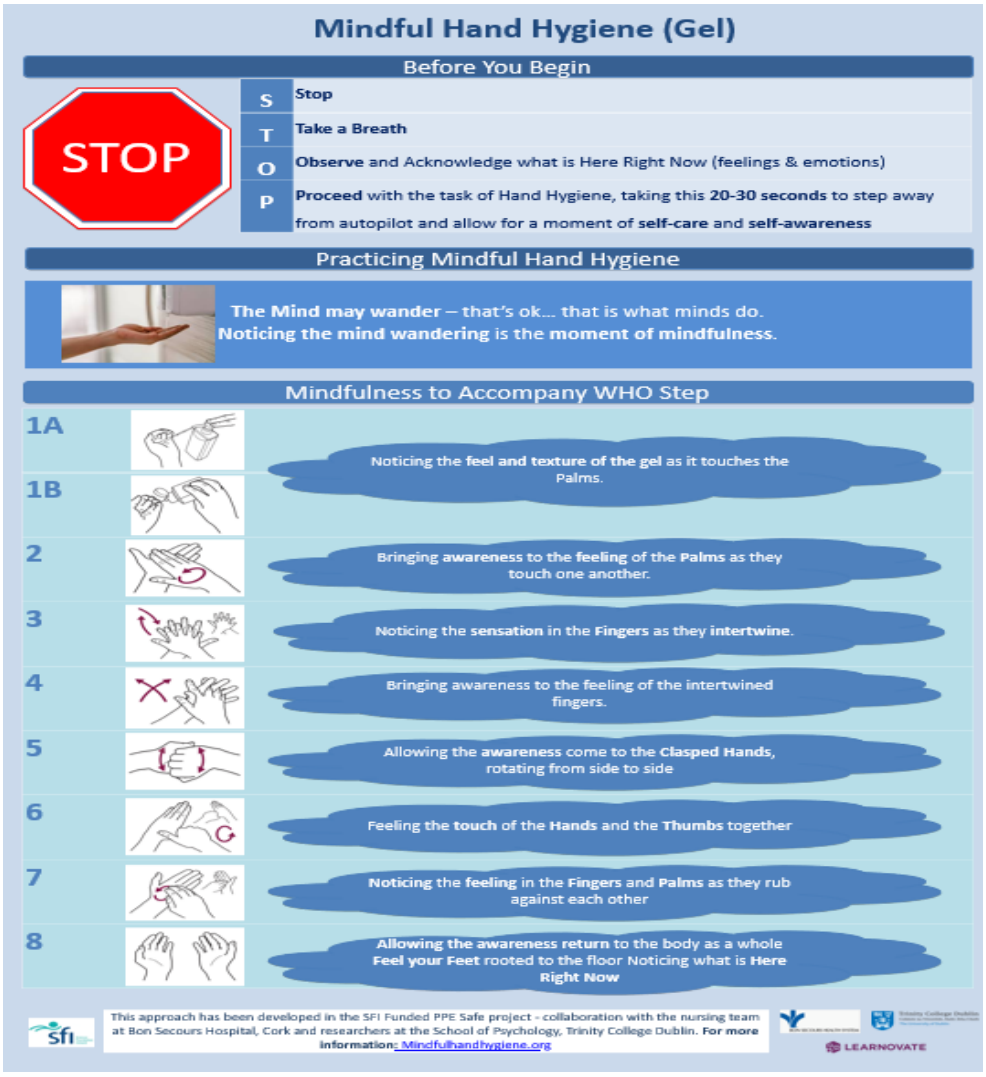
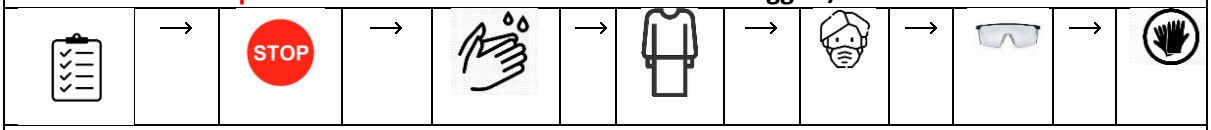
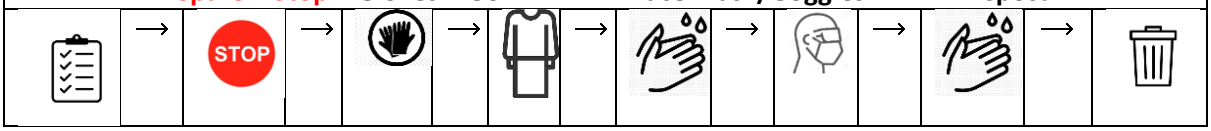
Appendix 1: Hazards

#	Category/Type	Examples	Count	%
1	Knowledge of procedures & competency (i.e., using incorrect technique)	Not aware of procedure Forgetting procedure Not followingprocedure/using incorrect technique (not using correct sequence of steps, not tying apron properly, not sealing mask properly, accidental touching of objects in environment, touching face, contamination of hands, contaminating environment with PPE, other HCW popping head into room/not in PPE)	18	40%
2	PPE quality and availability	PPE quality & breaks Availability of PPE/supplies Equipment and fit (gloves not fitting, apron not fitting) Googles/mask steaming up	14	31%
3	Rushing & Time availability	Staff rushing/speed, time availability and pressure	4	8%
4	Physical	Dehydration, general discomfort, sores, heat, redness, headaches	4	8%
5	Infrastructure	No anteroom	3	6%
6	Task difficulty	Steps hard to understand, complex task	3	6%
7	Distraction	Distraction (general, patient interaction, patient demands)	3	6%
8	Risk of contamination from environment	PPE become contaminated from environment (not clean), risks from environment	2	4%
9	Not being prepared		1	2%
10	Stress		1	2%
11	Difficulties in communication/co-ordination	Interaction with Colleague made difficult with PPE	1	2%

Appendix 2: Mindful Hand Hygiene Poster



Appendix 3: Preliminary Indicative Prototype for PPE Checklists (Workflow Only)

Putting On PPE (Donning)
Prepare > STOP > HH > Gown > Face mask > Goggles/Shield>Gloves

For respiratory protection, use a surgical mask or respirator. For eye protection, use goggles or a face shield.
Taking Off PPE (Doffing)
Prepare > Stop > Gloves > Gown > HH > Face mask/Goggles > HH > Disposal


Appendix 4: Preliminary Indicative Prototype for Safe Donning Checklist (With Information About Risk)

Putting On PPE (Donning)			
Prepare > STOP > HH > Gown > Face mask > Goggles/Shield>Gloves			
For respiratory protection, use a surgical mask or respirator. For eye protection, use goggles or a face shield.			
7 Steps	**1**		• Take your time! • Identify and gather proper PPE to don. • Remove all personal items (i.e., jewellery, watch, cell phone, pagers, pens, lanyards, stethoscope).
	2		• Stop • Take a breath • Observe and acknowledge what is **Here Right Now** (feelings & emotions) • Proceed
	3		• Follow the correct HH procedure.
	4		• Tie gown properly (tie at neck and waste, knot tied with a loop).
	5		• Check mask (and/or respirator if appliable) fits tightly and is tied correctly (straps in front of ears).
	6		• Place goggles (or shield if applicable) over face/yes and adjust to fit
	7		• Put on gloves (check gloves not pulled over cuffs of gown)

COMPUTER-RELATED MUSCULOSKELETAL SYMPTOMS DURING COVID-19: SURVEY OF UNIVERSITY EMPLOYEES

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Background

Computer use has been associated with the development of musculoskeletal symptoms (MSS). Previous research on working populations has demonstrated associations between computer-related MSS and age (Shuval and Donchin, 2005), female gender (Madeleine et al., 2013), longer computing time (Shuval and Donchin, 2005) (Madeleine et al., 2013), poor posture (Eltayeb et al., 2009) and poor workstation design (Ye et al., 2017). However, the factors associated with remote working have not been adequately addressed, despite the fact that many employees, including university staff, frequently conduct some or all of their work remotely (Crawford et al., 2011; James et al., 2018). With restrictions imposed by the COVID-19 pandemic, workers from many sectors, including the higher education sector, have been required to work from home and it was likely they were required to have greater screen time than they would when working onsite (Crawford et al., 2011). A recent questionnaire survey of employees in Ireland investigated aspects concerning remote working during the COVID-19 pandemic (McCarthy et al 2020). The study identified that 'physical workspace' was one of the top three challenges for the respondents when working remotely, although the specific aspects were not explored. This current study investigated the pattern of computer use, physical characteristics of onsite and remote computer workstations, and the prevalence and impact of computer-related MSS among university staff in an Irish university during the COVID-19 pandemic.

Methods

A cross-sectional study was conducted using an anonymous online 39-item questionnaire. The questionnaire consisted of 4 sections**:** computer use; other activities; demographics; musculoskeletal symptoms in the past 3 months (Kourinka et al., 1987). The survey link and participant information leaflet were sent by the university Secretary's Office to all staff on the college mailing lists in March 2021. Data were analysed using descriptive statistics and chi-squared analysis. Statistical significance was set at $p<0.05$.

Results

Response rate and demographics

Of those who were contacted (n=6653), 1121 responded, giving a response rate of 16.8%. Seventy-six surveys were incomplete and excluded from the analysis, therefore the analysis was based on 1045 responses. The respondents were mostly female (68%), right-handed (90%) and were aged 20-29 (8%); 30-39 (23%); 40-49 (33%); 50-59 (23%); and 60+ (13%).

Pattern of work

The majority of respondents (63%) worked solely from home (Figure 1). A laptop was more frequently used compared to a desktop (88% vs 50%) and for a greater number of hours at home than at the university.

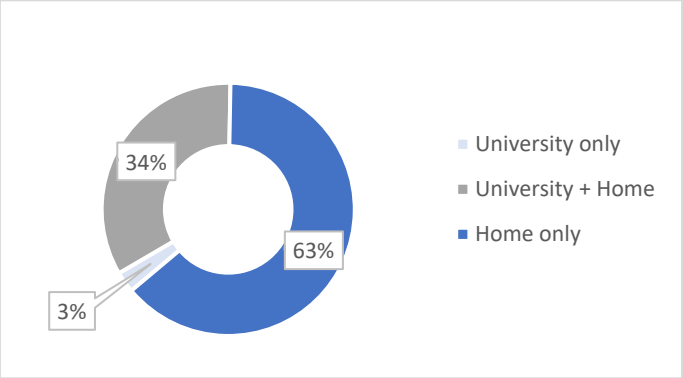

Figure 1. Place of work in past 3 months

Physical characteristics

Over half (52%) of those who worked remotely reported they had a dedicated home office or workspace. Computer equipment was more likely to be used at the university than at home (Figure 2). The comfort of the workspace was reported to be greater onsite at the university compared to home (Figure 3).

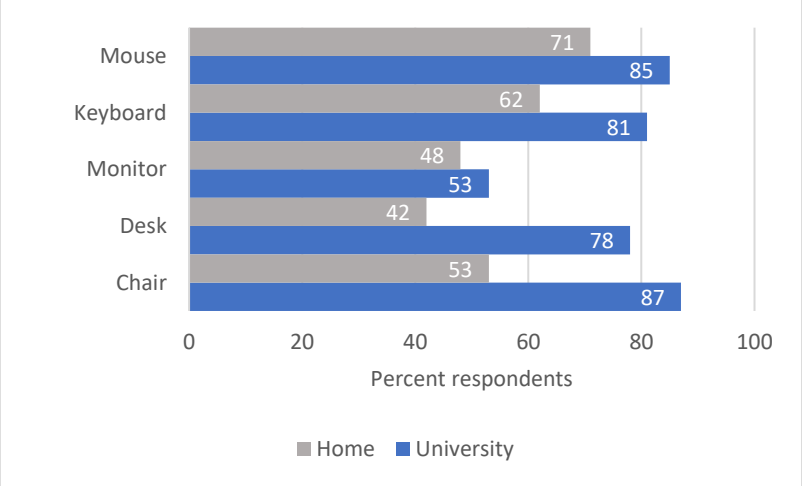

Figure 2. Use of equipment

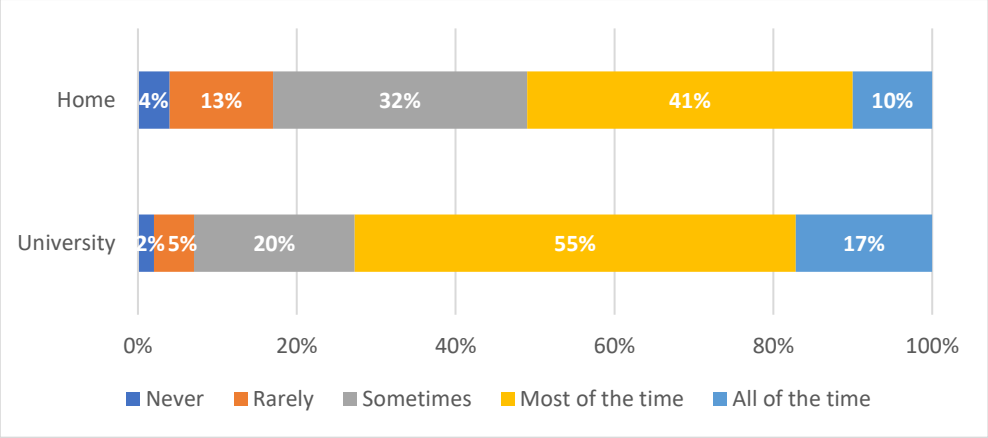

Figure 3. Comfort of the workspace

Computer-related MSS

The prevalence of computer-related MSS was 83%. The most often reported body areas were neck (62%), shoulder (57%), and lower back (47%) (Figure 4). The prevalence of laptop-related MSS was significantly higher (82%) than desktop-related MSS (65%) for the neck, shoulder, and lower back ($p<0.05$). A greater proportion of respondents reported symptoms related to working at home and working on a laptop. There was an association between equipment use at home and MSS; there was a lower prevalence of MSS associated with the use of an office chair, desk, and monitor ($p<0.05$), but not with a keyboard or a mouse. There were no significant associations between equipment use and MSS onsite at the university. Respondents who were female ($p<0.05$) or righthanded ($p<0.05$) were more likely to report computer-related MSS.

Impact of computer-related MSS

Computer-related symptoms resulted in a reduction in non-work-related activities (35%), work activities (19%) and individuals seeking medical attention (24%).

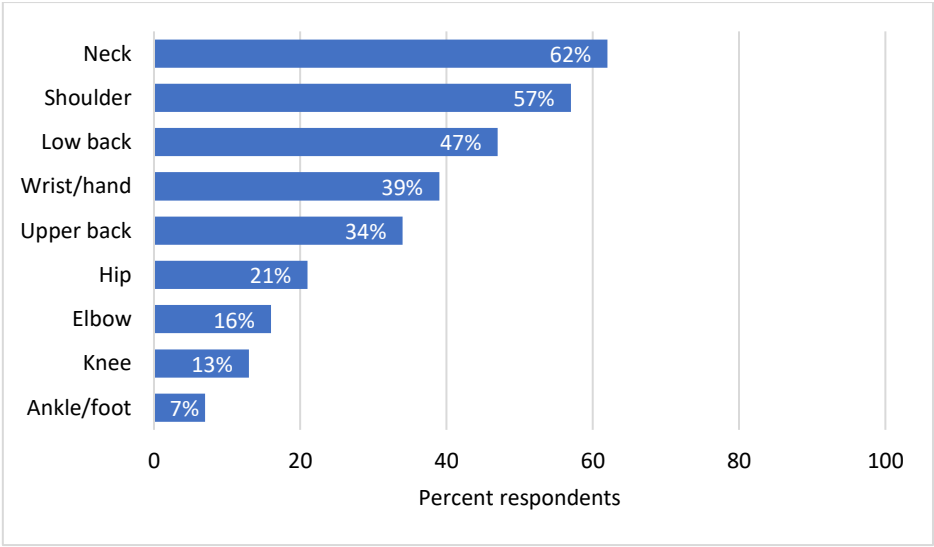

Figure 4. Prevalence of MSS by body part

Discussion

As expected, the majority of respondents worked from home only. This study found that a greater proportion of respondents reported symptoms related to working at home and working on a laptop. Lack of use of office furniture in the home was also associated with a higher prevalence of MSS. However, university staff frequently work from home under 'normal' conditions and are likely to continue to do so in the future. If staff work from home on a regular basis, they may be working in similar workspaces found in this study. As such, the findings are relevant to future remote working by university employees, and future research should aim to develop preventive strategies to mitigate the risks of computer-related MSS in remote workers.

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A STS ANALYSIS OF AN EFFECTIVE BIO-SECURITY RESPONDER IN TRINIDAD DURING COVID-19 PANDEMIC

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Abstract

Background

The year 2020 saw the pronouncement by the World Health Organisation (WHO) of the SARS-CoV2 / Covid-19 pandemic. Against unknown clinical factors, limited resources, fear among the local population and limited local guidance available, one organisation stood out in Trinidad in the performance of Infection, Prevention and Control (IPC) support to the two designated hospitals for the most severe cases of Covid-19. To have a more thorough understanding of what contributed to the effectiveness of this company an examination of the socio-technical system (STS) was undertaken. The nature of the examination including interrelationships among a fluid regulatory environment, unstable areas of operations regarding resource availability, and high stress among stakeholders required the use of a framework to guide this complexity.

Methods

The overarching research utilised a mixed-methods approach, more particularly, an explanatory sequential (two-phase) design. The initial phase took the form of an anonymised survey of operations and supervisory level personnel. The second phase comprising of a series of interviews of senior level personnel. The results of the former allowing the second phase to be more focused on areas highlighted.

The framework used for the design of Phase 1 in this research was an integrated, evidence-based STS analysis (STSA) framework called the CUBE which has been developed over several years across numerous programmes of research in aviation and healthcare safety (e.g. Corrigan et al., 2018; McDonald, et al., 2018; Ward et al., 2010).

The flexibility of this model allowed broader examination into those areas highlighted by the CUBE STSA (Figure 1). This allowed survey statements on International Health Regulations' eight core capacities (Brizee et al., 2019) that identify biosecurity priority areas to be interrogated. Responses were generally graded on a Likert scale. Local conditions during the pandemic included a national state of emergency with curfew restrictions thus requiring more online communications.

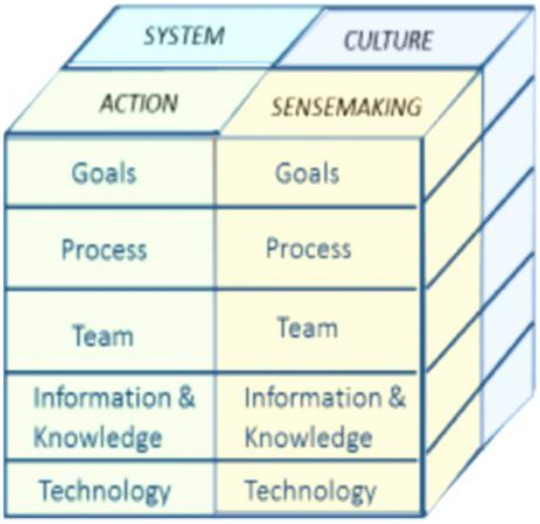

Figure 1 – CUBE STSA
Source: McDonald et al. (2021)

Results

The survey realised a response rate of 60% with a margin of error of 7.4% at a confidence level of 95% of a company population of 120 operational and supervisory staff. The thematic analysis conducted on the interviews with 6 senior level personnel suggested multiple themes. These indicated high level of teamwork and communications with management supported with redundant communication systems. WHO protocols were used where guidance was unavailable locally for planning and resource management.

Conclusions

In the absence of definitive guidance from local regulators in the pre-pandemic period and early stages of local infection, WHO standards were used by the company to allow for planning in materials acquisition, recruitment, and training.
Use of the CUBE STSA framework allowed for more effective interrogation of the complex relationships between elements of the STS of the bio-security provider and Fig. 2 presents a summary of the findings along the dimensions of the CUBE.

SCOPE Cube dimension	Characteristics Observed in Company
Culture →	Resilience, Team cohesion, organisational development through training
Sensemaking →	Situational awareness, planning, decision-making
Action →	Advance Procurement, scheduling, efficient logistics
System →	Technical standards adoption, process implementation

Figure 2 - STS Cube Characteristics observed within the Company

Two factors stood out as discriminating from other bio-security providers

(1) resilience in terms of arrangement into modular teams allowed flexibility to backfill missing members (2) advanced procurement, scheduling and logistics. These proved to be critical factors during the Covid-19 early waves with wide-reported material shortages of critical supplies and undertrained/unavailable personnel.

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CLINICAL HANDOVER IN THE ED – WHAT'S THE PROBLEM?

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Introduction

Effective clinical handover is a major patient safety issue. Elements of handover have been studied internationally and guidelines developed; in Ireland, National Clinical Guideline (NCG) No. 11 of the National Clinical Effectiveness Committee was published in 2015. So why is there such difficulty in implementing handover guidelines? In Emergency Departments (EDs) non-consultant hospital doctors are intimately involved in handover; for it to operate optimally their involvement is crucial.

Aim

A systematic review was undertaken as part of a MSc in Human Factors in Patient Safety at Royal College of Surgeons Ireland. The review explored the literature around non-consultant hospital doctors in Emergency Departments attitudes to handover and what they say about what is required to make handover work and what impedes it.

Methods

Medline, Embase and Web of Science were searched for relevant papers relating to two specific handover types in ED: (i) Interunit handover, that is handover of patients by ED doctors to doctors from admitting in-patient specialties; and (ii) intershift handover, that is handover by ED doctors to other ED doctors, predominantly at change of shift. Inclusion and exclusion criteria were applied. Data were analysed using Vincent's framework for analysing risk and safety in clinical. The methodological quality of the included studies was assessed using the Quality Assessment Tool for Studies with Diverse Designs (QATSDD). The QATSDD is a validated tool for assessing study quality. Scores on this measure can range between 0 and 48, with higher scores indicative of higher quality. The quality of the included papers ranged from 35/48 to 46/48.

Results

Initial filters and screening yielded 1933 papers from 4151. Further screening resulted in 90 full-text papers for review. Eleven papers were included for analysis. Insufficient time, lack of identification of high-risk patients and lack of an appropriate place to conduct handover are issues that are common to all handovers. Cultural issues such as information requirements and hierarchy have importance for interunit handovers. The need for structure in handover is agreed; the focus on tools such as mnemonics, less so.

Conclusion

The issues that create barriers or facilitators to safe clinical handover of patients in ED from the perspective of specialist trainees are clear. They align well with the general background literature findings on handover. The elements are interdependent and more complex than sometimes considered. The "structure" or standardization of "structured handover" is just one of those elements. It is clear that implementation of guidelines, including NCG No. 11, needs to take account of all the elements to achieve success. It will not be sufficient to present a written guideline and an associated mnemonic and expect optimal clinical handover to occur. Implementation requires, at a minimum, senior buy-in, leadership and intimate involvement, work environment conducive to good quality handover, training and education in communication and teamwork. Organisational and specialty cultural appreciation of the importance of high-quality clinical handover to patient safety, which finds expression in addressing all the necessary elements, may be the key fundamental facilitator for doctors in EDs. Organisational support needs to be at HSE national level with overt, rather than tacit, promotion by the Chief Clinical Officer and CEO, feeding into tangible structural and cultural support at hospital level.

In summary, efforts to implement clinical handover have often been too simplistic, leading to failure.