

# UK CoPACK Study: knowledge and confidence of healthcare workers in using personal protective equipment and related anxiety levels during the COVID-19 pandemic

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## ABSTRACT

### Background

Healthcare workers (HCWs) are at increased risk of coronavirus 2019 (COVID-19) infection. Personal protective equipment (PPE) and infection control guidelines help limit transmission. However, poor confidence leads to higher levels of anxiety rates and infection. We assessed knowledge and confidence in PPE among HCWs and associated anxiety.

### Methods

A cross-sectional, multi-centre survey using a validated questionnaire assessing actual and self-perceived knowledge on PPE was distributed among HCWs across the UK. Confidence in PPE and levels of anxiety were assessed using the General Anxiety Disorder-7 (GAD-7) tool.

### Results

In total, 1,055 responses were received; 99% had familiarity with PPE guidance; however, only 15% correctly answered questions on PPE guidance; 86% and 80% had received mask-fitting and donning-doffing training, respectively; 33% indicated poor/very poor hospital communication. Confidence and anxiety were related to: profession; comorbidities; self-perceived knowledge; and PPE training and communication.

### Conclusion

Confidence in PPE was poor and anxiety was related to inadequate information and training. Thus, improved communication is required for effective response to subsequent COVID-19 waves and similar pandemics.

**KEYWORDS:** CoPACK, COVID19, pandemic, PPE, anxiety, knowledge, UK

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### Introduction

A healthcare worker (HCW) is one who provides care to patients, within a healthcare or social care setting, varying in roles from providing direct care (eg nurses, doctors and allied health professionals) to indirect care (eg porters, laboratory workers and others). During the coronavirus 2019 (COVID-19) pandemic, the role of HCWs was vital in providing healthcare to patients. Severe acute respiratory syndrome coronavirus 2 (SARS-Cov2), the causative agent of COVID-19, spread expeditiously across the globe following its initial emergence in the Chinese province of Hubei in December 2019. The World Health Organization (WHO) subsequently declared a pandemic on 11 March 2020.<sup>1</sup> Transmission of the virus through droplet spread led to widespread implications for social distancing and use of personal protective equipment (PPE).<sup>2</sup> As demand for PPE surged, severe deficiencies in the UK and worldwide supply spurred unprecedented increases in cost, impacting supplies for HCWs.<sup>3,4</sup> In response to the rapid progression of disease, equally rapid changes in UK policies and advice on PPE were rolled out for high-risk workers within health and social care settings. Original guidance released by Public Health England (PHE) in March 2020 underwent several iterations; the latest guidelines being released in August 2020.<sup>5</sup> Consequentially, many HCWs lost confidence in governmental policies with concern and fear that they were not in line with WHO guidance; being based on 'supply rather than science'.<sup>6–8</sup> Calls for further revision of PPE guidance were additionally sought in light of newer variants of the virus.<sup>9</sup>

Outbreaks of COVID-19 among HCWs raise concerns about asymptomatic carriage and transmission of the virus; reported in the region of 3%.<sup>10,11</sup> HCWs are thought to be at a three-to-sevenfold increased risk of developing severe COVID-19 infection.<sup>12,13</sup> Furthermore, at least 7,000 deaths had occurred among HCWs across the world as of September 2020. The UK was identified as having the third-highest incidence, with 649 deaths reported at that time.<sup>14</sup> Notably, individuals from ethnic minority backgrounds were recognised to be at higher risk of developing

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severe complications and mortality from COVID-19. In addition,<sup>15</sup> these groups might be unduly affected by inadequate PPE provisions.<sup>7,13,15</sup>

Understandably, immense pressures of continuing work throughout the pandemic have led to significant anxiety, impacting negatively on the mental health of HCWs.<sup>17</sup> The highest levels of anxiety have been observed among doctors and nurses; particularly so among the Black, Asian-Indian and minority ethnic community.<sup>18,19</sup> The predominant concerns raised among HCWs include: fear of exposure; transmission to family; lack of accessibility to adequate PPE; perceived inadequate PPE supplies; lack of education surrounding use of PPE; frequency of guideline changes; and poor communication of up-to-date information.<sup>7,19–21</sup>

The health and wellbeing of HCWs is paramount to providing optimum and safe care for patients.<sup>22</sup> Therefore, it is imperative that HCWs in close contact with patients on the frontline are provided with adequate PPE and, importantly, have confidence in using it.<sup>23</sup> However, evidence suggests that direct training for HCWs has been lacking, with clinical work continuing despite deficiencies in training and PPE supplies.<sup>7,21,24</sup>

## Study aims

Our study aimed to assess the knowledge, and confidence in the use, of PPE among HCWs. In addition, we looked to assess levels of anxiety that HCWs experienced and to determine whether this correlated with the knowledge and use of PPE in the healthcare setting.

## Methodology

The study was a multimodal cross-sectional survey that started in April 2020 and ran until June 2020. It was registered and approved by the Audit & Research, and Infection Control departments of local hospitals. An avian flu-validated questionnaire was modified appropriately to reflect the nature, symptoms and consequences of the COVID-19 pandemic, and was independently validated.<sup>25</sup> The questionnaire included an internationally validated anxiety measurement tool (General Anxiety Disorder-7; GAD-7). A multimodal strategy was used for data collection to maximise the number of respondents, decrease any potential bias and improve representation.

The questionnaire comprised 13 items grouped into six sections (See supplementary material S1): demographics (gender, age, profession, workplace, professional experience, marital status, religion and ethnicity); contact with someone with COVID-19; knowledge regarding COVID-19 PPE guidance (Questions 14–17); PPE training (Questions 18,19); self-perceived knowledge (Question 20); self-perceived confidence in the role of PPE equipment in protection from contracting the virus (Q21); and level of hospital communication regarding PPE (Question 22). The final section measured levels of anxiety (Question 23) using GAD-7.

## Study participants

The study was conducted during the peak of the COVID-19 pandemic, targeting HCWs in secondary care settings (hospitals). The questionnaire was distributed to doctors, nurses, healthcare assistants (HCAs), physiotherapists, occupational therapists, pharmacists and ward clerks, using two data collection methods. Potential participants were informed of the aims of the study, and consented to partake in the survey either online or personally.

## Data collection

First, the questionnaire was distributed to HCWs in local hospitals within the West Midlands. Printed questionnaires were available in all departments to be filled in and returned anonymously in sealed envelopes to a secure collection tray. At the end of a 2-week period, all envelopes were retrieved for tabulation and analysis of data. Microsoft Excel was used for data entry.

Second, an online secured electronic form link was emailed to colleagues at various hospitals across the UK. A secure online forms software was used to extract the results in a Microsoft Excel sheet. Participation was entirely voluntary and anonymous.

## Statistical analysis

Data were analysed to determine relationships between: tested and self-perceived knowledge; level of confidence in PPE; and level of anxiety during the peak of the COVID-19 pandemic. Statistical analysis included descriptive parameters: means and frequencies with independent sample *t*-tests, Chi-squared tests, and one-way analysis of variance (ANOVA) for differences between them. Correlations between categorical variables (tested versus perceived knowledge) were studied using post-hoc analyses, including Scheffé's method, which has the advantage of having the flexibility to test any comparisons that appear interesting. Multivariate logistic regression was used to predict confidence in PPE and levels of anxiety among HCWs. Statistical analysis was performed using SPSS v.27.0 (SPSS Inc).  $P < 0.05$  was deemed to be statistically significant.

## Results

### Demographics

In total, 1,055 HCWs responded to the questionnaire, with a female-to-male ratio of 3:1 and a mean age of 40 years. Responses were received from 12 deaneries; the West Midlands (66%) being the most represented, followed by Wales (19%) and north-west England (6%). Of the respondents, 77% were White/White British, with Asian/Asian-Indians accounting for 6.3%, the second largest ethnicity. Christians accounted for 51% of respondents, with atheists comprising 17%. In addition, 73% of respondents were married or in a relationship; 20% of those having partners who were also HCWs. Of respondents, 23% had at least one medical comorbidity.

Most HCWs were from orthopaedic departments (27%), with general surgery, surgical theatre staff and medical departments being almost equally represented (6% each). Of the respondents, 52% spent their day on in-patient wards, whereas 16% were based in surgical theatres and 7% in outpatient departments. The professions of HCWs included: nurses (49%), who accounted for most of the respondents; HCAs (20%); doctors (17%); and physiotherapists (8%). At the time of our study, 79% of all respondents had contracted COVID-19 or knew someone (relative, friend, or patient they had treated) who had, although this then varied based on the type of HCW, with 92% of doctors, 76% of nurses, 69% of HCAs and 89% of physiotherapists.

### PPE guidance

#### Training

Of respondents, 99% had read one or more of the guidelines on PPE. Overall, 80% had received training on PPE donning–doffing

**Table 1. Responses to knowledge-based questions**

Question	Correct responses by profession (%)			
	Doctors	Nurses	HCA's	Physios
Q14: Infection control practice when performing a single aerosol-generating procedure in a patient with suspected/confirmed COVID-19 on a ward	82	77	61	84
Q15: Infection control practice while working in a high COVID-19 risk area, such as ITU	66	47	43	61
Q16: Most appropriate infection control practice when transferring a patient with suspected/confirmed COVID-19 infection	44	32	34	44
<b>All three questions</b>	<b>31</b>	<b>11</b>	<b>9</b>	<b>26</b>

ITU = intensive treatment unit.

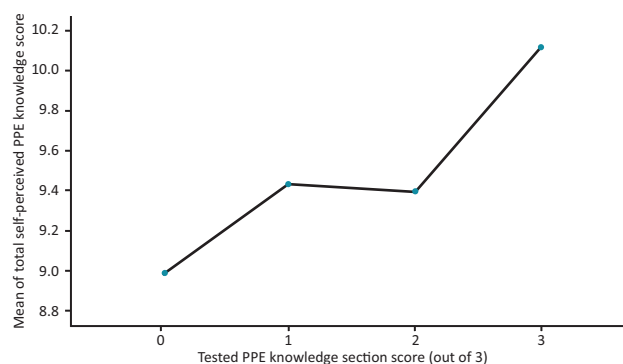
at their local trust and 86% attended FFP3 mask-fitting sessions. In addition, 85% of doctors received donning–doffing training and 90% attended mask-fitting sessions compared with nurses, who reported 83% and 89%, respectively. Comparatively, 67% of HCAs received training, with 82% attending mask-fitting training.

### Tested knowledge

Questions 14, 15 and 16 of the questionnaire assessed knowledge on: aerosol-generating procedures, working in high-risk environments and during patient transfers. Table 1 summarises the overall responses. There was a significant association between HCW profession and the knowledge tested by the three questions on appropriate PPE usage (chi-squared test,  $p < 0.05$ ). However, knowledge on PPE usage was not related to confidence in the effectiveness of PPE provided.

### Self-perceived knowledge

Question 20 contained three, five-point Likert scale queries assessing self-perceived knowledge regarding COVID-19 infection. All professions reported very high or high familiarity with PPE guidance: 48% of doctors and of nurses; 43% of HCAs; and 50% of physiotherapists. A considerable proportion reported low or very low knowledge about caring for patients with COVID-19: 20% of doctors; 22% of nurses; 24% of HCAs; and 23% of physiotherapists. Finally, when answering questions from the public on COVID-19, 41% of doctors perceived high or very high capability compared with 30% of nurses and 44% of HCAs, who reported low or very low perceived capability.



**Fig 1. Tested versus perceived personal protective equipment (PPE) knowledge among healthcare workers.**

There was a significant association between HCW profession and the level of self-perceived knowledge as explored by three questions (chi-squared test,  $p < 0.05$ ). Post-hoc analysis revealed a statistically significant correlation between the level of self-perceived knowledge on PPE and scores on the knowledge-based questions ( $F = 6.4$ ,  $p < 0.05$ ). HCWs who answered all three knowledge-based questions accurately also expressed the highest level of self-perceived knowledge.

### Confidence in PPE effectiveness

Only 27% of HCW had a high or very high confidence in the effectiveness of PPE guidance in protecting them from COVID-19. Most professions expressed moderate confidence in PPE effectiveness: 50% of doctors, 42% of nurses, 36% of HCAs and 52% of physiotherapists. 40% Of the respondees, 40% of HCAs had low or very low confidence in PPE. Similarly, there was a significant association between HCW profession and their confidence in the effectiveness of PPE to protect them from COVID-19 (chi-squared test,  $p < 0.05$ ).

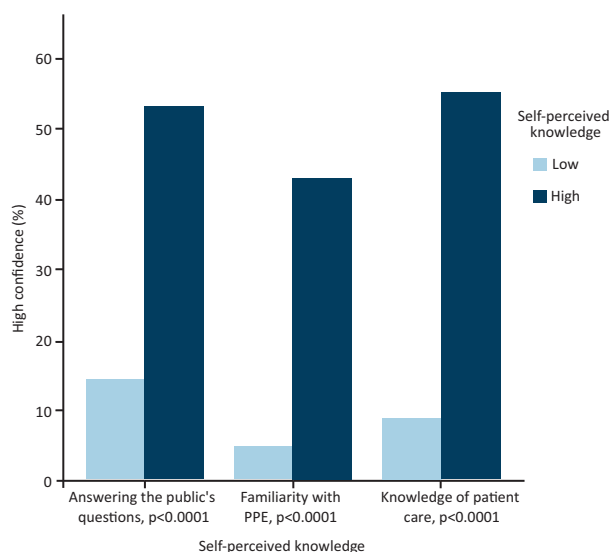
High confidence levels in familiarity with PPE usage, knowledge regarding caring for patients with COVID-19 and ability to answer questions from the public on COVID-19 (Question 20) were significantly associated with confidence in the effectiveness of PPE (chi-squared test,  $p < 0.05$ ; Fig 2).

### Communication from local hospitals

Only 52% of HCWs rated their hospital communication regarding guidelines on PPE usage as efficient. A higher proportion of doctors (60%) and physiotherapists (67%) were of the opinion that hospital communication was primarily good or very good, whereas a significantly lower proportion of nurses (51%) and HCAs (45%) shared this opinion. In addition, 33% of doctors and nurses, and 35% of HCAs thought that communication was poor or very poor. There was a significant association between HCW profession and hospital communication regarding PPE guidance (chi-squared test,  $p < 0.05$ ).

### Predictors of high PPE confidence

Table 2 summarises a multivariate logistic regression model of factors predicting levels of confidence in the effectiveness of PPE usage. The strongest predictor of confidence was good communication from hospitals with regards to PPE guidance (Odds ratio (OR) 3.3), whereas, in terms of profession, being a physiotherapist (OR 2.6) or nurse (OR 2.3) were also strong predictors. High self-perceived knowledge (OR 1.6) or having a partner who was also a HCW (OR 1.6) were moderate predictors



**Fig 2. Self-perceived knowledge and level of confidence in personal protective equipment (PPE) effectiveness of healthcare workers (HCWs).**

as well as receiving donning–doffing training (1.7). Increased age was associated with slightly increased confidence (OR 1.03). Contracting COVID-19 or being in contact with patients infected with COVID-19 resulted in lower confidence in PPE effectiveness (OR 0.5).

### Level of anxiety

Of respondents, 32% reported normal levels of anxiety, whereas 19% reported severe anxiety levels according to their GAD-7 score (Question 23). Abnormal levels of anxiety (mild, moderate and severe) were reported among 61% of doctors, 71% of nurses (severe anxiety in 20%) and 73% of HCAs (severe anxiety in 24%) (Table 3). There was a significant association between HCW profession and anxiety levels (chi-squared test,  $p < 0.05$ ).

The GAD-7 anxiety score had a negative correlation with tested knowledge and self-perceived knowledge scores (linear regression,

$p < 0.05$ ), demonstrating that high levels of actual or perceived knowledge regarding PPE usage led to lower anxiety levels.

### Predictors of high level of anxiety

Table 4 summarises the multivariate logistic regression model of factors associated with abnormal levels of anxiety among HCWs during the COVID-19 pandemic. The strongest predictors of abnormal anxiety were profession, namely being a nurse (OR 1.8) or HCA (OR 1.9), and having medical comorbidities (OR 1.8). HCWs receiving satisfactory (OR 0.5) or higher (OR 0.6) perception of hospital communication on PPE guidance were less likely to suffer from anxiety. The provision of donning–doffing training was also associated with reduced anxiety levels (OR 0.5).

### Discussion

Thomas *et al* evaluated national PPE guidance for NHS HCWs during the COVID-19 pandemic.<sup>8</sup> Their work concluded that, given the available evidence and comparison with international PPE guidance, concerns regarding PHE COVID-19 PPE advice were warranted. The purpose of this study was to identify areas in which preparation of HCWs working during the COVID-19 pandemic could be improved to better prepare for subsequent similar epidemics and pandemics. We sought to achieve this by evaluating HCW knowledge of PPE guidelines, training received, confidence in the effectiveness of PPE and, finally, by quantification of anxiety levels. Additionally, we aimed to identify factors that might predict levels of anxiety among HCWs.

This study highlights two significant findings. The first is that only 27% of HCWs reported high confidence in the effectiveness of PPE. This is unsurprising given that the self-perceived knowledge of HCWs, one of the predictors of confidence in PPE, was primarily in the moderate or lower categories across professions. A study in Israel during the H1N1 influenza pandemic similarly showed that high confidence in PPE among HCWs was strongly associated with high tested knowledge and high self-perceived knowledge.<sup>25</sup> According to our study, confidence in PPE effectiveness was higher among nurses (30% in the high or very high category) compared with doctors (20%). These results are in keeping with the study by Schwartz *et al* on the influenza pandemic of 2009.<sup>25</sup> A further

**Table 2. Multivariate logistic regression: predictors of confidence in PPE effectiveness**

Variable <sup>a</sup>	Odds ratio	95% CI for Odds ratio		p-value
		Lower	Upper	
<b>Comorbidities (yes)</b>	1.784	1.226	2.594	0.002
<b>Profession</b>				0.016
HCAs	1.883	1.083	3.275	0.025
Nurses	1.785	1.108	2.877	0.017
Physiotherapists/OTs	0.993	0.538	1.832	0.981
<b>Provision of donning–doffing training (yes)</b>	0.547	0.359	0.831	0.005
<b>Perception of hospital communication</b>				0.004
Satisfactory	0.544	0.346	0.857	0.009
Good/very good	0.587	0.417	0.826	0.002

<sup>a</sup>Only variables reaching statistical significance ( $p < 0.05$ ) were included in the table.

CI = confidence interval; HCA = healthcare assistant; OT = occupational therapist.

**Table 3. Levels of anxiety across different HCW professions**

Anxiety cases	Profession					Total
	Doctor	HCA	Nurse	Physiotherapist/OT	Other	
Abnormal	115	171	370	51	15	722
Normal	72	61	150	41	9	333
Total	187	232	520	92	24	1055

$\chi^2(4, n=1055)=16.521, p<0.002.$

Anxiety level	Profession					Total
	Doctor	HCA	Nurse	Physio / OT	Other	
Mild	53	67	164	33	4	321
Moderate	37	49	100	13	3	202
Severe	25	55	106	5	8	199
Total	115	171	370	51	15	722

$\chi^2(8, n=1055)=20.574, p<0.008.$

HCA = healthcare assistant; HCW = healthcare worker; OT = occupational therapist.

study during the 2003 SARS outbreak in Singapore showed that nurses had significantly higher confidence compared with doctors in the effectiveness of surgical masks in protecting them against the virus.<sup>26</sup>

Despite 99% of respondents reporting some familiarity with PPE guidelines, only a small proportion answered all three knowledge-based questions accurately: 31% of doctors, 11% of nurses, 9% of HCAs and 26% of physiotherapists. Inadequate knowledge regarding PPE can lead to poor attitudes and infection control practices among HCWs, with resultant spread of the disease.<sup>27,28</sup> Tested knowledge of guidelines was unsatisfactory in our study and this resulted in low self-perceived knowledge. HCWs were not confident in caring for infected patients and were also not confident that the PPE provided would protect them from

becoming infected. Contracting COVID-19 or knowing someone that was infected was a further factor in low confidence in PPE effectiveness.

The strongest predictor of high confidence was hospital communication. This study showed that 33% of HCWs reported that hospital communication regarding PPE policy was unsatisfactory (30% of doctors, 28% of nurses, 40% of HCAs and 19% of physiotherapists). Good communication is vital when dealing with a global emergency and it appears that herein lay the primary problem. The provision of donning–doffing training was another strong predictor of PPE confidence and 80% of all HCWs received this training. However, only 67% of HCAs received this training, far below the 85% of doctors. The determination of which type of FFP3 mask fit

**Table 4. Multivariate logistic regression: predictors of abnormal anxiety levels**

Variable	Odds ratio	95% CI for odds ratio		p-value
		Lower	Upper	
Age	1.029	1.011	1.047	0.001
Partner is a HCW	1.579	1.010	2.469	0.045
Profession				0.035
HCA	1.976	0.994	3.926	0.052
Nurses	2.323	1.278	4.223	0.006
Physiotherapists/OT	2.573	1.208	5.480	0.014
Donning–doffing training (yes)	1.697	1.021	2.819	0.041
Self-perceived PPE knowledge score	1.629	1.491	1.781	0.000
Contact with someone/self-contracted COVID-19 (yes)	0.493	0.330	0.737	0.001
Perception of hospital communication				0.000
Satisfactory	1.473	0.824	2.632	0.192
Good/very good	3.336	2.181	5.103	0.000

<sup>a</sup>Only variables reaching statistical significance ( $p<0.05$ ) were included in the table.

CI = confidence interval; COVID-19 = Coronavirus 2019; HCA = healthcare assistant; OT = occupational therapist.

the HCW best was less important than the training received on the process of handling PPE before and after coming into contact with a patient with COVID-19. This was evidenced by the fact that FFP3 mask fitting sessions had no correlation with confidence in the effectiveness of PPE, despite 86% of all respondents attending training.

The second significant finding of this study was that 68% of HCWs reported abnormal levels of anxiety as tested by GAD-7. This figure is marginally lower than that reported in an online survey of 512 respondents by Jain *et al*, finding 74% of anaesthetists on COVID-19 duty suffered from anxiety.<sup>29</sup> These authors also reported that 61% suffered with insomnia. A further survey of public perception reported 662 responses (~50% of participants were HCWs), 80% of which remained anxious about the pandemic.<sup>30</sup>

Doctors and physiotherapists were less likely to exhibit severe anxiety (Table 3). Nurses and HCAs reported similar numbers in each anxiety level, with severe anxiety in 20% of nurses and 24% of HCAs. Being a nurse or HCA was shown to be the two statistically strongest predictors of anxiety. This is likely because of the increased contact they have with patients with COVID-19, both in volume and duration. Furthermore, only 11% of nurses and 9% of HCAs answered all three knowledge-based questions accurately, compared with 31% of doctors and 26% of physiotherapists. In addition, 33% of nurses and 35% of HCAs felt that hospital communication with staff on PPE guidance was unsatisfactory. HCWs who reported satisfactory or higher communication from their hospitals were statistically less likely to suffer from anxiety. Unsurprisingly, higher anxiety levels were reported among HCWs who did not receive donning–doffing training from their hospitals.

There was also a statistically significant association between anxiety scores and staff with pre-existing medical conditions (univariate linear regression;  $p < 0.05$ ); there was no such association with ethnicity. The association between ethnicity and increased mortality was not publicised at the time of this study, and we suggest that repeating a similar study now might reveal such an association.

## Limitations

Limitations of this study included methods of participant recruitment. This was a convenience sample from regional and national hospitals, which is likely to have resulted in a degree of selection bias, impacting the generalisability of the study results. Nonetheless, a good representative sample was recruited from each subgroup.

Second, the method of data collection via a questionnaire to collect responses is somewhat subjective and might not explore the depth of confidence and/or anxieties experienced by participants. This greater understanding could be better explored via a qualitative study.

## Conclusions

During the COVID-19 pandemic, the UK government implemented changes to PPE guidance for HCWs, addressing emerging evidence of virus transmissibility and shortages of PPE. This is a unique study assessing levels of confidence among HCWs in the use of PPE at the peak of the COVID-19 pandemic. Our study recruited a large sample of HCWs working in secondary healthcare settings across the UK.

Previous studies identified suboptimal HCW compliance in adherence to PPE guidelines during pandemics because of a lack of confidence in, and knowledge of the use of, PPE. Poor compliance with guidelines is detrimental, resulting in virus spread and increased infection rates among HCWs and patients. This might increase staff absenteeism and reluctance to work in high-risk environments.

This study evidenced strong associations between self-perceived and tested knowledge of PPE. We also highlighted that positive communication and good initial training predicted a very high level of confidence in PPE usage. We believe that multiple amendments to PPE guidelines over a short period of time but during a large-scale pandemic without effective communication affected HCW confidence and performance and their commitment to treating patients with COVID-19.

Understandably, there were high levels of anxiety among HCWs during the peak of the pandemic. Improved hospital communication on PPE policies and training during pandemics would help decrease levels of anxiety and burnout among HCWs, as well as decreasing disease transmission.

Based on our results, we recommend a robust communication policy accompanying PPE guidelines or similar interventions during pandemics, with a focus on providing coherence, clarity and understanding of compliance among HCWs. Any communication strategy should be inclusive, incorporating a staff engagement strategy to obtain input from frontline workers that can feed into future updates.

Additional recommendations are for further research and analysis of the response of the UK healthcare system, in particular the availability of PPE, compliance, and the rate of infection, within both secondary healthcare settings and social care establishments during that crucial period, to improve readiness and preparedness for similar emergencies. ■

## Supplementary material

Additional supplementary material may be found in the online version of this article at [www.rcpjournals.org/clinmedicine](http://www.rcpjournals.org/clinmedicine): Appendix S1: Questionnaire

## Note

This work was presented in a preliminary form at the 2021 Association of Surgeons in Training International Surgical Conference.<sup>31</sup>

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