



ELSEVIER

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

## Infection Prevention in Practice

journal homepage: [www.elsevier.com/locate/ijip](http://www.elsevier.com/locate/ijip)

# Differential perceptions regarding personal protective equipment use during the COVID-19 pandemic by NHS healthcare professionals based on ethnicity, sex and professional experience

Tim Robbins<sup>a,b,\*</sup>, Ioannis Kyrou<sup>a</sup>, Maariyah Vankad<sup>a,c</sup>,  
Rishika Suthantirakumar<sup>a,c</sup>, Natalie Igharo<sup>a,c</sup>, Kiran Patel<sup>a,c</sup>,  
Harpal Randeva<sup>a,c</sup>, Sailesh Sankar<sup>a</sup>

<sup>a</sup> University Hospitals Coventry & Warwickshire NHS Trust, Clifford Bridge Road, Coventry, CV2 2DX, United Kingdom

<sup>b</sup> Institute of Digital Healthcare, WMG, University of Warwick, Coventry, CV4 7AL, United Kingdom

<sup>c</sup> Warwick Medical School, University of Warwick, Coventry, CV4 7HL, United Kingdom

## ARTICLE INFO

**Article history:**

Received 21 January 2021

Accepted 8 April 2021

Available online 12 June 2021

**Keywords:**

COVID-19

SARS-CoV-2

Personal protective equipment

Ethnicity

BAME



## SUMMARY

**Objectives:** To capture perceptions regarding personal protective equipment (PPE) among healthcare professionals during the COVID-19 pandemic, including staff subgroups at high risk for severe COVID-19, such as black and minority ethnic (BAME) groups.

**Design:** Electronically distributed survey with semi-quantitative analysis. Survey distributed at a major academic NHS tertiary referral centre in the West Midlands with a diverse medical workforce to medically qualified staff who completed COVID-19 redeployment training. (N=121; 47% female; 49% of BAME background; 26% international medical graduates).

**Results:** All demographic groups reported overall good awareness of when and how to use PPE during COVID-19 pandemic. Statistically significant differences in the perceptions regarding PPE use during COVID-19 were noted between BAME vs non-BAME staff, international vs UK medical graduates, and male vs female participants, as well as between professionals at different stages of their career. The differences related to perceptions around availability, degree of protection provided, perceived inconvenience, ability to raise concerns about availability, confidence in sharing underlying health conditions with managers and the impact of full PPE in emergency situations causing delay patient care.

**Conclusions:** Amongst medically qualified staff, significant differences exist in the perceptions relating to the, availability and effectiveness of PPE during the COVID-19 pandemic depending on country of training, ethnic background and sex.

**GAFREC Study Approval:** Study ID GF0392.

© 2021 The Authors. Published by Elsevier Ltd  
on behalf of The Healthcare Infection Society. This is an open access article  
under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

\* Corresponding author. Institute of Digital Healthcare, WMG, University of Warwick, Coventry, CV4 7AL, United Kingdom.

E-mail address: [Timothy.robbs@nhs.net](mailto:Timothy.robbs@nhs.net) (T. Robbins).

## Background

The COVID-19 pandemic due to the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus has caused unprecedented challenges for healthcare services internationally. Healthcare staff are at the frontline against this pandemic and are exposed to an increased risk of infection from SARS-CoV-2 [1], thus justifying the use of personal protective equipment (PPE). Indeed, early indications from China in March 2020 demonstrated significant infection rates amongst healthcare staff, whilst up to 20% of the healthcare staff in Italy become infected [2]. Tragically, a significant number of healthcare workers, both within and outside of the United Kingdom, [3], have lost their lives due to COVID-19.

Mortality from SARS-CoV-2 has been shown to be disproportionately high in certain population demographics/groups, specifically in men [4], those from Black & Minority Ethnic (BAME) groups [5,6], those of older age [7] and people with underlying co-morbidities [8]. In the United Kingdom there have been significant concerns regarding the disproportionate number of healthcare worker COVID-19 related deaths from the BAME workforce compared to the non-BAME workforce [3]. The term BAME relates to identification of ethnic backgrounds other than White-British background and has become an important population of study during the COVID-19 pandemic, and a term widely used in the UK [9]. The underlying reasons for the disproportionate mortality rate amongst BAME healthcare workers are not yet fully understood.

The use of PPE is pivotal in helping to protect healthcare staff from SARS-CoV-2 infection [10]. However, PPE availability and effectiveness has been a significant area of debate and concern amongst healthcare workers, particularly in the UK [11]. For PPE to be effective in preventing healthcare worker infection and potential mortality, there must be an adequate supply of appropriate in-date PPE which are used by healthcare staff who are appropriately trained on the correct PPE use (e.g. correct donning and doffing of PPE) [12,13]. Of note, PPE constitute only one element of protecting healthcare workers from COVID-19, with additional infection prevention and control considerations including appropriate hand hygiene [14], social distancing [15], and risk assessment to identify particularly vulnerable groups [16]. Moreover, additional debate remains regarding the relative importance of the initial viral load of SARS-CoV-2 infection in later risk of severe COVID-19; however, should viral load be an important factor, higher effectiveness and use of PPE is likely to lower the viral load exposure of healthcare workers in the event of SARS-CoV-2 transmission in the healthcare workplace [17]. Existing research suggests that provision of PPE alone is not sufficient, but adequate training and instructions are vital [18], this training provision has a direct impact on perceptions of staff using the PPE [19]. Importantly, in the UK, a national survey of junior doctors reported that women and those of BAME/mixed ethnicity were less likely to report that they have received sufficient information and training [20].

Given the importance of effectively used PPE in protecting healthcare workers from SARS-CoV-2, and the differential impact of SARS-CoV-2 in certain healthcare demographics, it is important to understand the range of perceptions of PPE

availability, use and effectiveness within the medical workforce (which represents a diverse population regarding ethnic background, country of training and work experience). Therefore, here we present a semi-quantitative online survey focusing on the perceptions of PPE use amongst medically trained staff at a large academic tertiary referral NHS hospital. To our knowledge, this is the first research study of this kind and aimed to help understand differential perceptions regarding PPE use during the COVID-19 pandemic by NHS healthcare professionals based on ethnicity, sex and professional experience.

## Methods

The survey was conducted at University Hospitals Coventry & Warwickshire NHS Trust (UHCW), which is a major teaching hospital in the West Midlands region of the United Kingdom with a markedly diverse workforce. 24% of staff are from a BAME background. For the objectives of this study, all members of the UHCW medical workforce who completed a trust-wide COVID-19 education package at the start of the COVID-19 pandemic were invited to participate in a PPE focused electronic survey (n= 432). Perceptions were therefore those at the inception of the pandemic.

This survey was designed to capture PPE perceptions and pertinent demographic information of the participants, including sex, ethnic background, country of medical training (UK or non-UK graduates), age (age groups: <29; 30–39; 40–49; 50–59; >60 years) and years in clinical practice (0–5 and >5 years of experience). More specifically, the survey was designed to consider perceptions regarding PPE availability, PPE use and PPE effectiveness. All replies to these questions were based on a 5-point Likert Scale, ranging from “strongly disagree” to “strongly agree.” A literature search was conducted to identify relevant pre-existing validated questionnaires; however, such pre-existing tools could not be identified. The applied survey was piloted with a small group of medical doctors and another of medical students.

The survey was distributed via GoogleForms, with an invite link and subsequent reminder sent to all members of the UHCW medical workforce (doctors from first year of training to consultant) who had completed the COVID-19 education package at the start of the COVID-19 pandemic. The introduction to the survey stated that participation was anonymous and voluntary.

Ethical permission for the survey was granted by the local Research & Development Department under GafREC arrangements (Study ID GF0392).

### Statistical analysis

Descriptive analysis was conducted for all survey questions, and proportions are presented as percentages. Mann-Whitney-U testing was applied to explore potential statistical differences between different groups of participants. Participants were categorised by sex, ethnic background, country of medical training (UK or non-UK graduates), age (age groups: <29; 30–39; 40–49; 50–59; >60 years) and years of clinical practice (0–5 and >5 years of experience). All analyses were performed on Microsoft Excel (Microsoft Corp., MS Excel. 2016,

Redmond, WA, USA) [21] and IBM SPSS (IBM, SPSS Statistics for Windows, Version 24.0, Armonk, NY) [22].

## Results

### Respondent characteristics

From 432 invitations sent to eligible members of the UHCW medical workforce, 121 completed the online survey, representing a response rate of 28%. Amongst the study responders, 47% were female, 51% from a BAME background, and 26% completed their primary medical degree in a country outside of the United Kingdom. The age demographics for respondents are detailed in Table 1. Details regarding specialty and job role were not collected due to the risk of compromising the anonymity of participants.

### Survey responses

Table 2 provides a full summary of the survey responses in a quantitative numerical form with identification of statistically significant differences between groups.

#### Survey question 1: "I know when to wear an FFP3 mask during COVID-19 care."

In response to this question, there was no difference between healthcare staff of a BAME background versus those of White-British Background ( $P=0.507$ ). Moreover, there was no difference between healthcare staff who obtained their initial medical degree in the UK versus non-UK regarding ( $P=0.217$ ), nor was there a difference between male versus female healthcare staff ( $P=0.683$ ). However, there was a statistically significant difference between healthcare staff with 0–5 years of experience versus those with >5 years of experience ( $P>0.001$ ), with the latter more strongly agreeing they knew when to wear an FFP3 mask.

#### Survey question 2: "I know when to use eye protection and an apron during COVID-19 care"

In response to this question, there was no difference between healthcare staff of a BAME background versus White-British background ( $P=0.186$ ). Similarly, there was no difference between UK versus non-UK trained ( $P=0.348$ ) and male versus female healthcare staff ( $P=0.554$ ). For this question, a statistically significant difference was noted between

healthcare staff with 0–5 years of experience versus those with >5 years of experience ( $P=0.012$ ), with the latter more strongly agreeing to knowing when to wear eye protection and aprons.

#### Survey question 3: "I am confident I know when to protect myself and my patients during the pandemic"

In response to this question, there was no difference between healthcare staff of a BAME background versus White-British background ( $P=0.553$ ), neither between healthcare staff who obtained their initial medical degree in the UK versus non-UK trained staff ( $P=0.538$ ), and male versus female staff ( $P=0.418$ ). As for the previous questions, here a statically significant difference was documented between healthcare staff with 0–5 years of experience versus those with >5 years of experience ( $P=0.001$ ), with the latter responding as more confident in knowing how to protect themselves and their patients during the pandemic.

#### Question 4 "I believe PPE is important"

In response to this question, there was no difference between any of the groups compared, namely for healthcare staff of a BAME background versus White-British background ( $P=0.089$ ), healthcare staff who obtained their initial medical degree in the UK versus non-UK trained staff ( $P=0.647$ ), male versus female staff ( $P=0.595$ ), and staff with 0–5 years of experience versus those with >5 years of experience ( $P=0.319$ ). All staff strongly agreed that PPE was important.

#### Question 5: "I believe PPE is readily available at UHCW trust"

In response to this question, there was a statistically significant difference between staff of a BAME background versus White British background ( $P=0.038$ ), with the latter agreeing more strongly that PPE is readily available at the organisation.

Similarly, such a statistically significant difference was also noted between staff with 0–5 years of experience versus those with >5 years of experience ( $P=0.037$ ), with the latter agreeing more strongly that PPE is readily available at the hospital.

There was therefore a significant reduction in the degree of confidence in assurance around availability of PPE for BAME Doctors and Junior Doctors. To the contrary, there was no such difference in perceptions of PPE availability between healthcare staff who obtained their initial medical degree in the UK versus non-UK trained staff ( $P=0.816$ ), and between male versus female staff ( $P=0.392$ ).

#### Question 6: "Current PPE guidelines are sufficient to protect healthcare workers from COVID-19"

In response to this question, there was no difference between healthcare staff of a BAME background versus White-British background ( $P=0.429$ ), between healthcare staff who obtained their initial medical degree in the UK versus non-UK trained staff ( $P=0.816$ ) and between male versus female staff ( $P=0.368$ ).

**Table 1**

Demographics of clinical staff who responded to the study survey.

Age Group	Number of participants	Responders %
20-29 years	31	25.62%
30-39 years	30	24.79%
40-49 years	32	26.45%
50-59 years	23	19.01%
60+ years	5	4.13%

Total Number of participants: 121; Male/Female: 64/57 (53%/47%); Black & Minority Ethnic (BAME)/Non-BAME: 59/62 (49%/51%).

**Table 2**  
Summary of survey results with significance testing.

Survey Question	Mean average score by respondent grouping								
	All respondents	Female	Male	BAME	White British	0-5 years experience	5 years + experience	UK Degree	Non-UK Degree
I know when to wear an FFP3 mask during COVID-19 care.	4.46	4.36	4.54	4.53	4.40	3.93*	4.77*	4.39	4.68
I know when to use eye protection and an apron during COVID care.	4.59	4.64	4.54	4.54	4.63	4.39*	4.70*	4.60	4.55
I am confident I know how to protect myself and my patients during the pandemic.	4.01	3.79	4.18	3.93	4.08	3.52*	4.29*	3.93	4.23
I believe PPE is important.	4.93	4.94	4.93	4.90	4.97	4.95	4.92	4.94	4.90
I believe PPE is readily available at UHCW Trust.	3.61	3.49	3.71	3.41*	3.81*	3.36*	3.75*	3.59	3.68
Current PPE guidelines are sufficient to protect healthcare workers from COVID-19.	2.71	2.85	2.60	2.61	2.81	2.30*	2.95*	2.62	2.97
Use of PPE by staff protects patients from COVID-19 during their episode of care at hospital.	3.71	3.66	3.75	3.64	3.77	3.61	3.77	3.57*	4.13*
PPE use is inconvenient.	3.21	2.77*	3.56*	3.07	3.35	3.05	3.31	3.20	3.26
PPE use interferes with patient care.	3.06	2.85	3.22	2.71*	3.39*	2.75*	3.23*	3.04	3.10
I feel comfortable raising concerns about PPE availability.	3.40	3.08*	3.66*	3.27	3.53	3.05*	3.61*	3.37	3.52
In an emergency I will always wear all required PPE before attending to a patient.	4.09	4.08	4.10	4.19	4.00	3.84*	4.23*	4.08	4.13
Prior to COVID-19 I always washed my hands at each of the "WHO 5 moments of hand hygiene" for every patient I saw.	3.89	4.25*	3.62*	3.88	3.90	3.91	3.88	3.83	4.06
During COVID-19 pandemic I have become more diligent in hand washing.	4.91	5.30	4.60	4.49	5.31	5.45	4.60	4.99	4.68
I feel confident in sharing and discussing underlying health conditions with my line manager.	4.13	3.81*	4.38*	4.02	4.24	3.91	4.26	4.03	4.42
I feel confident in the process of donning and doffing PPE.	4.11	4.09	4.12	4.20	4.02	3.89	4.23	4.08	4.19

\* = statistically significant difference  $p < 0.05$

1 = strongly disagree, 2 = slightly disagree, 3 = neither agree/disagree, 4 = slightly agree, 5 = strongly agree

However, a statistically significant difference was noted between staff with 0–5 years of experience versus those with >5 years of experience ( $P=0.011$ ), with the former group disagreeing that guidelines during the pandemic were sufficient.

**Question 7: "I believe use of PPE by staff protects patients from COVID-19 during their episode of care at hospital"**

In response to this question, there was no difference between healthcare staff of a BAME background versus White-British background ( $P=0.811$ ), between male versus female staff ( $P=0.863$ ) and between healthcare staff with 0–5 years of experience versus >5 years of experience ( $P=0.501$ ).

However, there was a statistically significant difference between healthcare staff who obtained their initial medical degree in the UK versus non-UK trained staff ( $P=0.021$ ), with the latter more strongly agreeing that PPE would protect their patients from COVID-19.

**Question 8: "I believe PPE is inconvenient"**

In response to this question, there was no difference between healthcare staff of a BAME background versus White-British background ( $P=0.281$ ), those who obtained their initial medical degree in the UK versus non-UK trained staff ( $P=0.860$ ) and staff with 0–5 years of experience versus those with >5 years of experience ( $P=0.197$ ).

However, there was a significant difference between male versus female healthcare staff ( $P=0.02$ ), with more male than female staff feeling that PPE is inconvenient (Figure 1).

**Question 9: "I believe PPE use interferes with patient care"**

In response to this question, there was a statistically significant difference between staff of a BAME background versus White British background ( $P=0.004$ ), with the latter group feeling more strongly that PPE interferes with patient care.

Similarly, such a statistically significant difference was also documented between staff with 0–5 years of experience versus those with >5 years of experience, with the latter feeling more strongly that PPE interferes with patient care ( $P=0.036$ ).

In comparison, the responses for this question did not differ significantly between healthcare staff who obtained their initial medical degree in the UK versus non-UK trained staff ( $P=0.976$ ), nor between male versus female healthcare staff ( $P=0.170$ ).

**Question 10: "I feel comfortable raising concerns about PPE availability"**

In response to this question, there was no difference between healthcare staff of a BAME background versus those of

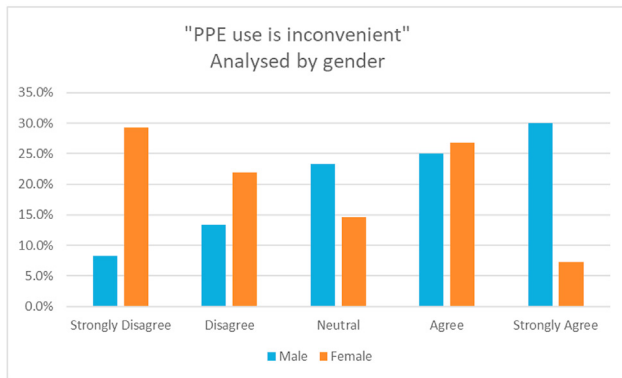


Figure 1. PPE use is inconvenient analysed by gender.

White-British background ( $P=0.331$ ), and between UK versus non-UK trained staff ( $P=0.591$ ).

On the other hand, there was a statistically significant difference between male compared to female staff, with the former more strongly feeling they are comfortable raising concerns about PPE availability ( $P=0.010$ ).

Similarly, a statistically significant difference was noted between healthcare staff with 0–5 years of experience versus those with >5 years of experience, with the latter group more strongly feeling they are able to raise concerns about PPE availability ( $P=0.013$ ).

**Question 11: "In an emergency I will always wear all required PPE before attending to a patient"**

In response to this question, there was no difference between healthcare staff of a BAME background versus White-British background ( $P=0.383$ ) and those who obtained their initial medical degree in the UK versus non-UK trained staff ( $P=0.606$ ), as well as between male versus female staff ( $P=0.555$ ).

However, there was a statistically significant difference between healthcare staff with 0–5 years of experience versus those with >5 years of experience ( $P=0.003$ ), with the latter group more strongly agreeing that they would always wear all required PPE before attending to a patient.

**Question 12: "prior to COVID-19 I always washed my hands at each of the "WHO 5 moments of hand hygiene for every patient I saw"**

In response to this question, no difference was noted between healthcare staff of a BAME background versus those of White-British background ( $P=0.858$ ), those who obtained their initial medical degree in the UK versus non-UK trained staff ( $P=0.368$ ) and those with 0–5 years of experience versus staff with >5 years of experience ( $P=0.393$ ).

However, responses to this question differed significantly between male and female staff ( $P=0.022$ ), with the latter group reporting more that they washed their hands at each of the WHO 5 moments of hand hygiene.

**Question 13: "During COVID-19 pandemic I have become more diligent in hand washing"**

In response to this question, there was no difference between any of the compared study groups regarding becoming more diligent in hand washing during the COVID-19 pandemic [healthcare staff of a BAME background versus White-British background ( $P=0.950$ ); staff who obtained their initial medical degree in the UK versus those that were non-UK ( $P=0.232$ ); male versus female staff ( $P=0.793$ ); staff with 0–5 years of experience versus those with >5 years of experience ( $P=0.586$ )].

**Question 14: I feel confident in sharing and discussing underlying health conditions with my line manager"**

In response to this question, there was a statistically significant difference only between male and female staff ( $P=0.022$ ), with more men feeling confident in sharing and discussing their underlying health conditions with their line managers (Figure 2). No difference was noted for between other compared groups [healthcare staff of a BAME versus White-British background ( $P=0.159$ ); staff who obtained their initial medical degree in the UK versus non-UK trained staff ( $P=0.196$ ); and staff with 0–5 years of experience versus >5 years of experience ( $P=0.076$ )].

**Question 15: "I feel confident donning and doffing PPE"**

In response to this question, there was no difference between any of the compared groups [healthcare staff of a BAME versus White-British background ( $P=0.303$ ); UK versus non-UK trained staff ( $P=0.317$ ); male versus female staff ( $P=0.656$ ) and staff with 0–5 years of experience versus those with >5 years of experience ( $P=0.058$ )].

## Discussion

The findings of the present study offer important insight into the perceptions regarding PPE between different demographics of medically trained NHS staff. Our data show that the largest differences in perceptions are seen between less experienced and more experienced staff. Indeed, comparing

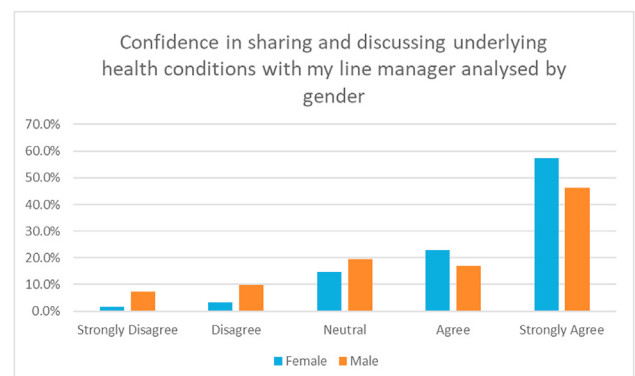


Figure 2. Confidence in sharing and discussing underlying health conditions analysed by gender.

staff members with 0–5 years of experience to those with over 5 years of experience, there were differences noted across the different survey questions. These differences in perception are particularly important given that large cohorts of junior doctors were redeployed as a consequence of the COVID-19 pandemic, many to areas with high numbers of COVID-19 patients [23]. Accordingly, these findings suggest that potentially specific induction and training requirements may be different between junior and more senior staff members [24], and this should be borne in mind during future outbreaks of COVID-19 or during future pandemics.

Moreover, there were also statistically significant differences in perception of PPE documented between male and female medical staff in topics regarding the belief that PPE use is inconvenient, feeling comfortable raising concerns about PPE availability, always washing their hands at each of the 5 moments of hand hygiene prior to the COVID-19 pandemic and feeling confident in sharing and discussing underlying health conditions with line manager. These differences suggest a need for relevant targeted actions, since increased risk for severe COVID-19 is generally noted for men compared to women, which makes to some extent the male healthcare workforce a relatively more vulnerable group [25]. It was reassuring to see that the pre-COVID relative laxity in male adherence to the WHO 5 steps in hand hygiene was improved during the COVID-19 outbreak (identified in questions 12 and 13 of the survey). With respect to risk assessment and concerns regarding confidentiality in sharing information with line managers, it would be prudent to have a cadre of individuals undertaking risk assessment and imparting risk reduction advice. These individuals should have defined training, competencies and a standardised, confidential approach to risk assessment to avoid the risk of line managers undertaking assessment with limited voluntary declaration of risk factors. Employers should take staff concerns regarding confidentiality very seriously.

There has been much media attention regarding access to PPE. Comparing the responses between staff of a BAME versus White British background, statistically significant differences were found regarding both the perception of availability of PPE across the Trust and the perception that PPE interferes with patient care. These findings are particularly important in the context of COVID-19, where healthcare staff from a BAME background have been shown to be at increased risk of both infection and poorer outcomes following infection [26]. Furthermore, this is a vital area to consider in the context of wider longstanding concerns of racism in the NHS [27]. We must ensure that all staff feel equally supported and protected both during the COVID-19 pandemic and beyond. It is important to note that this work does not look to identify whether or not there are in fact differences in PPE availability between groups of different ethnicities, but looks specifically as to whether there are difference in perception regarding availability. BAME Doctors felt that PPE was less available than white Doctors, despite there being sufficient PPE for all Doctors. This may reflect the impact of anecdotal claims of lack of availability and the impact of media and reports of lack of PPE availability being responsible for the deaths of BAME Doctors. Such claims can have a damaging effect on staff. These differences in perception are nevertheless vitally important and warrant further investigation and must ensure that in future, if there are claims of unavailability of PPE, these are rapidly

investigated and corrective action taken in order to avoid a detrimental impact on staff morale, particularly those in at risk groups.

One interesting finding was that Junior Doctors were more likely to put patients first, by not donning PPE in an emergency, compared to seniors. This is most critical in situations such as cardiac arrest, where a delay to cardiac compressions may lead to an increased risk of adverse outcome. During COVID-19, not only was there significant debate, which is still ongoing, as to whether CPR was an aerosol generating procedure, but there was inconsistent and heterogeneous advice across organisations and professional bodies. Health services must step up to generate universal advice and guidance to protect all staff equitably in future.

Finally, responses regarding the belief that PPE worn by staff protects patients themselves from COVID-19 during their episode of care differed significantly between staff who obtained their primary medical degree in the UK versus non-UK. Whilst not shown in the data, we propose it is possible that these differences may arise from international medical graduates experiences and expertise developed in other countries, where they may see an increased amount of infectious disease based presentations and potentially also an increased rate of nosocomial infections [28]. This would be an important area of future research. It remains crucial however to remember that there will similarly be differences in approaches to infection control practices between countries which may, or indeed may not, protect patients in NHS hospitals. It is important therefore to understand the reasoning behind these variations in perception and what educational opportunities there may be for staff groups.

Identifying key differential perceptions amongst certain NHS staff groups regarding PPE use, effectiveness and availability is vital in the context of the current COVID-19 pandemic. Such findings are important in order to guide education and additional support to NHS staff groups that may need it in a tailored manner. These should also prompt further research into the underlying causes for such differences in perception. Indeed, concerns that PPE is not readily available, or that PPE is not sufficient may have a significant impact on staff morale and consequently contribute to further stress, and anxiety. During a pandemic, the need to manage anxiety amongst staff is essential and we must learn from this pandemic for future pandemics, that early assessment of perception and acting upon it, is vital to support staff.

Overall, the findings of the present research study suggest that this topic merits further qualitative research and recommendations for assessment and management of perception in this and in future pandemics. We have included in [Table 3](#) below a list of the recommended actions to ensure the differential perceptions described in this article can be addressed.

### *Study limitations*

The present study explored only differences in perception, and, thus these do not demonstrate any variability in practice or other differences between the compared groups. Moreover, this research does not causally explain any increased risk of infection or negative outcomes related to COVID-19 in any of the studied groups.

**Table 3**  
Suggested mitigating actions for all health services.

Recommended actions	
1	There is significant concern amongst the workforce that current PPE provision is inadequate to protect the healthcare staff, this belief is most strongly held amongst those recently qualified. We should identify how best to reassure staff regarding the evidence base behind PPE provision and its ability to protect staff in their daily work. This could best be performed by a more in depth qualitative piece of research.
2	We should consider working with BAME groups, to identify why and where they feel availability of PPE provision is inadequate and correct this as a matter of urgency (given the increased health risks in this cohort). The power of media, both positive and negative, must not be underestimated.
3	We support all staff, regardless of gender to have open discussions with their line managers about underlying health conditions, particularly targeting this support to the female workforce. We recommend that risk assessment is adequately defined and consistently delivered.
4	There remains work to do in supporting staff to determine when and what to use in terms of FFP3 and eye protection in COVID-19 care, this is particularly important to those recently qualified.
5	Significant gains have been made in hand washing practices during the COVID-19 pandemic, the greatest improvements have been seen amongst the male workforce, it is important we sustain this improvement during restoration and beyond.
6	We should ensure junior doctors are better able to raise concerns about PPE availability where they feel this to be lacking.

The study considers a specific area for which there are no previous existing validated questionnaires. Whilst we made efforts (described above) to pilot the study in advance, this was only done with a small cohort of individuals. It is necessary to

consider that the response rate of the survey was 28%, however this was achieved from frontline staff at the peak of the pandemic and therefore we would suggest still represents an important and meaningful cohort despite being a single centre study. This introduced the potential for selection bias within the survey, although providing relevant useful indications, these findings cannot be generalised. We must further consider other areas of bias, most notably confirmation bias, where respondents to the survey are recalling their actions and perceptions. The respondents completed the survey after a voluntary COVID-19 online education package before assignment to COVID-19 care areas, so it is possible this could have influenced their perceptions. The education package, however, made no mention or distinction between sex, ethnicity, country of degree or length of experience, which are the key findings of this manuscript and the key areas of difference.

## Conclusions

Provision and use of PPE is effective in supporting healthcare staff to work safely during the COVID-19 pandemic. This study suggests that individual hospitals/centres may wish to consider not only their PPE provision, but also the perceptions of the local healthcare workforce. To our knowledge, this is the first research study to demonstrate a range of differential perceptions between NHS medical staff of different demographic groups. Variations in perceived availability of PPE, ability to raise concerns about PPE and ability to discuss underlying health conditions with line managers are particularly concerning. Further research work is urgently needed to both understand and address such concerns in greater detail.

## Credit author statement

Tim Robbins made substantial contributions to the conception and design of the work, data collection, analysis and interpretation. He drafted the first draft of the manuscript.

Ioannis Kyrou made significant contributions to the design of the work, analysis and interpretation of findings and was closely involved in multiple revisions of the manuscript.

Maariyah Vankad made significant contributions to the design of the work alongside acquisition and analysis of data and has been involved in drafting the manuscript with particular focus on the figures.

Risheka Suthantirakumar made significant contributions to the design of the work alongside acquisition and analysis of data and has been involved in drafting the manuscript with particular focus on the figures.

Natalie Igharo made significant contributions to the design of the work alongside acquisition and analysis of data and has been involved in drafting the manuscript with particular focus on the figures.

Kiran Patel was involved from the initial stages of the project, in particular with the ethical review and has provided both input and leadership at key project stages, including review of the manuscript prior to submission.

Harpal Randeve made substantial contributions to the project design/conception and provided leadership input throughout the project, he has been involved in the analysis, interpretation and drafting of the article.

Sailesh Sankar made substantial contributions to the initial idea/design/conception of the work and was involved in the acquisition of data as well as in the analysis and write up of the work.

### Conflict of interest statement

The authors have no conflicts to declare.

### Funding

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

### References

- [1] Lancet T. COVID-19: protecting health-care workers. *Lancet* (London, England) 2020;395(10228):922.
- [2] Remuzzi A, Remuzzi G. COVID-19 and Italy: what next? *The Lancet* 2020.
- [3] Cook T, Kursumovic E, Lennane S. Exclusive: deaths of NHS staff from covid-19 analysed. *Health Serv J*; 2020.
- [4] Li Lq, Huang T, Wang Yq, Wang Zp, Liang Y, Huang Tb, et al. COVID-19 patients' clinical characteristics, discharge rate, and fatality rate of meta-analysis. *Journal of Medical Virology* 2020;92(6):577–83.
- [5] Khunti K, Singh AK, Pareek M, Hanif W. Is ethnicity linked to incidence or outcomes of covid-19? *British Medical Journal Publishing Group* 2020.
- [6] Laurencin CT, McClinton A. The COVID-19 pandemic: a call to action to identify and address racial and ethnic disparities. *Journal of Racial and Ethnic Health Disparities* 2020:1–5.
- [7] Liu K, Chen Y, Lin R, Han K. Clinical features of COVID-19 in elderly patients: A comparison with young and middle-aged patients. *Journal of Infection* 2020.
- [8] Williamson E, Walker AJ, Bhaskaran KJ, Bacon S, Bates C, Morton CE, et al. OpenSAFELY: factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients. *MedRxiv* 2020.
- [9] Moorthy A, Sankar TK. Emerging public health challenge in UK: perception and belief on increased COVID19 death among BAME healthcare workers. *Journal of Public Health* 2020;42(3):486–92.
- [10] Organization WH. Rational use of personal protective equipment (PPE) for coronavirus disease (COVID-19): interim guidance. *World Health Organization* 2020. 19 March 2020.
- [11] Sayburn A. Are UK doctors getting sufficient protective equipment against covid-19? *BMJ* 2020:369.
- [12] Chughtai AA, Chen X, Macintyre CR. Risk of self-contamination during doffing of personal protective equipment. *American Journal of Infection Control* 2018;46(12):1329–34.
- [13] Kwon JH, Burnham C-AD, Reske KA, Liang SY, Hink T, Wallace MA, et al. Assessment of healthcare worker protocol deviations and self-contamination during personal protective equipment donning and doffing. *Infection Control & Hospital Epidemiology* 2017;38(9):1077–83.
- [14] Cavanagh G, Wambier CG. Rational hand hygiene during the coronavirus 2019 (COVID-19) pandemic. *Journal of the American Academy of Dermatology* 2020.
- [15] Lewnard JA, Lo NC. Scientific and ethical basis for social-distancing interventions against COVID-19. *The Lancet. Infectious Diseases* 2020.
- [16] Khunti K, de Bono A, Browne I, Greenhalgh T, Hanif W, Majeed A, et al. Risk Reduction Framework for NHS Staff at risk of COVID-19 infection. *Workforce* 2020;20(17):44.
- [17] Liu Y, Yan L-M, Wan L, Xiang T-X, Le A, Liu J-M, et al. Viral dynamics in mild and severe cases of COVID-19. *The Lancet Infectious Diseases* 2020.
- [18] Savoia E, Argentini G, Gori D, Neri E, Piltch-Loeb R, Fantini MP. Factors associated with access and use of PPE during COVID-19: a cross-sectional study of Italian physicians. *Plos One* 2020;15(10):e0239024.
- [19] Piché-Renaud P-P, Groves HE, Kitano T, Arnold C, Thomas A, Streitenberger L, et al. Healthcare worker perception of a global outbreak of novel coronavirus (COVID-19) and personal protective equipment: Survey of a pediatric tertiary-care hospital. *Infection Control & Hospital Epidemiology* 2020:1–7.
- [20] Norton EJ, Georgiou I, Fung A, Nazari A, Bandyopadhyay S, Saunders KE. Personal protective equipment and infection prevention and control: a national survey of UK medical students and interim foundation doctors during the COVID-19 pandemic. *Journal of Public Health* 2020. Oxford, England.
- [21] Microsoft Corp. MS Excel. WA, USA: Redmond; 2016.
- [22] IBM. SPSS Statistics for Windows. NY: Armonk; 2019. Version 24.0.
- [23] Coughlan C, Nafde C, Khodatars S, Jeanes AL, Habib S, Donaldson E, et al. COVID-19: lessons for junior doctors redeployed to critical care. *Postgraduate Medical Journal* 2020.
- [24] Hettle D, Sutherland K, Miles E, Allanby L, Bakewell Z, Davies D, et al. Cross-skilling training to support medical redeployment in the COVID-19 pandemic. *Future Healthc J* 2020.
- [25] Walter LA, McGregor AJ. Sex-and Gender-specific Observations and Implications for COVID-19. *Western Journal of Emergency Medicine* 2020;21(3):507.
- [26] Kirby T. Evidence mounts on the disproportionate effect of COVID-19 on ethnic minorities. *The Lancet Respiratory Medicine* 2020;8(6):547–8.
- [27] Adebowale V, Rao M. It's time to act on racism in the NHS. *British Medical Journal Publishing Group* 2020.
- [28] Ruef C. Infection control measures to prevent the transmission of nosocomial pathogens: can or should there be an international consensus?. 2010 [Springer].