

# Personal protective equipment and infection prevention and control: a national survey of UK medical students and interim foundation doctors during the COVID-19 pandemic

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## ABSTRACT

**Background** The adequacy of personal protective equipment (PPE) and infection prevention and control (IPC) training in UK medical students and interim Foundation Year 1 (FiY1) doctors during the COVID-19 pandemic is unknown, as is its impact on COVID-19-related anxiety.

**Methods** Cross-sectional, multi-centre study analysing self-reported adequacy of PPE and IPC training and correlation to a modified pandemic anxiety scale. Participants were current medical students and FiY1 doctors in the UK. Data were collected by an online survey.

**Results** Participants reported that they received insufficient PPE information (43%) and IPC training (56%). Significantly, fewer participants identifying as women or BAME/mixed ethnicity reported receiving sufficient PPE information, compared with those identifying as men and White British/White Other, respectively. COVID-19-related anxiety was significantly higher in those without sufficient reported PPE or IPC training, in women compared with men, and in FiY1 doctors compared with medical students.

**Conclusions** With medical students currently volunteering in and imminently returning to hospitals in an educational capacity, levels of self-reported PPE and IPC training are sub-optimal. Better training is paramount to avoid harm to patients and healthcare professionals and to reduce COVID-19-related anxiety among medical students and FiY1 doctors.

**Keywords** coronavirus, COVID-19, infection prevention and control, interim foundation doctors, medical students, personal protective equipment

## Introduction

Adequate personal protective equipment (PPE) is a central component of infection prevention control (IPC) and is of paramount importance in the fight against COVID-19.<sup>1,2</sup> Consistent and effective use of PPE is essential for protecting patients, healthcare workers and their families. This has been illustrated throughout the fight against COVID-19, with lack of PPE cited as a common cause of COVID-19-related death in healthcare workers.<sup>3</sup> Furthermore, PPE provision has been highlighted as inadequate across the healthcare sector.<sup>4</sup>

UK medical students were called upon to volunteer during the pandemic. Many took on clinical roles in hospitals or volunteered in the community in addition to their studies. To mitigate workforce shortages, the UK government announced in March 2020 that final year students would graduate early

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and be provisionally added to the medical register to work as interim Foundation Year 1 (FiY1) doctors. Medical students were designated as ‘essential workers’ by the Medical Schools Council in May 2020, meaning that the ‘teaching and supervising medical students on clinical placements are seen as essential work within the health service’.<sup>5</sup> With medical schools and teaching hospitals resuming the teaching of medical students over the coming months, this poses a substantial infection control challenge due to the large student population and their contact with vulnerable patient populations across multiple specialties in the context of their education. It is essential that medical students and FiY1 doctors are given appropriate IPC training to prevent spreading the virus to patients and to safeguard themselves, their friends and families. To date, few studies have explored the provision of IPC training and access to PPE information in the medical student population.<sup>6,7</sup>

It is increasingly evident that the physical, mental and emotional effects of the pandemic are attributable not only to the direct impact of COVID-19 on individuals but also to the measures implemented to combat the pandemic at the levels of local communities and entire countries. The SPICE-19 collaborative recently conducted a prospective, observational, multi-centre study identifying how COVID-19 has impacted the lives of medical students and FiY1 doctors across the UK.<sup>8</sup> Mood in this cohort was shown to be significantly lower since the start of the pandemic—influenced by social distancing measures and self-isolation, among other factors.<sup>8</sup>

This paper presents the first study on training and perceptions of PPE and IPC training in UK medical students and FiY1 doctors during the COVID-19 pandemic. It also explores factors contributing to disparities in the information received and the impact of the adequacy of PPE and IPC training on anxiety related to COVID-19.

## Methods

A cross-sectional, multi-centre study was conducted using the UK National Research Collaborative Model.<sup>9</sup> Medical students and FiY1 doctors were invited to complete an online questionnaire regarding their mental health and wellbeing. Real-time data were collected over 4 weeks and commenced on the 4th of May 2020. Ethical approval was received by the University of Oxford Medical Sciences Inter-Divisional Research Ethics Committee (Ethics Approval Reference: R69297/RE001).

The primary outcomes were self-reported the sufficiency of PPE information and IPC training received (yes/no) and source of this information/training. These measures were compared to gender, ethnicity, age, working status during

the pandemic (medical students compared to FiY1s; medical students working in hospital roles during the pandemic compared to those not) and Likert-type questions relating to IPC (‘I am worried that I will catch COVID-19’; ‘I am worried that friends and family will catch COVID-19’ and ‘I am worried I might transmit the infection to someone else’). The Likert-type questions were derived from the pandemic anxiety scale,<sup>10</sup> with ‘strongly disagree’ scoring 0 points, ‘strongly agree’ scoring 4 points and the remaining points from 1–3 points being awarded to were assorted to the variables in the middle.

The data were reported using IBM SPSS v25.<sup>11</sup> Chi-squared test was used to analyse the association between gender, ethnicity, age and working status during the pandemic, on the self-reported sufficiency of PPE information and IPC training. Mann–Whitney U test was used to analyse the relationship between the sufficiency of PPE information, IPC training, working status during the pandemic, gender and ethnicity, with scores on the Likert-type questions. After interim analysis, the mean and 95% confidence interval (CI) of the mean were also calculated for clarity. The relationship between age and the Likert-type questions was tested using Spearman Correlation. All the assumptions of the statistical methods were met.

## Results

A total of 2075 medical students and FiY1 doctors participated in the SPICE-19 study. Key demographics are listed in Table 1.

Of respondents, 43% felt that they had received sufficient information on PPE ( $n = 1752$ ), compared with 56% who responded that they had sufficient IPC training ( $n = 1729$ ),  $P < 0.001$ . The most commonly listed source of PPE information was NHS trusts with 56% including them as one of their sources of information ( $n = 748$ ). For IPC training, universities were the most commonly listed source, 70% ( $n = 975$ ). Other sources of information are listed in Table 1 and Fig 1.

### Influence of gender/ethnicity/age

About 41% women reported sufficient information regarding PPE ( $n = 1294$ ), compared with 47% of men ( $n = 443$ ),  $P = 0.026$ . About 58% women reported sufficient IPC training ( $n = 1328$ ), compared with 56% of men ( $n = 436$ ),  $P = 0.426$ . About 47% of those identifying as White British/White Other ethnicity reported receiving sufficient information on PPE ( $n = 1184$ ), compared with 33% of those identifying as BAME/mixed ethnicity ( $n = 537$ ),  $P < 0.001$ .

**Table 1** Population demographics and key PPE and IPC findings

<b>Population parameters</b>	
<b>Age (mean ± SD) (years) (n = 1713)</b>	22.2 ± 3.36, range 18–59
<b>Gender (n = 2022)</b>	Female: 1507 Male: 507 Non-binary: 8
<b>Ethnicity (n = 1993)</b>	White British/Other White: 1352 BAME: 641
<b>Stage of training (n = 2075)</b>	Medical student: 1909* FiY1: 166
<b>PPE</b>	
<b>Have you been provided with sufficient information on PPE? (n = 1752)</b>	Yes: 748 (43%) No: 1004 (57%)
<b>Who has provided this source of information? (n = 748)</b>	University: 288 (39%) NHS trust: 417 (56%) National body: 266 (36%) Other: 90** (12%)
<b>IPC</b>	
<b>Have you been provided with sufficient training in IPC (n = 1729)</b>	Yes: 975 (56%) No: 754 (44%)
<b>Who has provided this training? (n = 975)</b>	University: 682 (70%) NHS trust: 483 (50%) National body: 168 (17%) Other**: 50 (5%)

\*368 medical students listed in-hospital roles during the pandemic alongside their studies, most commonly healthcare assistant roles (209 students).

\*\*other sources of information include news/media, voluntary work, other employers and family.

Sufficient IPC training was reported in 61 and 49% of those identifying as White British/White Other ( $n = 1164$ ) and BAME/mixed ethnicity ( $n = 536$ ), respectively,  $P < 0.001$ . There was no significant relationship between age and sufficiency of PPE information provision or IPC training.

### **Influence of working during the pandemic**

About 54% responses from FiY1 doctors ( $n = 142$ ) stated that they had sufficient information on PPE, compared with 42% of medical student responses ( $n = 1610$ ),  $P = 0.007$ . About 69% responses from FiY1 doctors ( $n = 141$ ) stated that they had sufficient training in IPC, compared with 55% medical student responses ( $n = 1588$ ),  $P = 0.002$ . NHS Trusts were the most commonly reported source of PPE information for both FiY1 doctors, 86% ( $n = 76$ ), and medical students, 54% ( $n = 654$ ). IPC training was most commonly sourced from NHS trusts in FiY1 doctors, 73% ( $n = 141$ ), and universities in medical students, 73% ( $n = 1588$ ). Other information sources are shown in Fig. 1.

Within medical students, 62% of those that undertook hospital roles during the COVID-19 pandemic felt that they

had sufficient information about PPE ( $n = 359$ ) compared with 36% of those who did not list a hospital role ( $n = 1251$ ),  $P < 0.001$ . Similarly, 69% of those listing other hospital roles felt that they had sufficient IPC training ( $n = 359$ ), compared with 49% of those who did not list another hospital role ( $n = 1229$ ),  $P < 0.001$ .

### **Relationship between PPE/IPC and COVID-19-related anxiety**

'I am worried that I will catch COVID-19'. Those who reported receiving sufficient PPE information had significantly lower scores for this question (median 3, IQR 2) (mean 2.17, 95% CI: 2.10–2.24) ( $n = 754$ ), compared with those who reported not receiving this (median 3, IQR 2) (mean 2.32, 95% CI: 2.25–2.38) ( $n = 1018$ ),  $P = 0.004$ . Those who reported receiving sufficient IPC training had significantly lower scores for this question (median 3, IQR 2) (mean 2.20, 95% CI: 2.14–2.26) ( $n = 983$ ), compared with those reporting they did not (median 3, IQR 2) (mean 2.32, 95% CI: 2.25–2.39) ( $n = 766$ ),  $P = 0.011$ , Figure 2A–B.

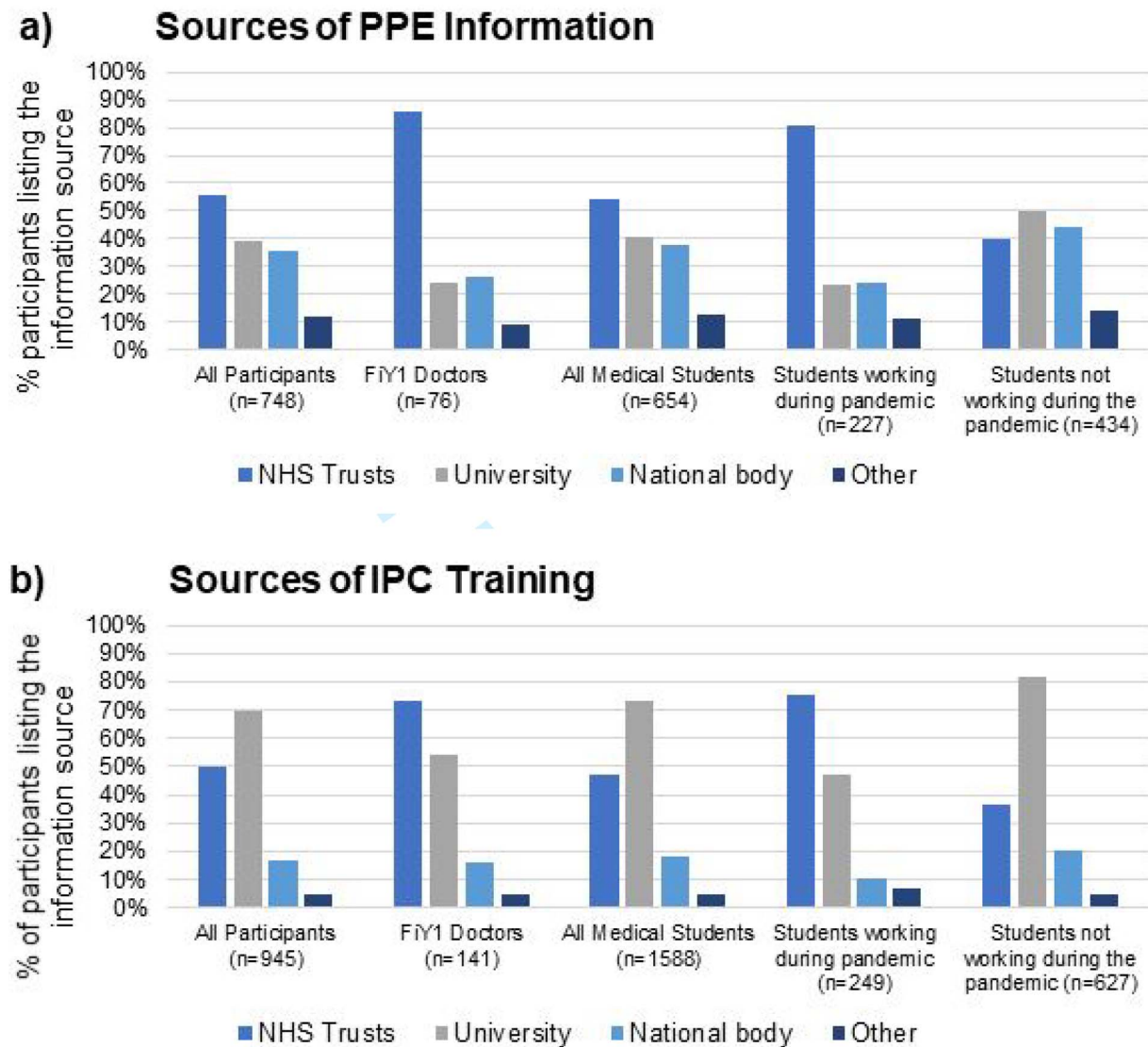


Fig. 1 Source of PPE information and IPC training by role.

'I am worried that friends and family will catch COVID-19'. There was no significant difference in the scores for this question between those reporting receiving/not receiving sufficient PPE information or IPC training. 'I am worried I might transmit the infection to someone else'. There was no significant difference in the scores for this question between those reporting receiving/not receiving sufficient information on PPE or IPC training.

#### Relationship between gender/ethnicity/age and COVID-19-related anxiety

Women had significantly higher anxiety scores for 'I am worried that I will catch COVID-19' (median 3 and IQR 2) (mean 2.30, 95% CI: 2.25–2.35) ( $n = 1487$ ), compared with men

(median 2, IQR 2) (mean 2.11, 95% CI: 2.02–2.20) ( $n = 501$ ),  $P < 0.001$ . Women had significantly higher scores for 'I am worried that friends and family will catch COVID-19' (median 3, IQR 1) (mean 3.24, 95% CI: 3.20–3.28) ( $n = 1488$ ), compared with men (median 3, IQR 1) (mean 3.09, 95% CI: 3.02–3.16) ( $n = 501$ ),  $P < 0.001$ . Similarly, women had significantly higher scores for 'I am worried I might transmit the infection to someone else' (median 3, IQR 0) (mean 2.96, 95% CI: 2.91–3.01) ( $n = 1488$ ), compared with men (median 3, IQR 0) (mean 2.78, 95% CI: 2.70–2.87) ( $n = 502$ ),  $P < 0.001$ , Figure 2C-E.

There was no significant difference in anxiety for any of the 3 questions tested between those identifying as White British/White other and BAME/Mixed Ethnicity.

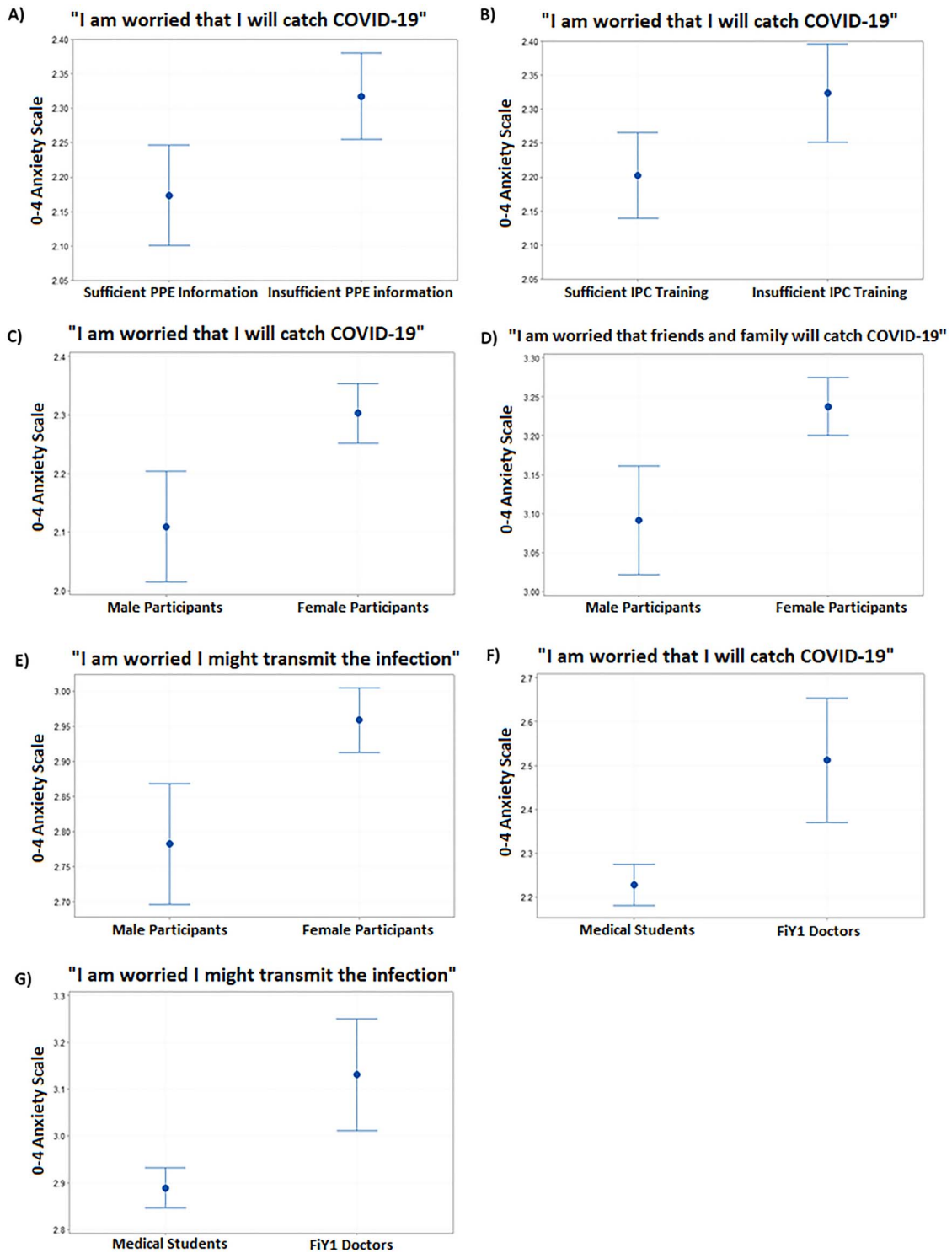


Fig. 2 Interval plots illustrating COVID-19-related anxiety (mean and 95% CI).

There was a significant positive correlation between age and anxiety scores for 'I am worried that I will catch COVID-19' ( $r_s = 0.085$ ,  $P < 0.001$ ). No correlation was seen between age and score for the remaining 2 questions.

#### Relationship between working during the pandemic and COVID-19-related anxiety

FiY1 doctors had significantly higher anxiety scores for 'I am worried that I will catch COVID-19' (median 3 and IQR

1) (mean 2.51, 95% CI: 2.37–2.65) ( $n = 160$ ), compared to medical students (median 3, IQR 2) (mean 2.23, 95% CI: 2.18–2.28) ( $n = 1852$ ),  $P = 0.001$ . Similarly, FiY1 doctors had significantly higher anxiety scores for ‘I am worried I might transmit the infection to someone else’ (median 3 and IQR 1) (mean 3.13, 95% CI: 3.01–3.25) ( $n = 150$ ), compared with medical students (median 3, IQR 0) (mean 2.89, 95% CI: 2.85–2.93) ( $n = 1853$ ),  $P = 0.002$ , [Figure 2F-G](#). No significant difference was seen in scores for the question ‘I am worried that friends and family will catch COVID-19’ between FiY1 doctors and medical students. Within medical students, there was no significant difference in scores for any of the 3 questions between those working in hospital roles during the pandemic and those not.

## Discussion

### Main findings of this study

This study revealed sub-optimal self-reported PPE and IPC training in medical students from 33 medical schools in the UK during the COVID-19 pandemic. Sufficiency of PPE information was significantly worse than that of IPC training. Given the rapidly evolving nature of the COVID-19 pandemic coupled with the imminent re-introduction of medical students into hospitals across the UK, this indicates a pressing need to incorporate novel COVID-19-specific PPE information into general teaching on IPC measures already embedded in the medical school curriculum. Furthermore, it may be desirable to examine the proficiency of IPC measures and include ‘donning and doffing’ as a skill required of medical graduates by bodies such as the GMC. We speculate, however, that IPC knowledge will exponentially increase as medical students acclimatize to the ‘new normal’ of clinical environments.

### What is already known on this topic

Previous studies that identified inadequacies in the knowledge of medical students on various aspects of IPC, including contamination risks, hand hygiene and PPE prior to the COVID-19 pandemic.<sup>12,13</sup>

### What this study adds

This is the first study of its kind into PPE and IPC training in UK medical students and FiY1 doctors during the COVID-19 pandemic, to the best of the authors’ knowledge at the time of writing. It also, for the first time, investigates the influence of ethnicity, gender, volunteering to work during the pandemic within this cohort, and importantly investigates correlations with COVID-19-related anxiety.

IPC training is most commonly delivered in groups. Interestingly, our findings reflect both the training received and individuals’ perception of that training. The latter may in turn reflect individuals’ own unique risk perception and expectations of PPE/IPC training. Delivery of training via online platforms may also reduce the ability for trainers to address such individual concerns.

We report here, for the first time, that students identifying as BAME (Black, Asian and Minority Ethnic) or Mixed ethnicity were less likely to report sufficient PPE information provision and IPC training than students identifying as White British or White Other. It may be hypothesized that BAME individuals had higher expectations of PPE information and IPC training attributable to increased health anxiety due to being in a ‘higher risk’ category. The significant media attention gained by BAME individuals during the pandemic may have furthered heterogeneity in perceived risk among the medical student population. This study did not evaluate perceived risk from COVID-19, however, and not find COVID-19-related anxiety to be higher in BAME medical students. These results could also be explained, unfortunately, by discrimination against BAME individuals, for example when FIT testing masks due to beards, veils or turbans.<sup>14</sup> Nonetheless, these results are concerning given the emerging evidence that BAME groups are more likely to have more severe symptoms and poor outcomes associated with COVID-19 infection.<sup>15</sup> Recent data from UK intensive care units show that over a third of patients with confirmed COVID-19 are from BAME communities.<sup>16</sup> Given that 23% of UK medical graduates identified as BAME in 2019,<sup>17</sup> medical schools and NHS Trusts should endeavour to better understand why PPE and IPC information is felt to be insufficient in BAME groups and ensure adequate competency in training.

In addition, significantly fewer female students reported sufficient PPE information provision than male students. This is consistent with previous studies which have found that female healthcare workers are more likely to report the lack of PPE availability than male colleagues.<sup>18,19</sup> This may indicate that female healthcare workers are more anxious about IPC measures and/or highlight a male culture of under-reporting. Female medical students and FiY1 doctors had higher anxiety surrounding catching COVID-19, friends and family being infected and transmitting the virus, compared with males. Interestingly, males have lower risk perception towards COVID-19 compared with females,<sup>20</sup> despite being 1.5-times more likely to die from COVID-19 than females.<sup>21</sup> This suggests a mismatch between morbidity and mortality statistics reported in the media and those reported in the medical literature. Medical schools may benefit from delineating the misconceptions of infection risk and combating them by

providing accurate statistics relevant to their particular student populations. Further prospective studies on absolute risks and behavioural responses to pandemic control measures are needed to identify the factors driving ethnicity and gender inequality in the provision and access of PPE information.

Medical students were significantly less likely to report sufficient PPE information provision and IPC training than FiY1 doctors. This is perhaps unsurprising given the need for training to be prioritized for those in frontline roles but it is concerning that not all medical students who volunteered (62%) or FiY1 doctors (54%) reported receiving sufficient PPE information, illustrating the need for stronger communication from medical schools. It should also be noted that 13% of medical students sourced information from non-official resources, including media and family members, which may propagate inconsistencies and inaccuracies regarding appropriate PPE use.

Participants reporting insufficient PPE information or IPC training reported significantly greater levels of anxiety related to being infected with COVID-19. This builds on the limited number of studies on healthcare workers that have reported greater levels of psychological distress related to COVID-19 due to inadequate PPE<sup>22,23</sup> while supporting the global consensus that COVID-19-related anxiety in medical students is high.<sup>24</sup> This anxiety increased with age, which may be explained by more senior medical students having increased exposure to patients, being closer to joining the medical register and feeling that greater expectations are placed on them. Similarly, anxiety about being infected with and transmitting COVID-19 was higher in FiY1 doctors than medical students. Medical schools should ensure that students undergo adequate IPC training so that they are fully prepared for clinical environments in the era of COVID-19.

Our results on COVID-19-related anxiety are concerning given that poorer mental health outcomes are associated with higher infection risk in healthcare workers during previous outbreaks.<sup>25,26</sup> Given the high baseline levels of anxiety in the medical student population prior to COVID-19,<sup>27,28</sup> exacerbations of anxiety are to be expected and emphasis should be placed on protecting the mental health and emotional well-being of medical students as they acclimatize to a working environment that has been radically changed by COVID-19.

COVID-19-related anxiety may also have far-reaching effects on medical education. Students may be less inclined to talk to and examine patients, due to the fear of catching or spreading COVID-19 between patients or to friends and family. It is therefore essential that medical schools implement measures to ensure that this anxiety is acknowledged and addressed. Such measures could include: ensuring comprehensive PPE education; identifying psychologically

vulnerable groups of students; exploring options to minimize face-to-face teaching interactions when appropriate through telemedicine modalities; and issuing firm guidance on returning to clinical placements and pairing students with doctors as part of a student welfare scheme.

### Limitations of this study

Limitations of this study include: a predominantly female sample, which may have limited our findings on gender inequality and IPC training; not accounting for socio-economic and geographical differences which may have confounded ethnicity comparisons; grouping participants from multiple ethnic backgrounds into two categories, 'BAME' and 'White British or White Other'; and self-reported outcomes, which can introduce bias and degree of subjectivity with respect to how levels of sufficiency are determined. With respect to determining levels of sufficiency, however, one would expect inter-individual differences to be internally consistent. Furthermore, at the population level, these discrepancies are minimized inherently by the diversity of individuals present. Self-reported sufficiency of IPC training as an outcome measure encompassed both the training received and each individual's perception of that training which were both of significant interest. Ultimately, these findings have wide-reaching actionable implications within the medical community.

### Conclusion

This novel, multi-centre study shows that the levels of self-reported PPE information and IPC training are sub-optimal in UK medical students and FiY1 doctors, which significantly correlates to COVID-19-related anxiety. It is paramount that medical students currently in, and returning to, the workplace are fully proficient with respect to PPE and IPC. There is a need to deliver rapid training, adapted to current circumstances, to better prepare medical students and avoid further transmission of the virus to patients and healthcare professionals. Provision of mental health and well-being support for medical students and FiY1 doctors is of significant importance to the longevity of the medical profession beyond the COVID-19 pandemic.

### Collaborators

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## Authors' contributions

E.N., I.G., A.F., A.N. and S.B. all contributed to data collection. Data analysis was performed by E.N. and I.G. All authors contributed to and revised the manuscript.

## Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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## Conflict of interest

All authors confirm they have no conflict of interest.

## Ethical approval

Ethical approval was received by the University of Oxford Medical Sciences Inter-Divisional Research Ethics Committee (Ethics Approval Reference: R69297/RE001) on 16th April 2020.

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