



# Knowledge of face masks and attitudes to re-sterilisation among healthcare workers

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## Abstract

**Introduction** COVID-19 was declared a pandemic in March 2020. With the sudden surge in demand for personal protective equipment (PPE), significant concerns regarding the ongoing availability emerged. One solution proposed is re-sterilisation of respirator masks and this has been commenced in some parts of the world. On review of the literature, very little is documented regarding the knowledge of masks and the attitudes of healthcare workers towards using re-sterilised masks.

**Methods** A comprehensive questionnaire was used to assess general knowledge and attitudes around facemasks and respirators.

**Results** There were 190 respondents. There were significant gaps in knowledge and understanding of when particular face masks should be worn. One-third had significant concerns about ongoing availability. One-third had concerns about the quality of the masks as the pandemic continued. Only 10% of respondents underwent formal face-fitting. Eighty percent of respondents stated they would wear a re-sterilised mask. A further 15% would use a re-sterilised mask but required certain reassurances. Five percent of our respondents would not use a re-sterilised mask under any circumstances.

**Discussion** Ensuring an adequate understanding of face masks is crucial among healthcare workers (HCWs) and this study highlights a need for further education. It also demonstrates a general acceptability among HCWs towards the use of re-sterilised face masks.

**Keywords** Attitudes · COVID-19 · Education · Face masks · Healthcare workers · Occupational health · Pandemic · Personal protective equipment · Respirators · Re-sterilisation

## Introduction

The emergence of the novel coronavirus COVID-19 as a pandemic has led to a concern regarding an international shortage of personal protective equipment (PPE). The World Health Organisation (WHO), in recent guidance with respect to rational use of PPE, stated that “The current global stockpile of

PPE is insufficient, particularly for medical masks and respirators; the supply of gowns and goggles is soon expected to be insufficient also” [1]. Current guidelines from a number of bodies recommend the use of FFP2 or N95 respirator masks with eye protection as well as gloves and gowns [2–5].

The recommendation of these masks is based on the filtration of particles that they offer a seal to the face and that they are broadly available for use. However, there are limitations. These masks are not custom made for face-fit to the individual and each individual has to have a face-fit to ensure adequate protection. The filter efficiency of the N95 and equivalent respirator masks relates to their “ability to effectively filter submicron particles and are standardised against uncharged particles of sodium chloride measuring 300 nm or aerosolised *Staphylococcus aureus*” [6, 7]. With regard to the general availability, there is a global shortage of PPE including face masks, which is most concerning in the face of a respiratory droplet spread virus. This problem has led to bidding wars amongst governments to acquire PPE for the healthcare workers [8]. As health services are now very much

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reliant on external supplies of PPE, it is imperative that systems are put in place to allow for more self-reliance should this particular pandemic endure or resurface, and also in preparation for future pandemics.

There are protocols being developed with regard to standardising the sterilisation of face masks that show acceptable retention of the efficiency of the filtration after 5 cycles [9, 10]. These protocols involve steam sterilisation which is available in all standard theatre sterilisation facilities. There are other methods of sterilisation with standard operating protocols, using hydrogen peroxide and plasma treatments. These have quicker turn-around times and can be processed outside conventional sterilisation facility; however, this equipment is not widely available [11]. As a solution to the shortage of respirators, re-sterilisation processes and pathways for collection and distribution have already been developed in the USA at a large scale [12].

However, there is the acceptability to the users of implementing such a process. When discussing the possibility of re-sterilisation of respirators in our institution during the evolving pandemic, it was quickly apparent that there were concerns amongst the healthcare workers (HCWs) regarding a number of factors. This led to the aim of this study which is to survey knowledge and attitudes of HCWs in this jurisdiction regarding facemasks and respirators and attitudes to re-sterilisation. To date, there is no published literature on this topic.

## Methods

The study has institutional ethical approval. The questionnaire was distributed to all staff working within our hospital network. There was no personal identifiable data collected and participants only identified their occupation.

The questionnaire was refined over multiple iterations amongst the authors. The questionnaire comprised 24 questions over 3 pages using established survey software (SurveyMonkey®). The initial questions aimed to ascertain overall knowledge regarding facemasks and respirators. Subsequently, the questionnaire then introduced questions that explored attitudes regarding facemasks, re-sterilisation and re-use.

The questionnaire is provided in the [supplemental information](#). The responses were analysed using the filtering tools provided by the software and statistical analysis was carried out using the Microsoft Excel® software using Student's *t* test/Chi-squared analysis/etc.

## Results

There were 190 respondents to the questionnaire. The distribution of occupations is shown in Fig. 1.

## Knowledge about face masks

Since the use of facemasks and respirators is now more common, the authors wanted to explore the awareness of the various levels of protection of different masks and the appropriateness of when to use which type. When asked about the level of protection offered by facemasks and respirators, the majority of respondents understood the protection provided by the different masks; however, just over 25% of respondents thought that respirators were only appropriate when dealing with confirmed COVID cases or in theatre for general anaesthetic procedures. When given illustrations of 4 different masks (see Fig. 2), 16.8% of respondents incorrectly identified at least one mask as a respirator mask with 78% ( $n = 25$ ) of those answering incorrectly responding that none of the illustrations represented a respirator mask. Another interesting finding regarding respirators was that almost 90% of respondents had not had a formal face-fit for their respirator mask.

Respirator masks can be fitted with outlet valves and are used in industry when working in dusty environments to allow easier breathing when one is not trying to prevent the spread of respiratory droplet spread viruses. When shown a N95 mask with an outlet valve and asked specifically about the role of the valve, it was interesting that most HCW respondents were not aware of the role of the outlet valve. Despite these masks not being distributed by their hospitals, over 70% of respondents thought that the valve was necessary to get the best filtration of particles and 87% did not realise that the respirator masks fitted with an outlet valve were not appropriate in the healthcare setting.

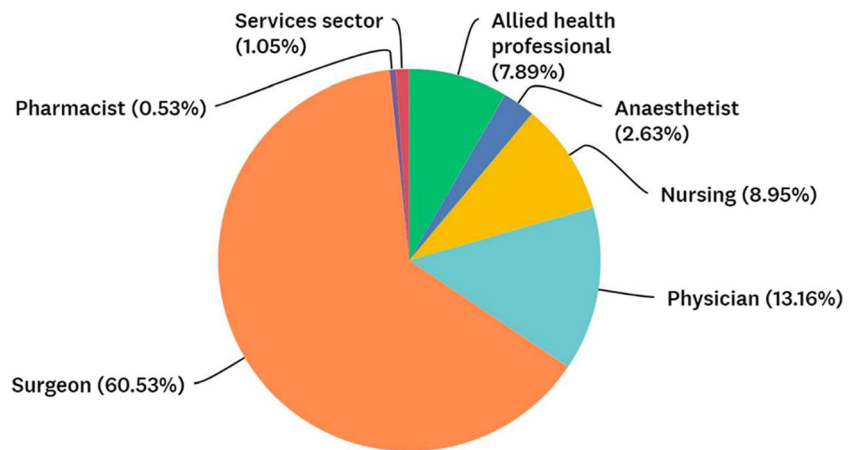
## Concerns about face masks

Close to 4 of 5 respondents felt that they had adequate access to facemask and respirator masks when necessary, but one-third had concerns about their ongoing availability. Both these had broadly similar distribution within the subgroups of HCWs.

## Attitudes towards re-sterilisation

Eighty percent of respondents when asked “in the setting of a shortage of respirator masks would you be happy to use a re-sterilised mask?” said that they would be. Upon further questioning of this given the option of using some form of identification of one's own mask going through re-sterilisation, 25% of respondents would demand that they would be able to identify their facemask or would not use it and 65.6% would prefer to be able to use their identifiable respirator after sterilisation. Five percent would rather go without the appropriate PPE, but not necessarily work without it, than use a re-sterilised respirator.

**Fig. 1** Distribution of respondent’s occupations



When asked how many times would you be willing to reuse a re-sterilised mask, 63.2% responded that they would be satisfied to go with whatever the certification deemed as safe, 14.7% were only happy to reuse a re-sterilised mask once, 16.6% would reuse it up to 4 times and 5.5% would not use a re-sterilised mask under any circumstances which corresponds to the 5% who responded to the identification of re-sterilised masks.

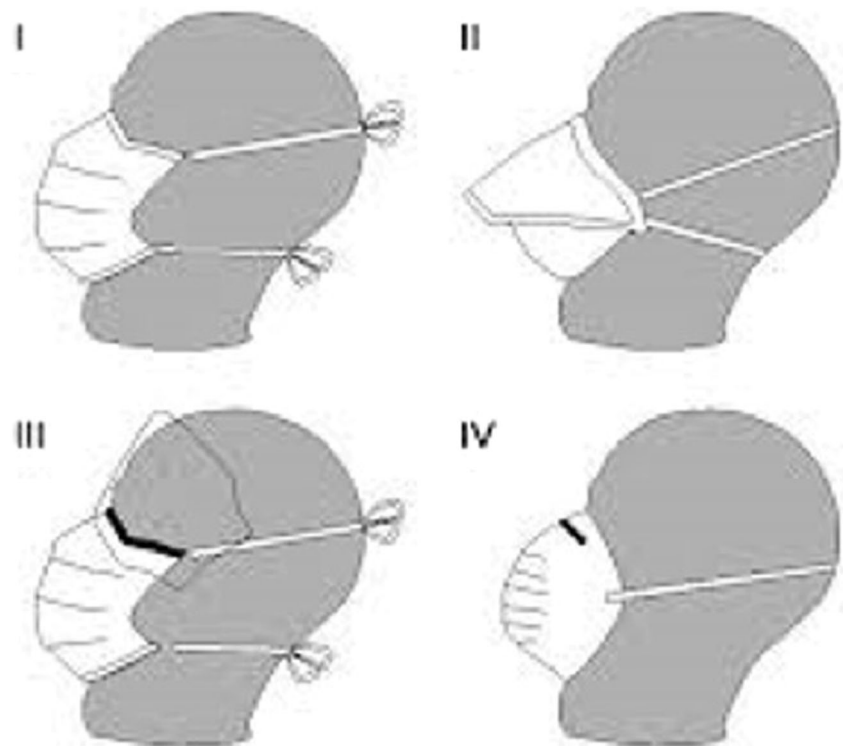
A total of 74.2% of respondents would be satisfied that if the re-sterilisation process has been validated by an appropriate authority that they would not require formal education regarding the re-sterilisation process with the rest of the respondents requesting formal education session.

Finally, from discussions with HCWs prior to the questionnaire, we formulated a list of 5 common concerns that were voiced anecdotally by HCWs when asked:

1. What concerns they may have about the supply and use of facemasks or respirators?
2. What concerns they may have about the re-sterilisation process?

In the survey, we listed these 5 concerns and asked respondents to rank them 1-5 with 1 being the greatest level of concern and 5 being the least. These questions were optional at the end of the survey and 148 of the 190 respondents filled out

**Fig. 2** Illustrations of facemasks and respirators for identification



the question. The aggregate responses were then weighted by frequency of rank. Tables 1 and 2 show the results of these two questions with “score” showing the frequency-weighted score for each. The main concern voiced regarding the supply and use of facemasks and respirators was that donning a facemask/respirator may provide a false sense of security to the user and that simple hand hygiene and social distancing are then ignored; the level of protection provided against contracting the virus may be overestimated was second, somewhat echoing the first concern. Table 2 very much represents the concerns that were gathered in the previous questions regarding the efficacy of the respirator after the sterilisation process followed by the concern perceived by HCWs regarding the ability of the sterilisation process to truly remove potential viruses from the respirator that may have been there from the previous user.

## Discussion

The outbreak of the COVID-19 pandemic has emphasised the importance in preparing for the future by optimising the availability and quality of our personal protective equipment. The widespread shortage of PPE during the peak of the pandemic highlighted a vulnerability in our health system leading many to consider methods by which we could become more self-reliant. One of the many proposals is the re-sterilisation of facemasks; however, within our institution, this approach was met with a variety of opinions. For this reason, we performed a qualitative study regarding the knowledge of HCWs with regard to surgical facemasks and respiratory masks as well as the attitude towards reuse of respiratory masks following re-sterilisation processes.

### Understanding of face masks

Ensuring our HCWs have an adequate understanding of face masks, and more generally PPE, is crucial. Schwatz et al. (2014) demonstrated that a high level of knowledge, both tested and self-perceived, regarding PPE use for A/H1N1 was associated with increased confidence in PPE among

HCWs, potentially promoting a sense of efficacy in coping with the pandemic [13]. They observe that the strong association between knowledge and confidence in PPE and its possible implications on preparedness and response to future events is promising, given that knowledge regarding the efficacy and appropriate use of PPE can easily be augmented. Similarly, Qureshi et al., when looking at HCW’s willingness to respond to duty during a catastrophe, describe HCW education as one of the most effective methods to allay fears and concerns for personal safety [14].

Some of our initial questions aimed to evaluate HCW’s general understanding of surgical facemasks and respirators. The majority of respondents knew the level of protection offered by both surgical facemasks and respirator masks. However, the questions revealed that 25% of HCWs underestimated the need for respirator masks and 16.8% of respondents incorrectly identified a respirator mask from Fig. 2. This finding indicates that there may be a need for continual education on a hospital wide basis, particularly for those who do not regularly use a respirator mask, which included over 40% of our respondents. Another interesting finding regarding knowledge of HCWs was that when shown a respirator mask with an outlet valve, the majority of respondents identified this as something that was necessary to obtain the best filtration. They did not realise that it was inappropriate in the healthcare setting as outlet valves allow unfiltered exhaled air leave the user leaving those surrounding them susceptible to infection. Our interpretation of this finding is that it is possibly pre-conceived. If one searches the internet for respirators, which many did during the outbreak of the pandemic, the marketing of specific masks may lead people to believe that this is the more superior type of respirator.

### Concerns regarding face masks

Our study identified availability, quality and lack of face-fitting as the three major areas of concern. One-third of HCWs had concerns about the availability of face masks in their hospital setting. One-third also had concerns about the quality of masks provided. For these respondents, they were given the option to describe their concerns and the majority

**Table 1** Concerns regarding the supply and use of facemasks or respirators

Rank	1	2	3	4	5	Weighted score
Counterfeit masks in circulation	14.69%	6.99%	20.28%	18.18%	39.86%	2.38
Level of protection provided against COVID-19 is overestimated	24.83%	18.62%	22.76%	20.00%	13.79%	3.21
Durability of masks for duration of use	13.79%	28.28%	18.62%	23.45%	15.86%	3.01
True face-fit is not achievable for respirator masks despite face-fitting procedure	14.48%	22.07%	22.07%	23.45%	17.93%	2.92
Provides false sense of security to the user and simple hand hygiene and social distancing are then ignored	33.33%	23.81%	16.33%	14.97%	11.56%	3.52

**Table 2** Concerns regarding the use of re-sterilised respirators

Rank	1	2	3	4	5	Weighted score
Efficacy of mask filtering after re-sterilisation	49.65%	30.07%	12.59%	5.59%	2.10%	4.20
Concerns regarding sterility regarding COVID-19 following the process	26.03%	30.82%	21.23%	15.75%	6.16%	3.55
Concerns regarding allergy to products used in sterilisation process	2.72%	6.12%	12.24%	24.49%	54.42%	1.78
Concerns about face-fit after re-sterilisation	6.34%	14.79%	26.76%	35.21%	16.90%	2.58
Concern regarding ability to monitor number of times a mask can be safely re-sterilised	14.97%	19.05%	27.21%	19.73%	19.05%	2.91

related to the poor fit and quality of the ties or ear loops to secure the mask in place. There was also the feeling of general deterioration of quality as the pandemic went on, presumably indicative of the supply concerns around face masks. Disappointingly, the majority of HCWs at time of survey had not had a face-fit for a respirator mask. This was unsurprising to the authors as when researching the potential of re-sterilisation, the issue of face-fit was a concern and when speaking anecdotally to various HCWs in our institution and others, there did not seem to be a hospital wide face-fitting process. This may be unique to our jurisdiction; however, given the nature of the pandemic suddenly changing the working environment of our HCWs, many who ordinarily would not encounter respiratory droplet spread precautions, it can be seen how this key step was not implemented correctly. We identified that over three-quarters of the respondents use multiple surgical face masks per day since the start of the pandemic. These concerns relating to quality and availability are hard to ignore and may herald the use of re-sterilised quality respirators in the healthcare setting as an alternative to disposable surgical facemasks.

### Attitudes towards re-sterilisation

The majority of our respondents agreed that in the setting of a shortage of respirator masks, they would be happy to use a re-sterilised mask. The majority of this group also reported that they would prefer the ability to identify their own facemask after sterilisation. The majority of the respondents indicated they would not require formal education regarding the re-sterilisation process providing the process had been validated by an appropriate authority. Given previous concerns over the quality of current face masks, we predict that these attitudes may change. If re-sterilisation is to be implemented, it is important to make the process and methods of certification publicly available. One of the biggest concerns among HCWs with regard to re-sterilised masks is the filtering efficacy of a respirator mask following re-sterilisation. This is a concern that can be at least reassured against with scientific evidence, for which there is growing literature. Five percent of our respondents said that they would not be satisfied to use a re-

sterilised mask under any circumstances. This is significant as if re-sterilised masks were the only available option in a future pandemic, we could potentially lose this 5% of our HCW population. It is possible that if we were to further explore the concerns of this subgroup, we may be able to take steps to address these concerns and lower this number.

### Conclusion

Optimising the availability and quality of personal protective gear is an essential component to surviving any future global health crises. Globally, there were high levels of HCW morbidity and mortality with the COVID-19 outbreak. While financial considerations, PPE supply and logistics are clearly important, healthcare systems and governments have occupational health and safety obligations to their HCWs [15]. They require reassurance that they are using the highest level of protection and not putting themselves, their families or colleagues at risk. The findings from this study provide us with an opportunity to enhance HCW knowledge and education towards masks and present us with a real potential in the future use of the re-sterilisation process.

**Supplementary Information** The online version of this article (<https://doi.org/10.1007/s11845-020-02493-z>) contains supplementary material, which is available to authorized users.

### Compliance with ethical standards

**Ethical approval** Ethical approval for this study was obtained from Cappagh National Orthopaedic Hospital Research Ethics Committee.

**Conflicts of interest** The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report.

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