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Essay No. 2

A Discussion of the Effectiveness of PPE during the Covid-19 Pandemic.

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Since emerging in China in December 2019, the novel coronavirus SARS-CoV-2 (causing the Covid-19 disease) has spread worldwide, crippling health services, causing lockdowns, and claiming the lives of nearly 2 million people[(1)] to date. Throughout the course of the last year, governments worldwide have instigated various measures to limit the spread of the virus, to protect the most clinically vulnerable and ensure the continuing function of health services, including lockdowns (at both national and local levels), social distancing, and widespread use of PPE of various standards. PPE is especially important in the healthcare setting, where Healthcare Workers (HCWs) are directly treating Covid-19 patients.

What is PPE?

PPE stands for Personal Protective Equipment[(2)(3)] and is designed to protect healthcare workers from chemicals and infectious agents; PPE acts as a barrier between viral contaminants and the skin, mouth, nose and eyes of HCWs[(4)]. Respirators, gowns, and gloves are all examples of PPE. PPE is essential in a pandemic situation to prevent transmission of disease.

A recent study from BMJ found that HCWs were 7 times more likely to test positive for SARS-Cov-2 or have a death attributable to the virus[(5)]. Moreover, in a survey by the BMA in December 2020 19.84% of doctors have had Covid-19 prior to or at the time of the survey[(6)], and 46,000 hospital staff members were self-isolating with Covid-19 on 10th January 2021[(7)]. Statistics like this are very distressing, and indicate the extent to which healthcare workers have, and continue to be, infected with SARS-CoV-2. This naturally makes people question the effectiveness of PPE in protecting HCWs.

Does PPE protect HCWs from infection?

A study funded by the Emerging/Re-emerging Infectious Diseases Project of Japan[(8)] concluded "that appropriate PPE is sufficient to prevent infection among HCWs". The study involved taking blood samples from 49 HCWs, who had worked in close contact with patients infected with SARS-CoV-2, every two weeks to test for antibodies to the virus. None were "seropositive for (the) SARS-CoV-2 neutralizing antibody". A similar study, posted on BMJ.com and based on information from Wuhan, China early in the pandemic, agrees that "appropriate" PPE sufficiently protects HCWs[(9)]. The term "appropriate" (mentioned in both studies) is imperative here; it shows how PPE is effective only if the proper PPE is used correctly and supplied and distributed fittingly. This is discussed in greater detail below.

It is important while discussing PPE to consider the clinical setting: PPE that is suitable in one clinical environment may not be in another. The NHS currently has three tiers for the management of Covid-19 patients: "high", "medium" and "low" risk settings, each with different PPE obligations[(10)]. Additionally, aerosol generating procedures (AGPS), such as CPR, suspend pathogens in the air for prolonged periods, and call for the use of a FFP3 respirator[(10)(11)] as surgical masks fail to provide protection against airborne transmission of SARS-Cov-2[(12)] during AGPs.

Furthermore, different types of PPE vary in effectiveness. Products such as the KN95 face mask and the Flosteril FLO-MED-8130 have been deemed unfit for use in healthcare[(2)] as they fail to provide adequate protection. Hand-made PPE is not permitted in the healthcare setting due to concerns around health and safety standards. However, there are "specific technical requirements" for all manufactured PPE set out by the UK government, so all PPE used in the NHS should be effective and sufficiently protect HCWs[(13)]. For example, the FFP3 respirator masks used on NHS wards is thought to have an efficiency of at least 99%[(11)].

Yet, while the PPE used by HCWs itself may be effective, there are a variety of other factors that may mean it is not effective in practice.

Other issues surrounding the effectiveness of PPE.

Incorrect use.

Incorrect use of PPE is thought to be a major factor in the spread of SARS-CoV-2 in HCWs[9], and can even put their families at risk[14]. SARS-CoV-2 lives longer on plastics than on ordinary clothes, so items like masks can spread the virus if not properly disposed of. Additionally, Respiratory Protective Equipment (RPE) is ineffectual if not fitted and used correctly[15].

Adequate training and well-defined instructions are a key solution to this[16]. Lack of awareness about the proper technique for removal of PPE and increased use of unfamiliar equipment during the pandemic, compound the risks surrounding inappropriate PPE use[12]. Training staff to know the correct PPE to where in each setting, and how to properly follow donning and doffing procedures (detailing how to put PPE and off) is also crucial in mitigating the risk of infection. Face-to-face training, computer simulation and video learning may be better than written information or traditional lectures in providing training[17].

Supply of PPE.

A major issue surrounding PPE is its supply; if HCWs do not have the required PPE they are rendered susceptible to infection. HCWs may have to resort to using inadequate PPE due to a lack of supply. There have been reports of equipment not being supplied for "fit tests" which prevent FFP3 masks from being effective[2]. There have also been issues about female HCWs only being supplied with PPE designed for men that doesn't fit properly, despite 77% of NHS staff being female[18]. The table below describes the percentage of doctors reporting PPE shortages in December 2020 in the NHS[6].

	ADEQUATE	SHORTAGES	NO SUPPLY AT ALL	DON'T KNOW	NOT RELEVANT	TOTAL
FFP3 masks / respirators (for AGP areas)	48.03% 2,972	5.49% 340	5.43% 336	9.79% 606	31.25% 1,934	6,188
Fluid-Repellent facemasks	78.44% 4,861	3.63% 225	1.82% 113	6.68% 414	9.42% 584	6,197
Aprons	86.06% 5,329	3.38% 209	0.36% 22	4.12% 255	6.09% 377	6,192
Long sleeved disposable gowns	37.72% 2,335	6.53% 404	11.03% 683	13.76% 852	30.95% 1,916	6,190
Gloves	88.24% 5,472	2.98% 185	0.23% 14	3.21% 199	5.34% 331	6,201
Eye protection	67.90% 4,212	9.46% 587	4.77% 296	7.82% 485	10.04% 623	6,203

Expired PPE.

Expired PPE is ineffective in protecting HCWs from infection and puts HCWs at potential risk[19] as PPE degrades over time. Despite this a sizeable amount of the PPE stored by the NHS and provided to HCWs at the start of the pandemic was past its expiry date[20] or had this date altered. Prolonged exposure to extreme conditions (heat, humidity, sunlight) can also lead to deterioration of PPE. Extended use or re-use of PPE has been advised in exceptional circumstances but has been linked with the potential to increase the risk of infection[11].

Physical issues.

PPE is extremely uncomfortable to wear and has been described as "one of the biggest physical and psychological challenges experienced by physicians" during the pandemic[16]. PPE can also make

it difficult for HCWs to perform their jobs. Issues include repeated donning and doffing of equipment, and communication issues with peers due to PPE, that can have a profound psychological effect on HCWs. This is during a time when 62.20% of doctors reported increased levels of exhaustion[6]. This could in turn lead to increased rate of human error heightening risk of exposure to the virus.

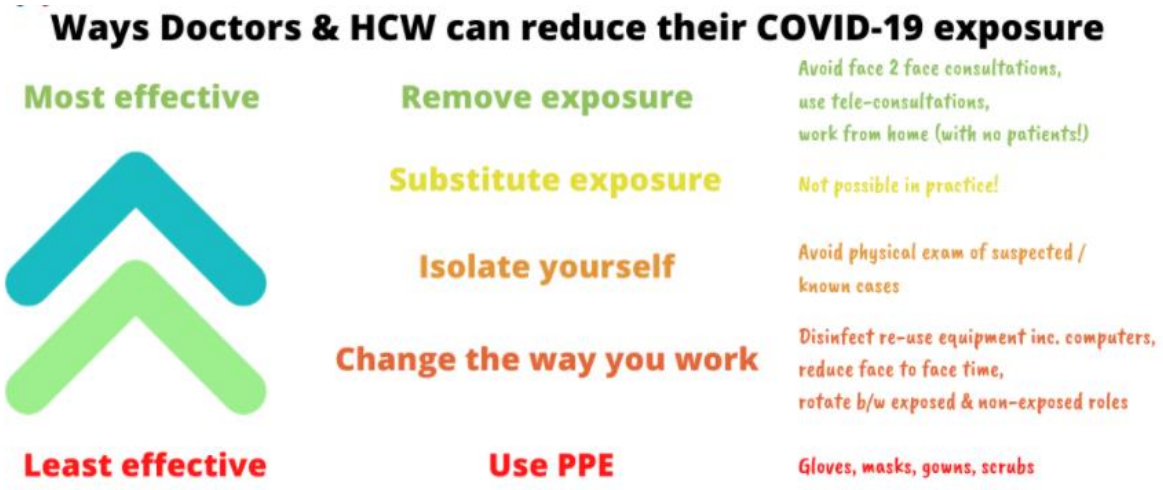
Some workers may also have impairments that mean that some methods of PPE are ineffective (i.e., those with sensory impairments or require use of prosthesis)[2]. The irritating nature of PPE may lead to HCWs touching their face to adjust it, which could cause infection[21].Wearing PPE can also cause HCWs to suffer from heat stress[22] or skin damage[12]. Alternative measures of PPE are needed for those with latex allergies. Having a beard can also influence the effectiveness of FFP3 respirators; some may be unable to shave due to religious beliefs, meaning a respirator hood would need to be provided.

Limitations of PPE.

PPE alone is not sufficient protection for healthcare workers[21]. The diagram below illustrates how PPE is one of the least effective ways to reduce exposure to the virus in a hospital. PPE's effectiveness can be compromised because of many of the factors previously discussed, and no PPE is 100% effective, even when correctly used. To fully rely on PPE to ensure the safety of HCWs, would be a foolish and reckless policy that could endanger lives, and it is imperative that appropriate protocols are maintained to diminish exposure to the virus. These should include procedures on regular cleaning, minimising direct contacts with Covid-19 patients, and continuous handwashing. PPE is one aspect of "a hierarchy of infection control measures"[12], all of which must be respected to certify the safety of HCWs.

However, PPE is still vital in keeping HCWs safe. Measures around removing exposure to SARS-CoV-2 are better in terms of minimising the risk to HCWs but are not always possible in practice. While treating patients, there are times when HCWs will need to be directly exposed to SARS-CoV-2. PPE is an efficient measure to protect HCWs during times like these.

Asymptomatic carriers of the virus working in the healthcare setting can pose a significant problem in terms of spread of the virus[23]. HCWs can also be infected outside of the healthcare setting. Factors like these can undermine the protection PPE provides.



Conclusion.

PPE is an important weapon in the fight against Covid-19, shielding HCWs from the disease. If suitably used, successfully supplied, and used alongside a host of other protective measures it will protect HCWs from illness at a time when they are most badly needed. Ultimately the

effectiveness of PPE is dependent on how well it used when it is needed. Governments have a moral duty to ensure that the proper PPE is supplied to HCWs and that they are capably trained in its use. But if PPE can be used correctly, it is effective protection against Covid-19.

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