Protective solutions for airborne COVID-19

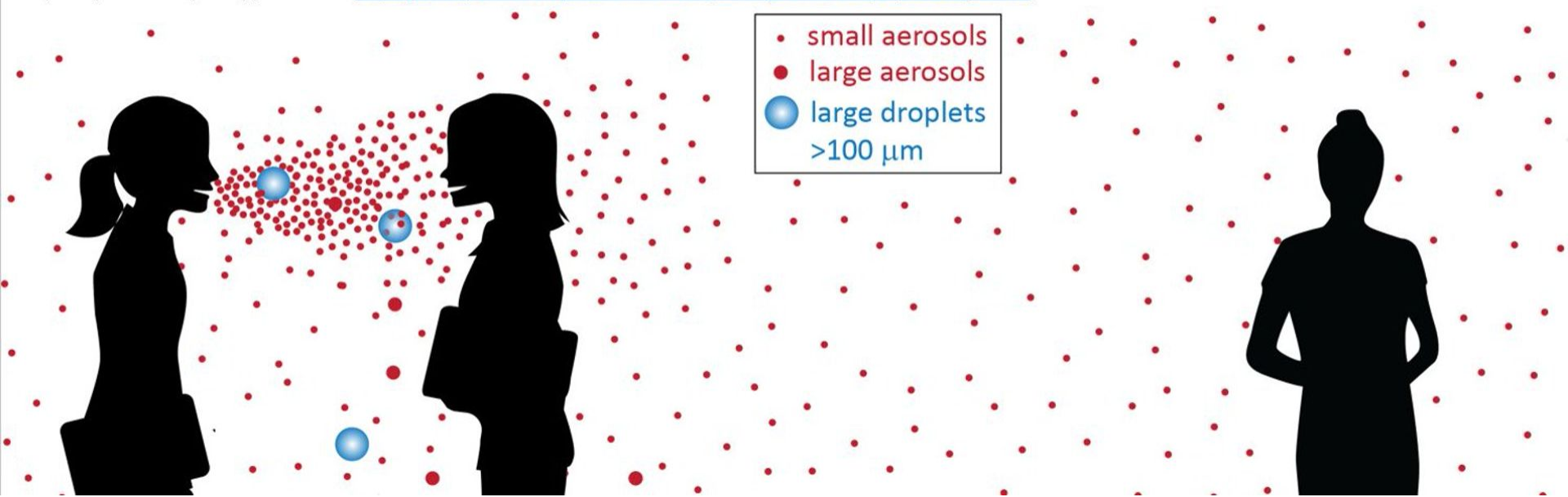
Our Aim:

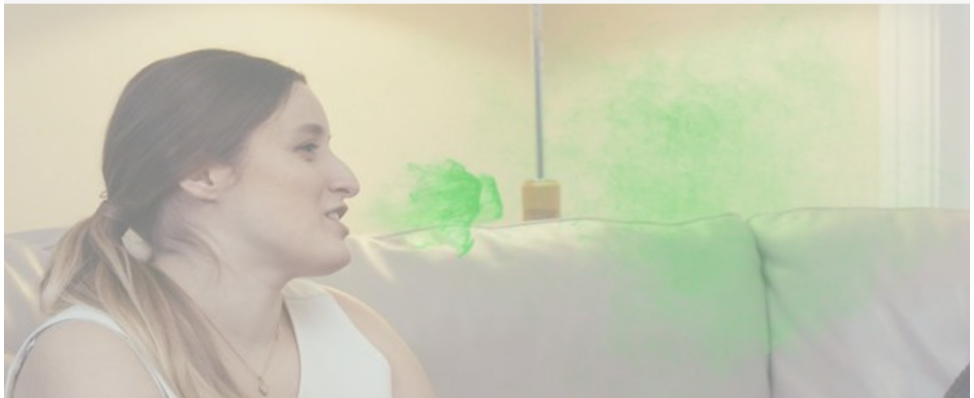
To protect frontline workers and reduce morbidity and mortality from occupational airborne COVID-19.

Our Objectives:

- Four Nation standardisation, redefining aerosol risk irrespective of “AGP” status
- Respiratory and eye protection for airborne COVID-19 available for all patient facing interactions in all care settings
- Improved ventilation
- Improved collaboration with policy makers, as stakeholders for guidance development

Graphic by Prof. Linsey Marr, published in https://www.journalofhospitalinfection.com/article/S0195-6701(21)00007-4/fulltext

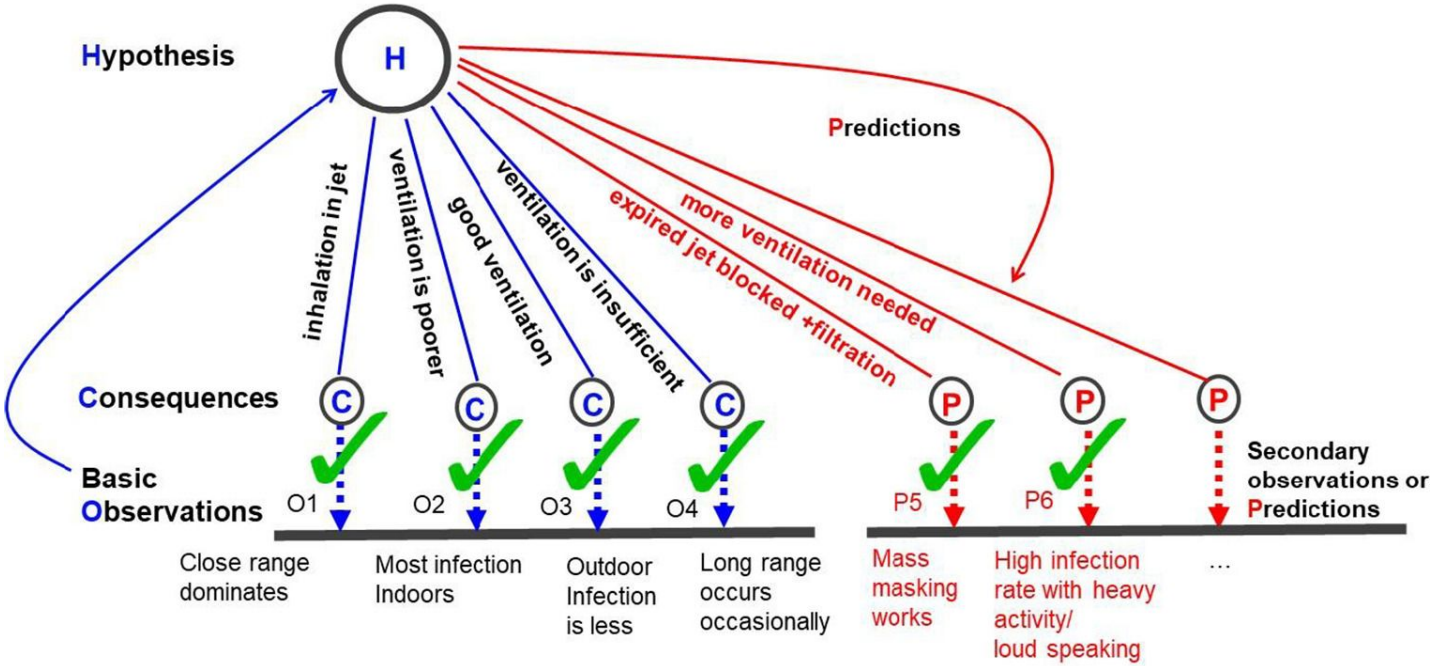




"If someone breathes in virus particles that are suspended in the air, they can become infected with COVID-19...This is known as airborne transmission"

PHE 2021

Short-range airborne route predominates, with long-range route as its continuation



The physics of aerosol behaviour means that if small particles can be generated in sufficient quantity to cause infection at longer distances, they will also present at close proximity to the infectious person and at much greater concentration

SAGE April 2021

https://doi.org/10.1111/ina.12837 Li Indoor Air 2021

Risk increases with proximity, time and low mask filtration

$$\text{Healthcare worker risk} \propto \frac{b \times v \times t}{e}$$

where:

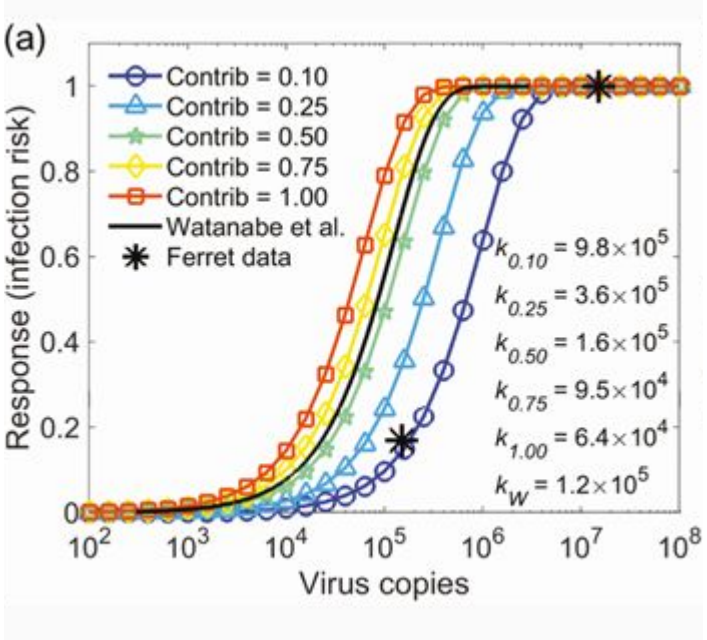
b = breathing zone particle viable virion aerosol concentration

v = minute volume of healthcare worker

t = time exposed

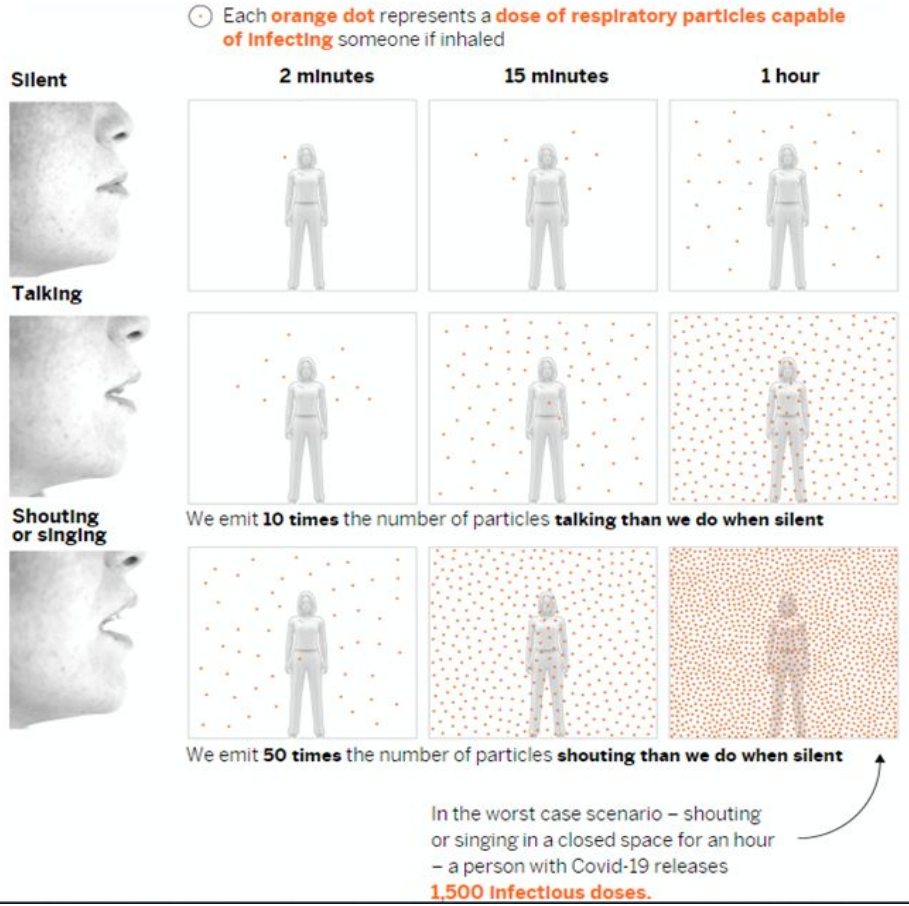
e = mask efficiency.

Wilson NM, Norton A, Young FP, Collins DW. Airborne transmission of severe acute respiratory syndrome coronavirus-2 to healthcare workers: a narrative review. *Anaesthesia* 2020; 75: 1086– 95.

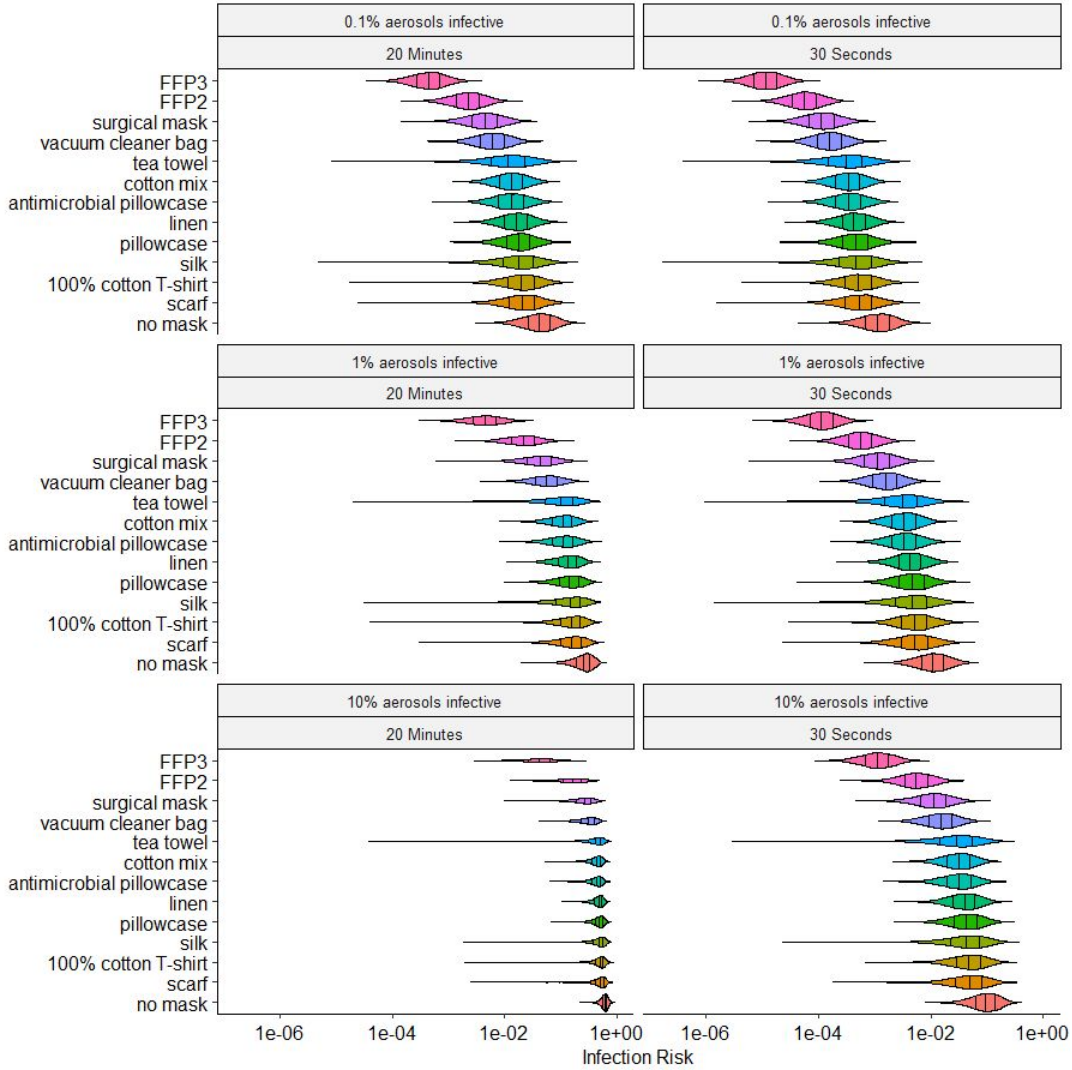


Zhang X, Wang J. Dose-response Relation Deduced for Coronaviruses from COVID-19, SARS and MERS Meta-analysis Results and its Application for Infection Risk Assessment of Aerosol Transmission. Clin Infect Dis. 2020 Oct 29:ciaa1675. doi: 10.1093/cid/ciaa1675. Epub ahead of print. PMID: 33119733; PMCID: PMC7665418.

Risk increases with natural aerosol generation and time



https://english.elpais.com/society/2020-10-28/a-room-a-bar-and-a-class-how-the-coronavirus-is-spreading-through-the-air.html

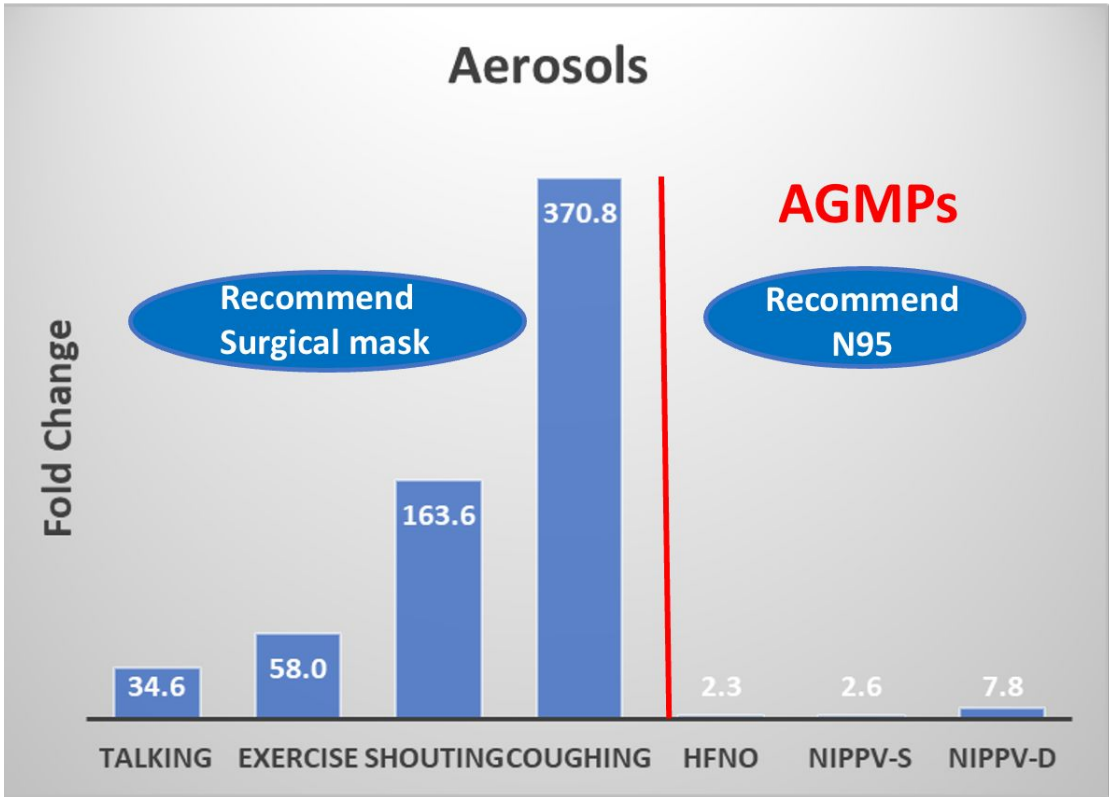


FFP3 respirator gives best protection

Courtesy of Prof Cath Noake and M Lopez-Garcia
COVID-19 and use of non-traditional masks: how do various materials compare in reducing the risk of infection for mask wearers?
Wilson, A.M. et al.
Journal of Hospital Infection, Volume 105, Issue 4, 640 - 642

Lower protection currently provided, in areas of greater risk

38% FFE



98.5% FFE

Sickbert-Bennett EE, Samet JM, Clapp PW, et al. Filtration Efficiency of Hospital Face Mask Alternatives Available for Use During the COVID-19 Pandemic. *JAMA Intern Med.* 2020;180(12):1607–1612. doi:10.1001/jamainternmed.2020.4221

Graph courtesy of Prof Kim Prather based on Wilson et al 2021

UK guidance offers less protection than other nations

Understanding the Difference

	Surgical Mask	N95 Respirator
Testing and Approval	Cleared by the U.S. Food and Drug Administration (FDA)	Evaluated, tested, and approved by NIOSH as per the requirements in 42 CFR Part 84
Intended Use and Purpose	Fluid resistant and provides the wearer protection against large droplets, splashes, or sprays of bodily or other hazardous fluids. Protects the patient from the wearer's respiratory emissions.	Reduces wearer's exposure to particles including small particle aerosols and large droplets (only non-oil aerosols).
Face Seal Fit	Loose-fitting	Tight-fitting
Fit Testing Requirement	No	Yes
User Seal Check Requirement	No	Yes. Required each time the respirator is donned (put on)
Filtration	Does NOT provide the wearer with a reliable level of protection from inhaling smaller airborne particles and is not considered respiratory protection	Filters out at least 95% of airborne particles including large and small particles
Leakage	Leakage occurs around the edge of the mask when user inhales	When properly fitted and donned, minimal leakage occurs around edges of the respirator when user inhales
Use Limitations	Disposable. Discard after each patient encounter.	Ideally should be discarded after each patient encounter and after aerosol-generating procedures. It should also be discarded when it becomes damaged or deformed, no longer forms an effective seal to the face; becomes wet or visibly dirty; breathing becomes difficult; or if it becomes contaminated with blood, respiratory or nasal secretions, or other bodily fluids from patients.

CDC NIOSH

Personal Protective Equipment - CDC

HCP who enter the room of a patient with suspected or confirmed SARS-CoV-2 infection should adhere to Standard Precautions and use a NIOSH-approved N95 or equivalent or higher-level respirator, gown, gloves, and eye protection.

UK PHE 01/06/21

To ensure maximum workplace risk mitigation, organisations should undertake local risk assessments based on the measures as prioritised in the hierarchy of controls. If an unacceptable risk of transmission remains following this risk assessment, it may be necessary to consider the extended use of RPE for patient care in specific situations.

Australia advocates **optimal protection**

Promotes a precautionary approach to transmission based precautions, aligned with the relevant clinical procedure and based on a risk assessment and consideration of the status of scientific evidence. For example, in relation to COVID-19, infection is transmitted by aerosols in specific circumstances, and evidence continues to evolve. A precautionary approach would involve the adoption of airborne precautions in situations where there is uncertainty about the type of circumstances that may arise in the care of a patient who is a confirmed or suspect COVID-19 case. This means that healthcare workers would use a P2/N95 respirator mask, in addition to other personal protective equipment that may be required as part of standard precautions, to care for this type of patient.

https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare

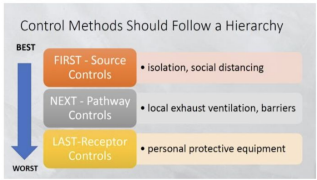
BOHS
The Chartered Society for Worker Health Protection
Website : http://www.bohs.org/
Email any enquires to: marketing@bohs.org

Exposure = Likelihood x Duration

Likelihood	Daily Duration		
	D1 (0 to 3 hours)	D2 (3 to 6 hours)	D3 (> 6 hours)
L0 (No Exposure)	E0	E0	E0
L1 (Exposure Unlikely)	E1	E1	E1
L2 (Possible Exposure)	E2	E2	E3
L3 (Exposure is Likely)	E2	E3	E4

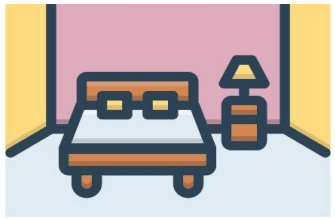
Control Band

Exposure Rank	Control Band
E0	N
E1	A
E2	B
E3	C
E4	D

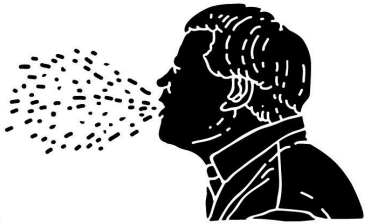


Aim to lower exposure level Goal: Reduce exposure to E1 levels by selecting additional control strategies from the source and pathway categories and reducing reliance on PPE	Control Band	Control Options
	A	Source – Do these first
		Pathway – Maybe necessary
		Receptor – Not necessary
	B	Source – Do these first, may require multiple options
		Pathway – Do these next, and may require multiple options
		Receptor – Only if source & pathway controls aren't effective
		Source – Do these first, may require multiple options

Many patient care circumstances present high risk



Technology and tools
- Aerosol generating interactions
- PPE guidance widely varies



Environment
- Lack of ventilation
- Small space

Worker
- PPE fit
- Risk status

System
- PPE supply challenges
- Long interactions with patients (>15mins)

Task
- Close contact patient (<1m)
- COVID-status unknown

Adapted from SEIPS: https://chfg.org/works-system-design-for-patient-safety-the-seips-model/

The risk assessment should include evaluation of the ventilation in the area, and prevalence of infection/new variants of concern in the local area

PHE June 2021

Risk assessment = FFP3

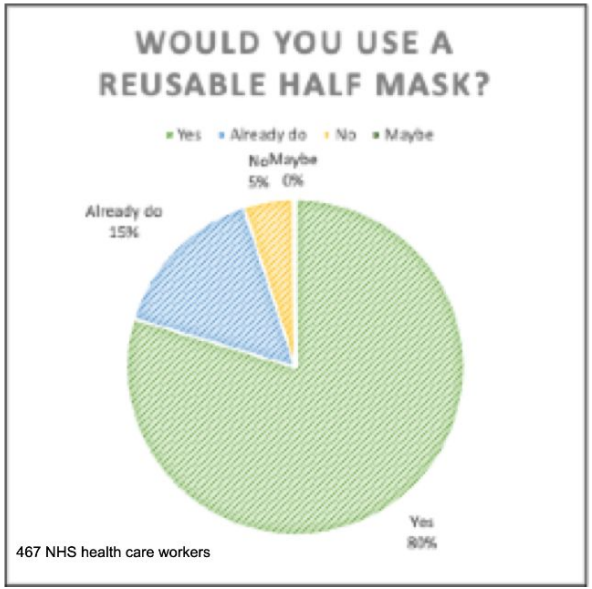
- Time
- Crowded
- Proximity
- Difficult ventilation
- Unquantifiable aerosols
- Unknown infection status (varies with prevalence)
- Staff risk factors

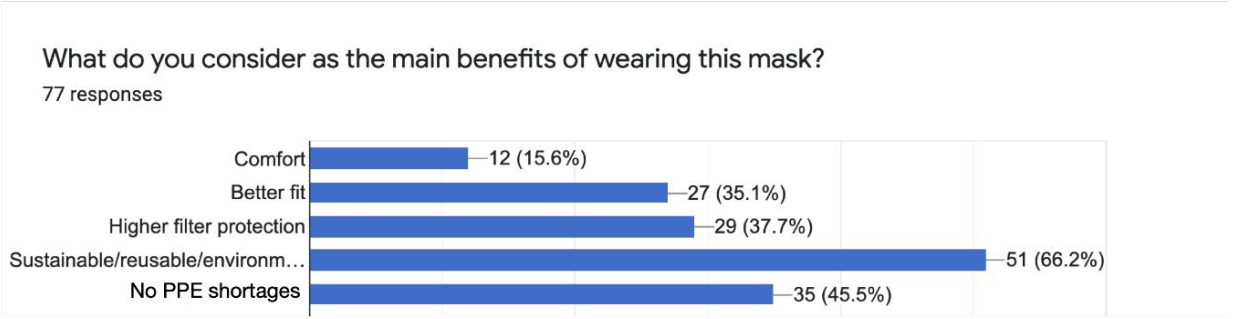
Mitigation impossible via hierarchy ?

Risk assessment = FFP3

UK health and social care workers want better protection

The workforce does not feel safe treating COVID-19 patients wearing an FRSM (81% surveyed)
33% nurses (RCN 2021) and 21% doctors (BMA 2021) are considering leaving NHS
Frontline workers want reusable P3 protection (80% surveyed)





UK health and social care workers need better protection

UK one of highest hcw + scw COVID-19 death rates, globally

Country	**HCW** COVID-19 **deaths**/100,000 HCW	**General population** COVID-19 **cases**/100,000 population
UK	**11**	**420**
USA	7.6	798
Germany	0.61	233
New Zealand	0	31.6

Data reflecting Mar-Jul 2020. Wu *et al.* 2021

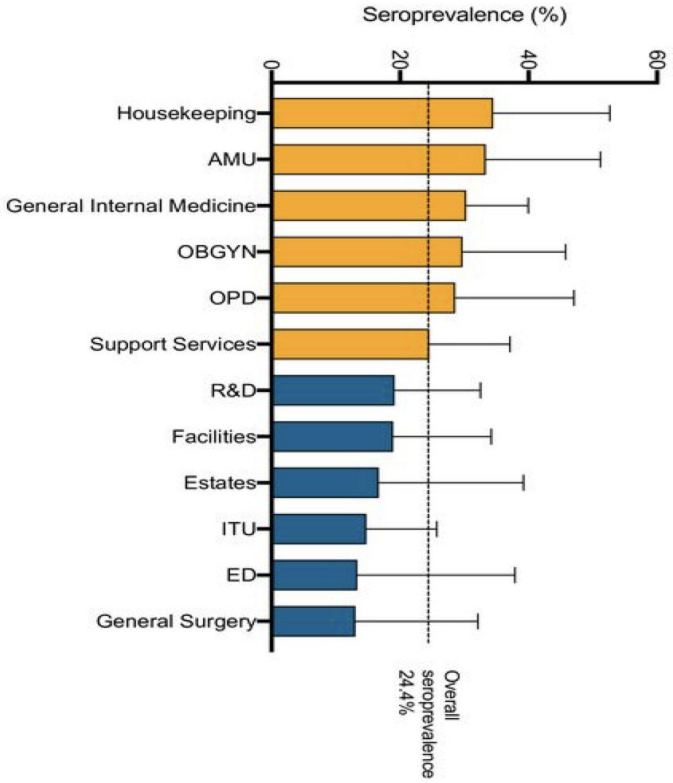
66% deaths in BAME

Young females in NHS 50% more likely to die from COVID-19

Highest death rates in "low risk zones"

Kursumovic *et al.* 2020

A Shields *et al.* 2020



Morbidity and mortality from occupational COVID-19 exposure is **preventable**

Feb '20
3,019 hcw infections,
23 hcw deaths

Mar '20
42,000 hcw
0% hcw infections
0% hcw deaths

Zhang *et al.* 2020

May '20

Koh *et al.* 2020

Dec '20
53 NHS hcw

Significant (37%) reduction
in hcw sick days from
COVID-19

Butler *et al.* 2020

Solving UK PPE inequalities with reusable P3 respirators

Non-Maleficence

- Higher protection factor
- Environmentally friendly

Beneficence

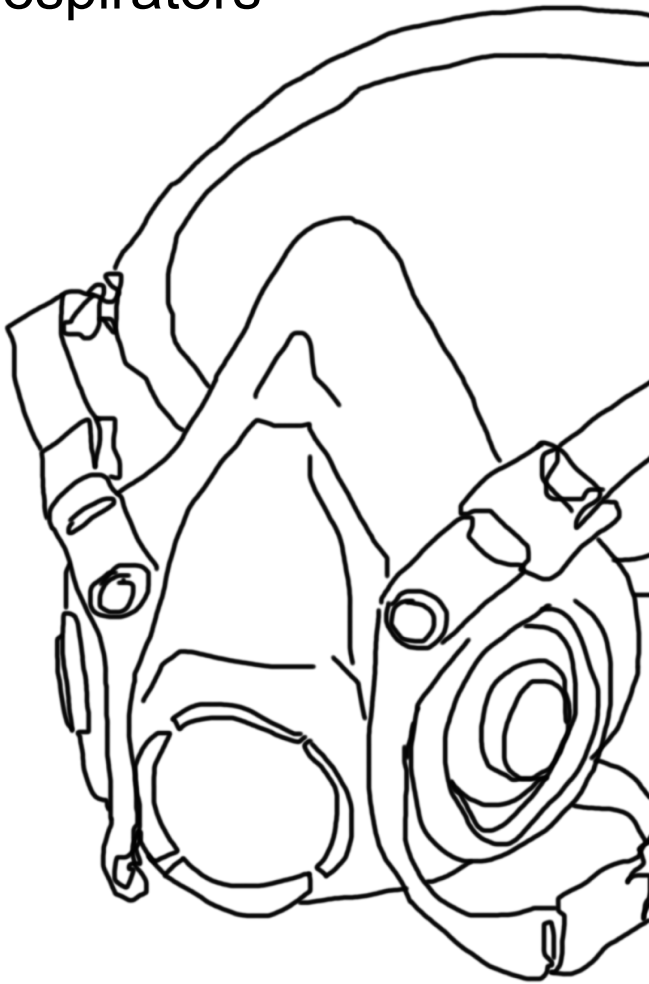
- Large cost savings (97% saving per worker, per year)
- Reliable UK procurement and local jobs

Equity

- Fit wider demographic
- Already being used in multiple UK healthboards

Autonomy

- Workers want them
- Decontamination options based on local process



Higgins *et al*. BMJ 2021

UK innovative solutions, for UK worker protection

UNIVERSITY OF CAMBRIDGE

myMaskFit™

- Wide choice UK manufacturers
- Frontline worker led
- Transparent to improve communication
- 3d printing custom option
- 3d face scanning app for speed and accuracy of fit test
- >95% fit test pass rate
- Decontamination protocols as per NSS/NHS
- No exhale valves/exhale valve filters
- Robust supply chains
- Local jobs

MedSupplyDriveUK

3DPPE

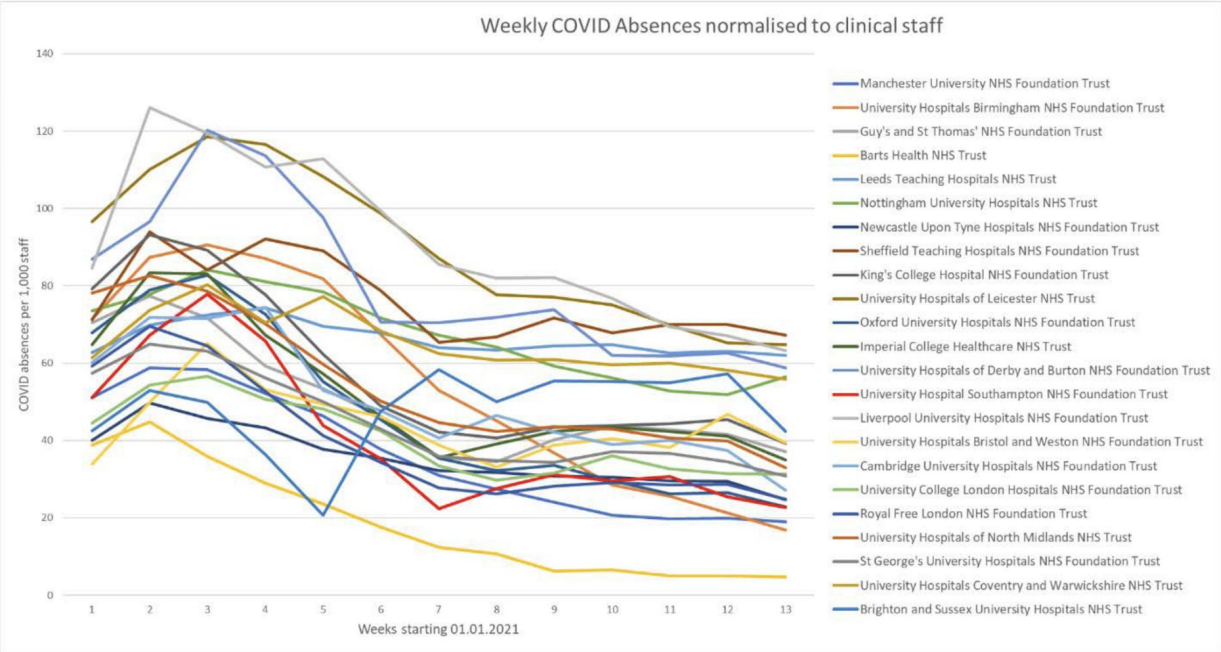
THE UNIVERSITY OF EDINBURGH

GVS

FILTER TECHNOLOGY

Honeywell

Southampton staff absence fell rapidly during deployment (red line)



Southampton outcomes were excellent

Together we have made a difference

What is becoming apparent is just what this collective effort has meant for us all. UHS is in top the 10% of trusts across the UK for low death rates in Covid-19 positive patients and nosocomial (hospital acquired) infection. A great achievement and testament to how you have worked individually and as teams over this period in order to protect the safety of each other and our patients. That of course does not diminish the difficulty of what we've all faced.

Collaboration, clarity and transparency; guidance that focuses on needs of health professionals

- We represent voice of members in roles width and breadth of UK health and social care
- Current guidance does not meet their needs or concerns on the ground
- We need guidance that reflects dynamic care situations and risks
- To protect health and social care workers in all settings
- Collaborative stakeholder engagement to achieve aims and international equity

Conclusion- moving forwards together

- Changes to the PPE guidance with explicit recognition of the impact of airborne transmission of COVID-19 in the delivery of care
- Consistency within the guidance in line with this
- Align with other countries e.g. US with the provision of N95 for all HCWs when seeing COVID-19 positive (suspected) patients:
  - not just for high risk procedures
  - vaccination is not 100% effective
  - surgical masks do not provide effective protection against airborne transmission
  - ventilation not always possible
  - Risk assessments complex and diverse
- UK manufacturers have developed reusable FFP3 and stand ready to scale up to meet needs
- We are ready to support a constructive way forward