Infection transmission and face coverings

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Infection transmission

Person to person

Via aerosols

Via food or water

Contaminated objects or soil

Via insect or animal vectors

Inhalation

Ingestion

Through cuts or damaged skin

Sexual transmission

Airborne transmission

Particulate production not new

TABLE II. Numbers of Particles in Different Initial Diameter Ranges Emitted in One Cough and One Sneeze According to Duguid

Diameter Range (μm)	Number of Particles in a Cough	Number of Particles in a Sneeze
1–2	50	26,000
2–4	290	160,000
4–8	970	350,000
8–16	1600	280,000
16–24	870	97,000
24–32	420	37,000
32–40	240	17,000
40–50	110	9000
50–75	140	10,000
75–100	85	4500
100–125	48	2500
125–150	38	1800
150–200	35	2000
200–250	29	1400
250–500	34	2100
500–1000	12	1000
1000–2000	2	

Source: Data from Duguid, "The Size and Duration of Air-Carriage of Respiratory Droplets and Droplet-Nuclei." *Journal of Hygiene 4*:471–480, Table 3 (1946).

Breathing, talking, coughing, sneezing

author, reference	method or technology	subjects	respiratory behaviours	results
Jennison [33]	high-speed photograph	—	cough and sneeze	most droplets ranged from 7 to 100 µm
Duguid [25,26]	solid impaction (celluloid-surfaced slide for collection)	one healthy subject	cough and sneeze	size ranged between 1 and 2000 µm and 95% were between 2 and 100 µm
Buckland & Tyrrell [34]	liquid impaction (impinger)	two subjects infected with unknown bacteria	cough, sneeze and speech	size ranged from 50 to 860 µm, and 76% were between 80 and 180 µm
Gerone *et al.* [27]	solid impaction (chamber for collection)	one patient infected with coxsackievirus A	cough and sneeze	most were less than 1 µm (large droplets not measured)
Loudon & Roberts [28]	solid impaction (chamber with bond paper for collection)	three healthy subjects	cough and speech	geometric mean of 55.5 µm for cough and 85 µm for speech
Papineni & Rosenthal [29]	solid impaction (glass slide for collection) and optical technology (optical particle counter)	five healthy subjects	cough	85% of the particles had diameters of less than 1 µm
Fennelly *et al.* [30]	cough aerosol sampling system and solid impaction	16 patients infected with tuberculosis	cough	most particles were in the respirable size range
Hersen *et al.* [15]	electrical impaction (electrical low pressure impactor)	35 healthy subjects and 43 patients	cough	the number and size of the droplets that exhaled by infected subjects and healthy subjects are different
Edwards *et al.* [36]	optical technology (optical particle counter)	12 patients infected with influenza	breath	size range from 0.15 to 0.19 µm
Yang *et al.* [31]	time-of-flight technology (aerodynamic particle size) and charge separation (scanning mobility particle sizer)	54 healthy subjects	cough	size range from 0.62 to 15.9 µm with the average mode of 8.35 µm
Fabian *et al.* [37]	optical technology (optical particle counter)	12 patients infected with influenza	breath	over 87% of particles exhaled were under 1 µm in diameter
Chao *et al.* [35]	interferometric Mie imaging technique	11 healthy subjects	cough and speech	geometric mean of 13.5 µm for cough and 16 µm for speech
Johnson *et al.* [32]	aerodynamic particle sizer and droplet deposition analysis	17 healthy subjects	breath and speech	a BLO tri-modal model was found for the droplet size distribution
Xie *et al.* [14]	solid impaction (glass slide with microscopy) and optical technology (dust monitor)	seven healthy subjects	cough and speech	average size is about 50 to 100 µm
Fabian *et al.* [44]	optical technology (optical particle counter)	three healthy subjects and 16 patients infected with human rhinovirus	breath	82% of particles detected were 0.300–0.499 mm.

Numbers particles produced likely increase with increasing energy

- Measles 50-500 nm
- Flu/SARS 100 – 1000 nm
- TB – 1000 – 3000 nm

Other factors to consider

- Load
- Speed/distance
- Survival in the environment/robustness
- Infectious dose
- Immune status of the host
- RH
- Temperature
- Ventilation / air flow / wind speed
- Numbers of people
- Face touching

Infectious dose

Coughs and sneezes spread diseases

What is a face covering?

UK Government Guidance:

- In the context of the coronavirus (COVID-19) outbreak, a face covering is something which safely covers the nose and mouth.

- There are many types of face coverings available. Cloth face coverings and disposable face coverings work best if they are made with multiple layers (at least 2) and form a good fit around the face.

- Bandanas or religious garments may be used but are likely to be less effective if they do not fit securely around the face.

- A face visor or shield may be worn in addition to a face covering but not instead of one. This is because face visors or shields do not adequately cover the nose and mouth, and do not filter airborne particles.

Who does it protect?

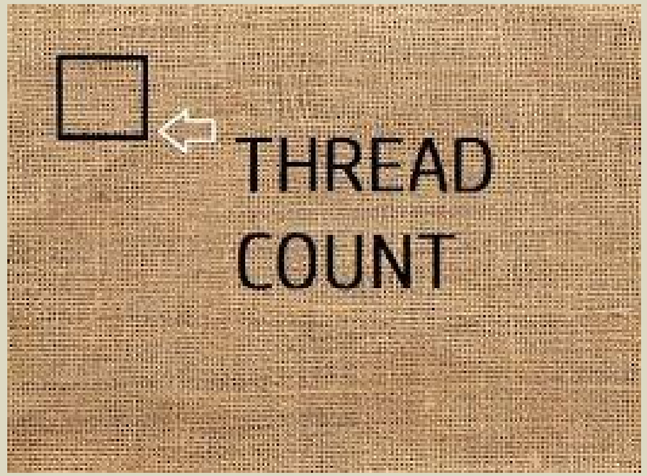
- Face coverings are not classified as PPE .

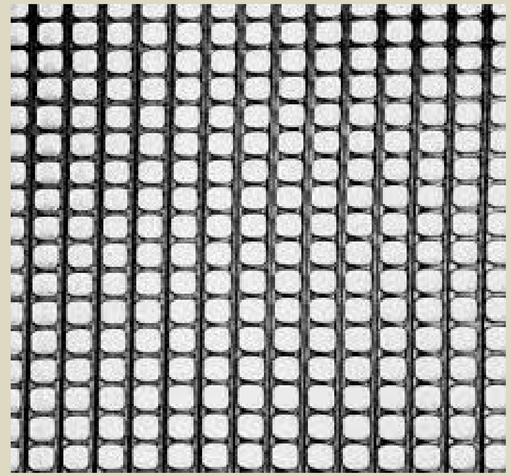
- Largely intended to protect others, not the wearer, against the spread of infection because they cover the nose and mouth, which are the main confirmed sources of transmission of virus that causes coronavirus infection (COVID-19).

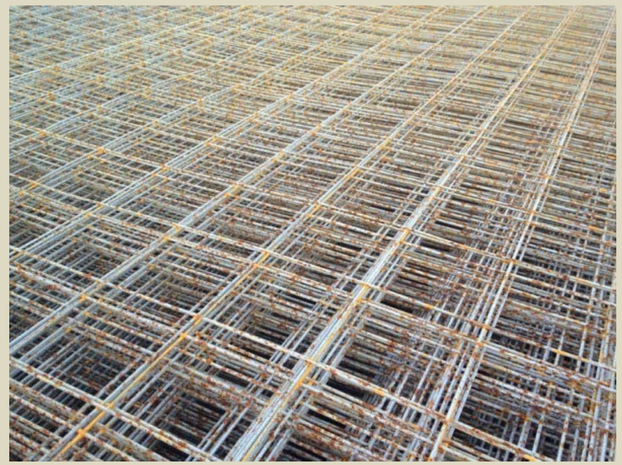
Level of protection

Dependencies:

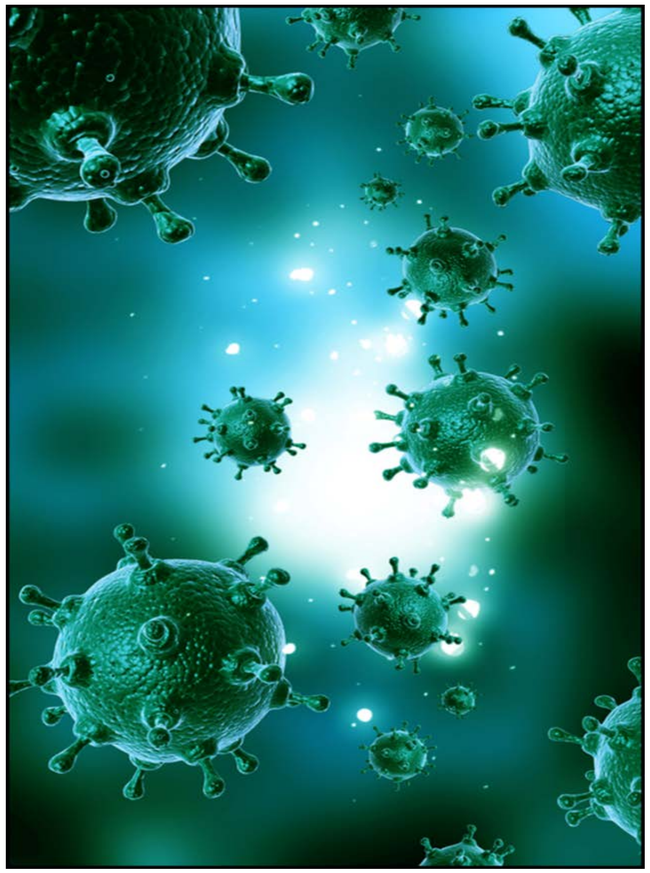
- How it’s worn
- Material type
- Layers
- Face touching
- Removal

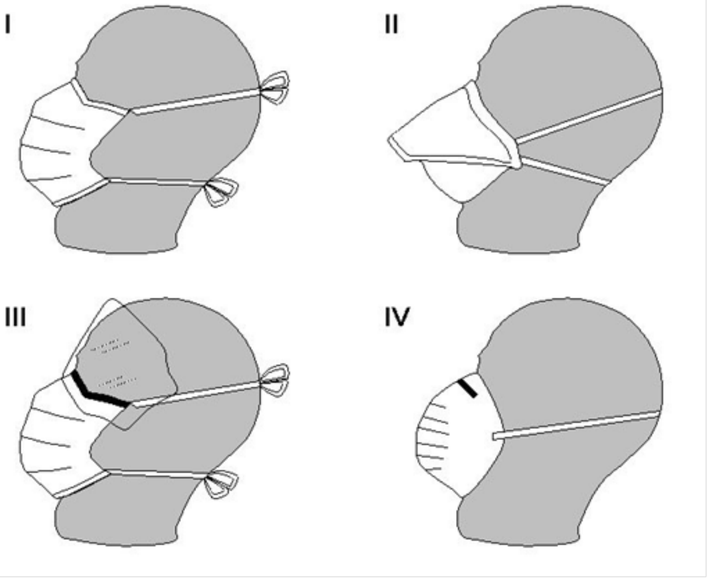






Research





Removal and handwashing

Summary

- Multiple disease transmission pathways
- Respiratory diseases – droplets, aerosols, inhalation, contact
- Other characteristics play a part in transmission
- Face coverings may confer some protection for the wearer
- For protection of others
- Hand hygiene

Thankyou

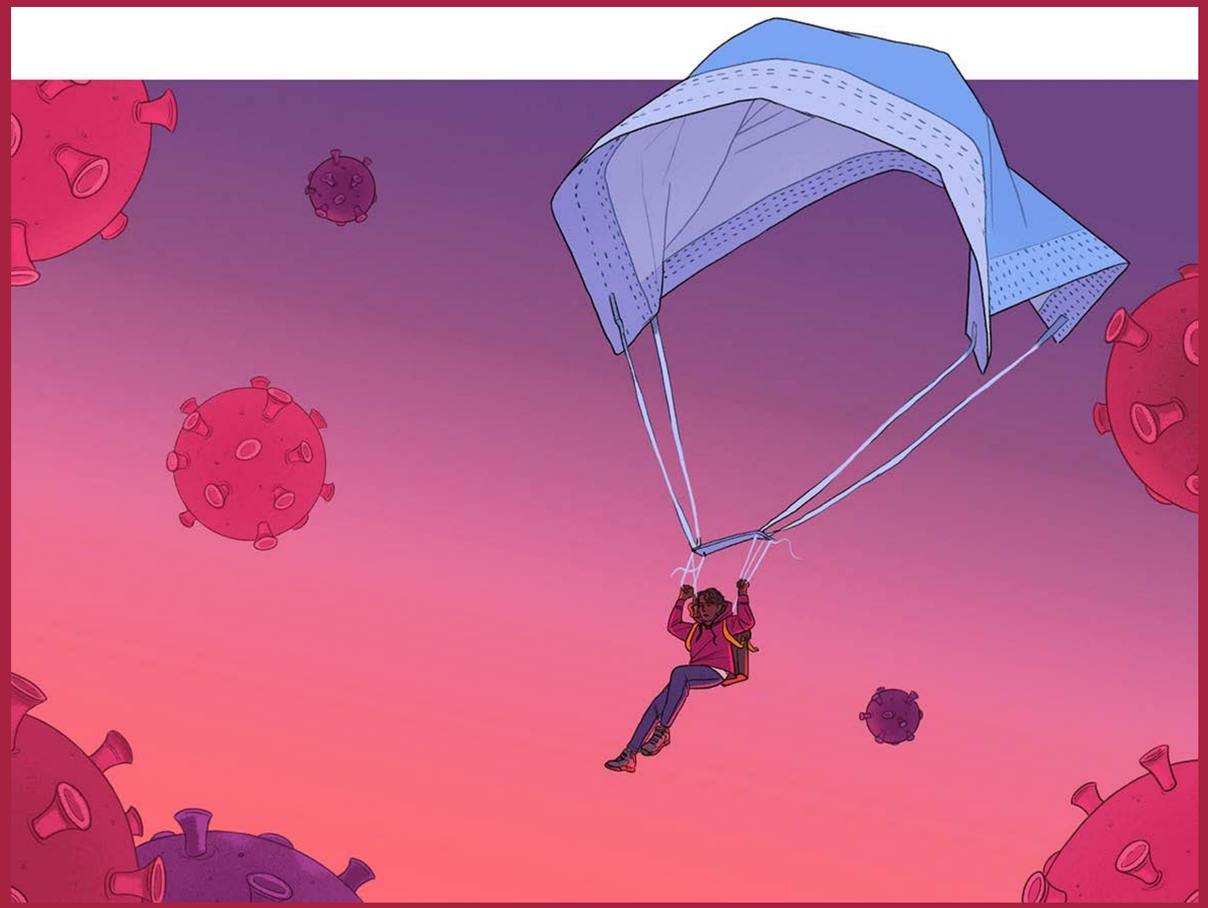


Image from Nature.com