COVID-19 and relationship to the environment

Prof Cath Noakes

SAQN Air Quality and CV-19 meeting

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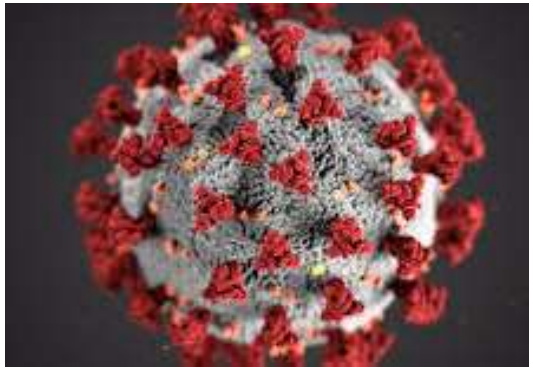
What do we know about SARS-CoV-2?

- Small (~100nm) enveloped virus with lipid bilayer
- Dispersed through respiratory aerosols + possibly faecal aerosols



- Transmission likely dominated by short-range droplet + contact – evidence for close and prolonged contact
- Growing evidence for airborne transmission in poorly ventilated spaces
- Very little evidence for outdoor transmission

Cough aerosols

- Difference between cough particle and virus carrying – not all cough particles will carry virus
- Sampling for microorganisms in cough is hard!
- May be dependent on viral titre – throat, nose, saliva? This ranges significantly from 600-10^11 per ml
- Won't be naked virus – proteins, surfactants, salts in respiratory droplets – affects the evaporation
- Shedding may depend on the individual and stage of infection – likely that more at beginning although faecal later

Dispersion of respiratory aerosols

- Ejection rate and direction - Sneeze, cough, sing, talk, breathe all affect the release
- Interaction between droplets – cough can be a turbulent “puff” which transports the droplets further
- Human thermal plume can influence exhalation flows
- Respiratory behaviours – mask, cough into hand
- Ventilation/local flow patterns – determine dispersion further from the source
- Virus stable in aerosol under room air conditions - over 3 hours shown in laboratory study

Surface contacts

- Contaminated through deposition + touching of surfaces
- Viral transfer depends on viral load, frequency of touching, type of surface, cleaning frequency
- Decay over time – very slow
  - Studies show 30 min tissue, 4 hours copper, 2 days + on plastic/steel at room temperature
  - Very stable at 4C – 14 days
  - Relationship with temperature and humidity https://www.dhs.gov/science-and-technology/sars-calculator
- Where are the frequently touched sites?

Controls

Focus on three transmission routes:

- Contact
  - Hand hygiene, surface cleaning, no-touch, face touching, anti-microbial surfaces, daylight?
- Droplet/short-range
  - Face covering as source control + some protection, 2m distance, avoid face-to-face, screens, sanitation systems, lose hand dryers
- Aerosol
  - Good ventilation, UV light, ventilation flow patterns, air cleaning devices
- All routes – reduce the occupany – reduce viral load in space, reduce chance of coming across an infector
- Reduce the time of exposure – shift patterns etc – stay below the dose

Transmission – Research Qs

- Dose – how much to get infected?
- Prevalence/survival of virus in real environments
- Viral shedding from people at different times in their disease
- Biological and physics of droplet behaviour
- Relative importance of different transmission routes
- What is the importance of faecal shedding?

Environments – Research Qs

- How do we mitigate in specific environments
  - Schools, care homes, hospitals, close contact occupations, transport
- Synergistic effects of different mitigation measures
- How do we adapt buildings to become more resilient?
- How do we balance the energy/risk/comfort challenge?
- Interaction between engineered environment and human behaviour?
- How do we adapt to enable different behaviours but without losing social contexts – lectures, cafeteria?
- What to do in winter?

Things to consider in research

- Big interdisciplinary questions that need to engage with users/policy
- For the rapid call there is a Q on whether the research will have an impact on public health in 12 months
- Need to show how the work will have impact