COVID-19 and relationship to the environment

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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 [link](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 occupancy – 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