Summary of the Discussion. Chris Budd

- The group centered on the clinical issues linked to the airflow studies raised in the earlier talks.
- There was a lengthy discussion on the link between aerosols numbers and the actual amount of active virus, and hance on the calculation of the actual viral load and calibration of the air flow models
- Some studies have been published where samples of airborne viruses have been collected in an intensive care unit and cultured.
- It is possible that the means of collecting the virus might damage it as well as the time between collection and of checking viability.
- PCR studies have also been made of virus contamination in the same locations. The link between PCR values and actual virus numbers is unclear.
- The group looked at a recent paper looking at viral contamination in a car over a 30min drive. These indicated that dust in the air can be important in viral transmission and that the 500nm size fraction was the most important.
- The type of ventilation is important. Recirculating air can significantly increase viral load.

1. Is it reasonable to structure passengers' train travel (e.g., only travel on certain days)? **David Sykes**

Assumed during pandemic as opposed to 'normality'
Not if it makes journeys worse – longer with multiple stages (modes) as opposed single shorter journeys
Hybrid models / working from home might alleviate change people's working travel patterns, this is more optimistic due to people commuting less.
3 days weeks from office
How would this work with season tickets (previous 5 days system – to 3 days system)?
Trains or Underground (sealed system is different risk)

2. What are the key data points on a train journey (getting on and off a train, mixing in the station, turnstiles etc) where infection can occur? Where should we be putting in the most effort to avoid risk?

The answer is not known – only within a vicinity of an infected person
Enclosed space as opposed to passing someone who is infected
Modelling locations within enclosed spaces
Ventilation strategies / methods on trains are so varied / different that there is no real defined place on a particular train and assess a risk on any train
Limited to the journey, so it is about location to an infected person, not about a key points of a journey.

3. Key evidence is needed if we are to model the airborne route of transmission in a way that can be addressed by Non-Pharmaceutical Interventions. How can we work with clinicians to design an experimental virus transmission study (e.g., an animal study) that would explicitly account for the ventilation in a space, and determine under which conditions a virus can truly be considered "airborne", and quantify these conditions?

Should not be just clinicians, but biologists and virologists. They should work out how to follow the virus, some / many still question whether the virus is truly airborne or aerosolised (or consensus of terminology)
Hamster and Ferret models used to show aerosol transmission of other viral diseases and likely SARS-CoV-2, including sized aerosols
Fluid and Mechanical modelling might be useful (has been shown) for specific ventilation systems on vehicles

4. What would be the best "good enough" and achievable ventilation inside/on board vehicles and should this be expressed in terms of supply of fresh air per person or of internal CO2 targets as a proxy for virus concentrations accumulating in a space?

Can we model virus concentration to CO2? It might be very difficult
High ppm correlated with poor mixing within buildings and suggestive of coming from someone breathing
Thus, it is possible this could be possible to measure this within vehicles theoretically
CO2 is a proxy for ventilation
Use ventilation guidance from buildings
Would idling vehicles have higher CO2?
400ppm ambient… what would be high?

5. Is 1m spacing between people on vehicles distant enough with regards to small droplet and aerosol transmission inside small spaces, and does this distance need to be smaller or greater than the conventions for office spaces?

Dispersion in not uniform, and not 1 or 2 metre, is totally dependent on ventilation, physical environment and the source.
Too many variables, artificial constraints
This suggest we are still discussing droplets and not considering aerosols – advice is still droplets (from government etc.) not aerosol

6. Is there anything else from the talks today which you think is particularly important?

Clarity as to pulse or continuous source from Andy Wood presentation with regard to how well mixed – suggest to discuss directly

Day 1 breakout session topics. Chair: Liora Malki-Epshtein

Original questions:

1. Is 1m spacing between people on vehicles distant enough with regards to small droplet and aerosol transmission inside small spaces, and does this distance need to be smaller or greater than the conventions for office spaces?
2. What would be the best “good enough” and achievable ventilation inside/on board vehicles and should this be expressed in terms of supply of fresh air per person or of internal CO2 targets as a proxy for virus concentrations accumulating in a space?
3. Key evidence is needed if we are to model the airborne route of transmission in a way that can be addressed by Non-Pharmaceutical Interventions. How can we work with clinicians to design an experimental virus transmission study (e.g., an animal study) that would explicitly account for the ventilation in a space, and determine under which conditions a virus can truly be considered “airborne”, and quantify these conditions?
4. What are the key data points on a train journey (getting on and off a train, mixing in the station, turnstiles etc) where infection can occur? Where should we be putting in the most effort to avoid risk?
5. Is it reasonable to structure passengers’ train travel (e.g., only travel on certain days)?
6. Is there anything else from the talks today which you think is particularly important?

Discussion:

- Is it more about airborne or ballistic droplets?
- Face masks – no flu this winter, must mean that face masks and social distancing are working.
- The other point that I wanted to raise is that SARS2 as influenza is sensitive to humidity and temperature (as someone else raised) and this could be accounted in ventilation and aircon designs, see https://peerj.com/articles/11024/
- What is the infectious dose? Diluting the concentrations should be helpful even if not all particles are actually removed from the space
- Assume complete mixing for airborne route with aerosols. Dose-response based on SARS rather than using Wells-Riley?
- Important to differentiate types of terminology used: source quantification; viral load, quanta emission rates for activities, dose-response, concentrations vs risk, etc
- Maintaining social distance may be impossible on public transport – the real question is the occupancy levels, passenger density
- Air pollution problems and the challenges and trade-offs between reducing exposure to covid and increasing exposure to outdoor air pollution, especially in traffic. Consider emissions of VOCs or other emissions internally from other vehicle parts too