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@AirPollSurrey @pk_shishodia
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- ...
- RAMP T7 SG7 Team members
Overview of SG7

“SG7 considered the earlier topics through the lens of real-life situations working with industry”

Meetings  Weekly
Attendees  ~55 Members, 10-20 attending each meeting
Who  Academics and businesses (e.g., Rail industry; Buildings; Sainsbury; Tesco; Arup + Local councils.....)
Focus  Enclosed environments with high density of people and restricted ventilation where the case studies could be relevant: i.e., supermarkets, schools, trains, buses, care homes, hospitals, etc.

Scientific goal
“Understanding the current state of science and challenges faced by the business/industry related to 2m rule/indoor spread, and setting up scientific questions and case studies to help address them”
Transmission pathways...

- **Contact transmission**
  - Direct (deposited on persons) or Indirect (deposited on objects) contact

- **Airborne transmission**
  - Inhalation
    - Suspended in air

**Droplets**
- Short range

**Aerosols**
- Extended distance and time

Zhang et al., 2020, PNAS
Airborne transmission was not recognised.

Research Article
Could fighting airborne transmission be the next line of defence against COVID-19 spread?

Prashant Kumar, Lidia Morawska

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WHO acknowledges airborne transmission of coronavirus in closed settings, and asymptomatic spread
Questions

- How important is airborne transmissions in built spaces? The smaller-sized particles will remain suspended in air for longer time and a lack of adequate ventilation may increase vulnerability of exposure to virus-laden particles.

- What is intensity of aerosol versus non-aerosol (e.g. surfaces) spread?

- Is partitioning rooms/office spaces/restaurants effective in reducing spread?

- Does the specific locations (e.g., queuing outside/inside) increase the vulnerability of exposure?

- Are people more vulnerable to spread in trains compared with platforms?

- Social distancing rule outdated and varied – 1m, 1m+, 2m – they cannot offer >20-30% usage of space; are there ways to increase the capacity (e.g., reduced distance, increased ventilation, germicides and masks etc).

- Supermarkets are diverse layouts – approaches for modelling people, flow and aerosol dispersion that can allow some generalisation?

- What full scale experiments can be done for generalisation of results in enclosed spaces, e.g. supermarkets/trains?
Micro-macro scale: around person in building
source – receptor – in-between (surfaces)

FACE TO FACE

SUPERMARKET

QUEUE

HOSPITAL

AIRPLANE

Susceptible – Exposed – Infectious – Recovered (SEIR) model
CFD + Data Assimilation for extrapolating measurements around a person in different environments

Arcucci, Quilodran et al. in progress
Face masks assessment @GCARE Surrey

- N95 Respirator
- Surgical masks
- Home-made

X

Y

Z
Face masks: test rig @GCARE Surrey

1. Testing rig
2. Filter holder (2 cm by 2 cm)
3. Solenoid switching system
4. Fast particulate analyser (DMS500)
5. Nebuliser (KCl particles)

Outer (hydrophobic) layer

Inner (hydrophilic) layer

Middle (filtering) layer

Kumar et al. in progress
Face masks: efficiency vs pressure

- **Style X (folded)** - Gray
- **Style Y (behind ears)** - Dark Blue
- **Style Z (tied)** - Light blue
- **Style Y (behind ears)** - Orange

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**Graph 1:** Efficiency vs Particle Diameter

- **X-axis:** Particle diameter, dp (nm)
- **Y-axis:** Efficiency [%]

**Graph 2:** Pressure Drop vs Time

- **X-axis:** Time (sec)
- **Y-axis:** dP (Pa)

Omidvarborna, Kumar et al. in progress
Face masks: what is typical usage time?

Sharma, Kumar et al. in progress
Schools... scenario analysis

Pupils at Bracknell schools test Covid-19 positive

Letters have been sent to parents at three different schools in the area

By Ruth Ovens
21:00, 7 SEP 2020 | UPDATED 08:44, 8 SEP 2020

September 2020

Mottet et al. in progress
TRAIN... aerosol distribution + ventilation

- Concentration change at different location with time
- Mimicking exhalation of aerosols (in red, source) while seated
- Normalised distribution of fine aerosol$_{2.5}$ concentrations

Kumar, Tiwari, Hama, et al. in progress. Thanks to First Group Rail & UKRI Project team: Cambridge, Imperial, Leeds.
In-progress review

Airborne transmission of COVID-19 and other coronaviruses in indoor and outdoor environments: a systematic review

Sotiris Vardoulakis, Daniela Andrea Espinoza Oyarce, Giovanni Lo Iacono, Gordon Nichols, Paolo Lauriola, Ariana Zeka, Simon Haberle, Cunrui Huang, Giovanni Leonardi, Olubusola Adedire, Yurong Wu, Prashant Kumar, Julia Alves Menezes, Rhavena Santos, Masahiro Hashizume

• Compare +/- ve test results reported in environmental sampling and/or epidemiological studies carried out in different environments/conditions, reporting on airborne transmission of any human coronavirus (HCoV), including SARS-CoV-2, SARS-CoV, MERS-CoV, and HCoV-HKU1.

• Main outcome(s): Coronavirus infections via airborne transmission. Environmental samples of airborne/aerosolised coronaviruses. Infectivity of airborne/aerosolised coronaviruses.
Concluding remarks...

A three-pronged approach targeting:

Building the knowledgebase to inform holistic decision-making in the best interests of the public and the economy..

Improving ventilation, occupancy..

Protecting individuals from infection via personal measures..

Kumar and Morawska (2020). City Env Int 4, 100033
Thanks to GCARE team + collaborators + funders

Global Centre for Clean Air Research

‘to realise a collaborative global vision of ‘clean air for all’

GCARE team

Visit Website
surrey.ac.uk/gcare