THE ENVIRONMENTAL HEALTH MATTERS INITIATIVE

AIRBORNE TRANSMISSION OF SARS-CoV-2

A VIRTUAL WORKSHOP OF THE ENVIRONMENTAL HEALTH MATTERS INITIATIVE
AUGUST 26-27, 2020

There is much we don't know about the transmission of SARS-CoV-2, the virus that causes COVID-19. We know it can spread from an infected person's sneeze or cough. But what do we know about transmission via speech and exhaled breath? How long do viruses linger in the air? How far can they travel? This workshop will delve into the rapidly evolving science on the environmental spread of the virus, as part of a larger body of COVID-19 related work at the National Academies, including the *Rapid Expert Consultation on the Possibility of Bioaerosol Spread of SARS-CoV-2 for the COVID-19 Pandemic* (April 1, 2020). This event will serve as a forum for interdisciplinary discussion, explanations of the basic foundational science, and clarification of terminology used differently among the relevant fields, all of which will be useful to those looking to understand the state of the science on SARS-CoV-2. We will feature experts in aerosol science, virology, infectious disease, epidemiology, and environmental health and seek to address the most critical questions (CQ) around the transmission of the virus.

Wednesday, August 26
(All times in Eastern Time, U.S. & Canada)

10:00 **Welcome**
Gregory Symmes, the National Academies of Sciences, Engineering, and Medicine

10:10 **Overview of the Environmental Health Matters Initiative**
Thomas Burke, Johns Hopkins Bloomberg School of Public Health

10:20 **COVID-19: Public Health and Scientific Challenges**
Anthony Fauci, National Institute of Allergy and Infectious Diseases (pre-recorded)

10:25 **Workshop Goals and Framework**
Jonathan Samet, Colorado School of Public Health

10:40 **Importance of Understanding the Role of Airborne Transmission in COVID-19**
Jay Butler, Centers for Disease Control and Prevention
11:05 Questions

11:15 **Aerosols and Transmission of Respiratory Viruses 101**
Linsey Marr, Virginia Tech
11:55 Questions

12:05 Break

12:30 **CQ1: What Size Droplets/Aerosols Are Generated by People and How Do They Spread in Air?**
Session Chair: Kim Prather, Scripps Institution of Oceanography, University of California, San Diego

1. What are the number and size of respiratory droplets/aerosols generated by individuals? Where in the respiratory tract are they generated? How do these vary by activity (e.g., speaking, coughing, singing)? How do these vary by individual?
2. How much virus is in different size droplets/aerosols? From where in the respiratory tract does virus originate? How does this vary by symptoms (including asymptomatic) and stage of infection? How does this vary by individual (i.e. superspreaders)? What leads to the variability?
3. How far do they travel in air?

12:35 Speakers (15 mins each)

Size Characteristics of Particles Generated by People
Lidia Morawska, Queensland University of Technology (pre-recorded)

Viruses in Respiratory Droplets
Donald Milton, University of Maryland School of Public Health

Transport of Droplets and Aerosols in Respiratory Activities
Lydia Bourouiba, MIT

1:20 **Panel Discussion** - *Kim Prather (moderating)*

- *Bill Lindsley, NIOSH*
- *Bill Ristenpart, University of California, Davis*
- *Robert Schooley, University of California, San Diego*
- *Linsey Marr*
- *Lydia Bourouiba*
- *Donald Milton*

(Panelists will discuss audience comments/questions after ~30 minutes)

2:30 Break

3:00 **CQ2: Which Size Droplets/Aerosols Are Infectious and for How Long?**
Session Chair: John-Martin Lowe, University of Nebraska Medical Center

1. Are smaller droplets/aerosols infectious?
2. How long do they remain infectious?
3. How do environmental conditions (e.g., humidity, sun) affect virus infectivity?
4. How well does masking protect the wearer and protect others from smaller droplets/aerosols?

3:05 Speakers (15 minutes each)

Size and Culturability of Human-Generated SARS-CoV-2 Aerosol
Josh Santarpia, University of Nebraska Medical Center

Impact of Environmental Conditions on the Infectivity of SARS-CoV-2 in Aerosols
Emmie de Wit, Rocky Mountain Laboratories

Effectiveness of Face Masks for COVID-19
Ben Cowling, University of Hong Kong (pre-recorded)

4:00 **Panel Discussion** - *John-Martin Lowe* (*moderating*)

- *Kanta Subbarao, WHO Collaborating Centre for Reference and Research on Influenza The Peter Doherty Institute for Infection and Immunity*
- *Catherine Noakes, University of Leeds*
- *Donald Milton*
- *Emmie De Wit*
- *Josh Santarpia*

(Panelists will discuss audience comments/questions after ~30 minutes)

5:15 Wrap Up and Day 2 Primer
Jonathan Samet

5:30 Adjourn

Thursday, August 27

10:00 **Welcome Back and Recap**
Jonathan Samet

10:10 **CQ3: What behavioral and environmental factors determine personal exposure to SARS-Cov-2?**
Session Chair: John Volckens, Colorado State University

1. What human behaviors increase risk of exposure?
2. Does droplet/aerosol size influence personal exposure and intake?
3. What role does the built environment play in determining exposure risk?
4. How does the built environment contribute to risk from super-spreader events?
5. What is the role of masks and face shields in mitigating exposure risk?

10:15 Speakers (15 minutes each)

Exposure to Expired Infectious Aerosols in Proximity and Distance
Yuguo Li, University of Hong Kong

Role the Built Environment Plays in Determining Exposure Risk for SARS-CoV-2
Shelly Miller, University of Colorado Boulder

COVID-19: Human Exposure Risks and Masks
Julian Tang, University of Leicester

11:05 **Panel Discussion** - *John Volckens* (*moderating*)
- *William Nazaroff, University of California, Berkeley*
- *Yuguo Li*
- *Shelly Miller*
- *Julian Tang*

(Panelists will discuss audience comments/questions after ~30 minutes)

11:55 Break

12:20 **CQ4: What Do We Know about the Infectious Dose and Disease Relationship for SARS-CoV-2?**
Session Chair: Seema Lakdawala, University of Pittsburgh

1. Can people inhale enough to be infected? How much does risk of being infected depend on inhaled dose?
2. Is clinical phenotype related to dose?
3. What are the biological modifiers of the dose-response relationship (age, sex, underlying conditions)?

12:25 Speakers (15 minutes each)

What Do We Know about the Infectious Dose and Disease Relationship for SARS-CoV-2?

Seema Lakdawala, University of Pittsburgh

Aerosol Transmission of SARS-CoV-2 and Influenza Virus in Animal Models

Hui-Ling Yen, University of Hong Kong

Disease Severity of Coronavirus as a Function of Dose, Age, and Genetic Background

Vineet Menachery, University of Texas Medical Branch

Sex and Gender Differences in SARS-CoV-2 Pathogenesis

Sabra Klein, Johns Hopkins Bloomberg School of Public Health

1:20 **Panel Discussion** - *Seema Lakdawala (moderator)*

- *Kevin Fennelly, Pulmonary Branch, NIH/NHLBI*
- *Charles Haas, Drexel University*
- *Hui-Ling Yen*
- *Vineet Menachery*
- *Sabra Klein*

(Panelists will discuss audience comments/questions after ~30 minutes)

2:20 Break

2:40 **Reflection and Syntheses: Identifying Opportunities and Gaps on the Path Ahead**

Session Chair: Arthur Reingold, University of California, Berkeley

CQ1: *Kim Prather, Scripps Institution of Oceanography, UC San Diego*
CQ2: *John-Martin Lowe, University of Nebraska Medical Center*
CQ3: *John Volckens, Colorado State University*
CQ4: *Seema Lakdawala, University of Pittsburgh*

3:30 **From Aerosols to Populations**

Jonathan Samet

3:45 **Panel: Implications for Disease Control**

Patrick Breysse, Centers for Disease Control and Prevention (moderator)

- *Georges Benjamin, American Public Health Association*
- *John "Jack" McCarthy, Environmental Health & Engineering, Inc.*
- *Nicole Alexander-Scott, Rhode Island Department of Public Health*
- *Trish Perl, UT Southwestern Medical Center*

(Panelists will discuss audience comments/questions after ~30 minutes)

5:00 **Reflections on the Science**
Thomas Burke, Johns Hopkins Bloomberg School of Public Health

5:20 **Closing Comments**
Gregory Symmes, National Academies Leadership

5:30 **Workshop Adjourns**

This workshop is hosted by the Environmental Health Matters Initiative, drawing on staff and volunteer expertise from the following groups across The National Academies Sciences, Engineering, and Medicine:

Division of Earth and Life Sciences
- Board on Atmospheric Science and Climate
- Board on Life Sciences
- Board on Environmental Studies and Toxicology
- Board on Chemical Sciences and Technology

Health and Medicine Division
- Board on Global Health and the Forum on Microbial Threats
- Board on Population Health
- Board on Health Science Policy: Standing Committee on Emerging Infectious Diseases

Division of Behavioral and Social Sciences and Education
- Board on Environmental Change and Society

Division of Engineering and Physical Sciences
- Board on Infrastructure and the Constructed Environment

National Academy of Engineering

For more information about the Environmental Health Matters Initiative, please see our website: https://www.nationalacademies.org/our-work/environmental-health-matters-initiative