Controlling the Spread of COVID-19: Best Practices

Ferric C. Fang, MD
Professor of Lab Medicine and Microbiology
University of Washington
Seattle, Washington

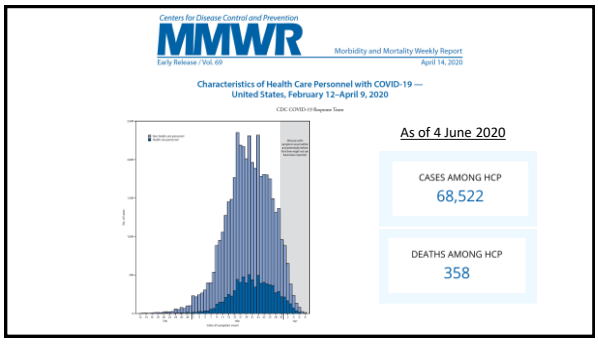
IAS–USA

Learning Objectives

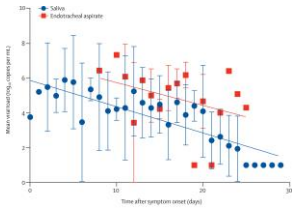
After attending this presentation, learners will be able to:

- Describe the dynamics of SARS-CoV-2 viral shedding and transmission
- Identify the limitations of SARS-CoV-2 PCR testing
- Recognize potential routes of SARS-CoV-2 spread in health care settings
- Recommend appropriate personal protective equipment to reduce the risk of SARS-CoV-2 acquisition by health care workers

Slide 3 of 33



SARS-CoV-2 Shedding Begins Before the Onset of Symptoms



- 23 patients in Hong Kong with laboratory-confirmed COVID-19
- Serial measurement of viral load in endotracheal aspirates or saliva of infected persons showed monotonic decline after symptom onset

To, et al. Lancet Infect Dis. 23 Mar 2020. https://doi.org/10.1016/S1473-3099(20)30196-1.

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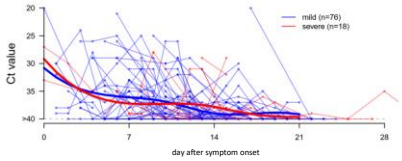
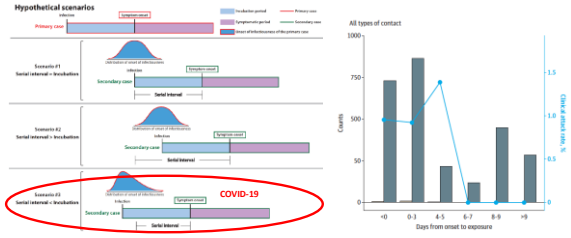


- 94 patients in Guangzhou with moderate COVID-19
- Serial measurement of viral load in throat swabs of infected persons showed monotonic decline after symptom onset

He, et al. Nat Med. 2020 May;26:672-675.

Pre-Symptomatic Transmission is Common

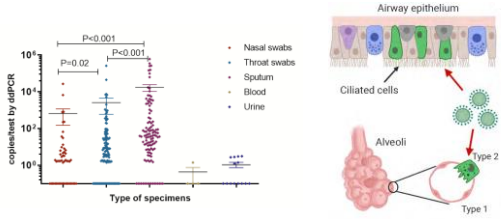


- the serial interval of COVID-19 is shorter than the incubation period, indicating a substantial amount of pre-symptomatic transmission

He, et al. Nat Med. 2020 May;26:672-675.

Cheng, et al. JAMA Intern Med. 2020 May 1:e202020.

Variable Sensitivity of Clinical Specimens for SARS-CoV-2 Diagnosis

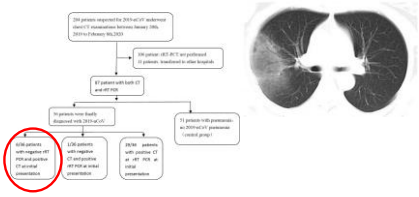


- Viral loads (sputum > throat swab > nasal swab) reflect the variable distribution of the virus in the respiratory tract

Yu, et al. Clin Infect Dis. 2020 Mar 28. pii: ciaa345.

Hou et al. Cell. 2020 May 20. https://doi.org/10.1016/j.cell.2020.05.042.

Variable Sensitivity of Clinical Specimens for SARS-CoV-2 Diagnosis



- It is not uncommon for patients with COVID-19 to initially test negative by PCR and subsequently test positive (17% in this study)

Long, et al. Eur J Radiol. 2020 Mar 25:126:108961.

Protecting Health Care Workers from COVID-19 Exposure

- analyzed COVID-19 in HCWs during the first 3 wks of the outbreak (Jan 2020) at Zhongnan Hosp.
- 28 patients with confirmed COVID-19 and 58 with suspected COVID-19 were seen
- 0 out of 278 HCWs working in the pulmonary/ID/ICU departments became infected (routine use of N95 masks); exposure OR 8.33
- 10 of 213 HCWs working in low-risk GI/trauma/GU units became infected (no masks)

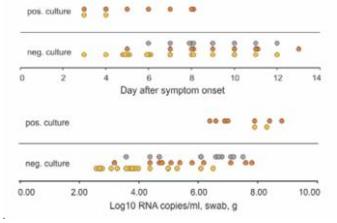
Wang, et al. J Hosp Infect. 2020 Mar 3. pii: S0195-6701(20)30097-9.

Routes of SARS-CoV-2 Transmission in Health Care Institutions

- Environmental sampling in a hospital caring for COVID-19 patients found frequent contamination of gloves, printers, keyboards, doorknobs and hand sanitizer dispensers

Ye, et al. J Infect. 2020 Apr 30:S0163-4453(20)30260-7.

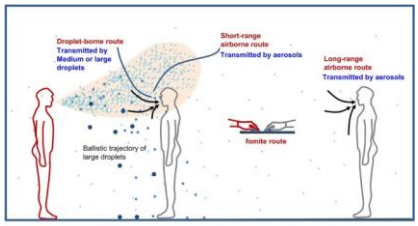
Difference between Viral Shedding and PCR-Positivity



- Viral shedding was assessed in 9 German patients with mild COVID-19 after exposure to an index case; shedding of virus from the upper respiratory tract stopped by day 8 but PCR positivity persisted for 2 weeks after symptom onset

Woelfel, et al. Nature. 2020 May;581(7809):465-469.

Droplet vs. Airborne



- Large droplets (>100 μm) : Fast deposition due to the domination of gravitational force
- Medium droplets between 5 and 100 μm
- Small droplets or droplet nuclei, or aerosols (< 5 μm): Responsible for airborne transmission

Wei & Li. Am J Infect Control. 2016 Sep 2;44(9suppl):S102-108.

COVID-19: Droplet vs. Airborne?

"Droplet and contact precautions are recommended for people caring for COVID-19 patients. Airborne precautions are recommended when aerosol generating procedures are performed." (World Health Organization)

"The epidemiologists say if it's close contact, then it's not airborne– that's baloney. . . I don't think (the WHO) knows and I think they are talking out of their hats." (Donald Milton, Univ. of Maryland)

"Personnel entering the room of a patient with suspected or confirmed COVID-19 should we appropriate PPE: gown, gloves, eye protection and an N95 respirator. . . If supply of respirators is limited, facemasks are an acceptable alternative." (CDC)

"The data we have for COVID-19 strongly support the possibility that SARS-CoV-2 is transmitted by inhalation of both droplets and aerosols near the source." (Lisa Brosseau, University of Illinois)

The New York Times

Some Hospitals Are Close to Running Out of Crucial Masks for Coronavirus

N95 masks are essential for protecting health care workers and controlling the epidemic, but some hospitals have been unable to get new shipments

The Washington Post

Face mask shortage prompts CDC to loosen coronavirus

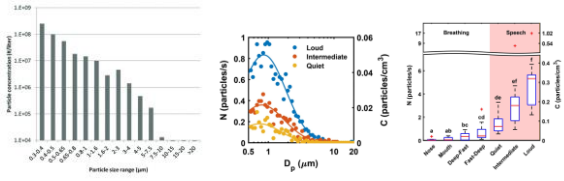
CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Based on local and regional situational analysis of PPE supplies, facemasks are an acceptable alternative when the supply chain of respirators cannot meet the demand. During this time, available respirators should be prioritized for procedures that are likely to generate respiratory aerosols, which would pose the highest exposure risk to HCP.

Steven A. McDonald, MD
Chair of Clinical Operations
Dept. of Emergency Medicine
New York-Prebyterian Hospital
Columbia University

"We feel like guidelines are changing, not because science recommends they change, but because we need people, we need warm bodies in the ER."

Airborne Transmission by Routine Activities



- Particles of every size are generated by coughing, sneezing, talking and breathing
- Transmission intensity correlates with speaking volume

Lindsley et al. J Occup Environ Hyg 9:681-690, 2012.
Gralton. J Infect. 62:1-13, 2011.

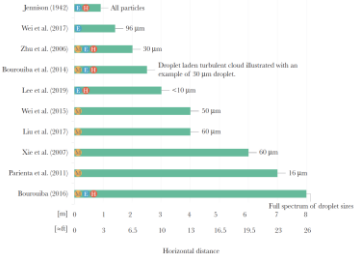
Asadi et al. Sci Rep. 2019 Feb 20;9(1):2348.

Airborne Transmission of SARS-CoV-2

- Airborne transmission suspected in an outbreak with 45 cases and 2 deaths following Skagit Valley Chorale practice (75% attack rate); none were symptomatic

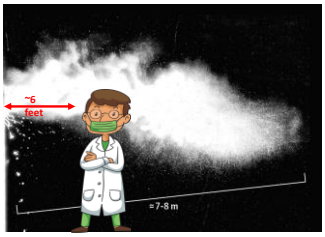
Hamner et al. MMWR Morb Mortal Wkly Rep. 2020 May 15;69(19):606-610.

Horizontal Spread of Respiratory Droplets



Bahl et al. J Infect Dis. 2020 Apr 16. doi: 10.1093/infdis/jiaa189.

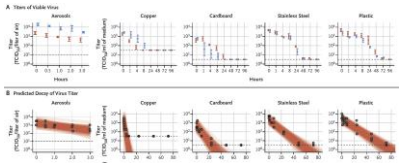
Personal Protective Equipment and Turbulent Gas Clouds



- "William Wells dichotomized respiratory droplet emissions into large and small droplets in the 1930s. . . The rapid spread of COVID-19 suggests that this may not reflect what actually occurs, contributing to the ineffectiveness of procedures used to limit its spread."

Bourouiba. JAMA. 2020 Mar 26. doi: 10.1001/jama.2020.4756.

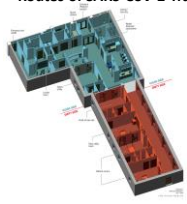
Experimental Aerosolization of SARS-CoV-2

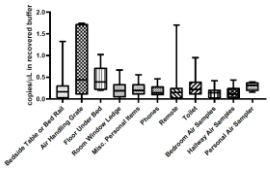


- Aerosolization under controlled experimental conditions indicates that SARS-CoV-2 may remain detectable in air samples for at least 3 h and is more stable on plastic/steel surfaces than on copper/cardboard

Van Doremalen, et al. N Engl J Med. 2020 Mar 17. doi: 10.1056/NEJMc2004973.

Routes of SARS-CoV-2 Transmission in Health Care Institutions

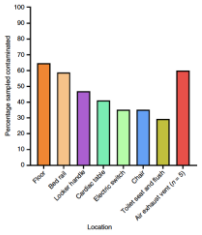




- Environmental sampling was performed during the isolation of 13 patients with COVID-19 at the Nebraska Biocontainment Unit
- Viral contamination of commonly used items, toilet facilities and air samples in the hallways outside patient rooms was detected, indicating the potential for fomite and airborne transmission as well as droplet and person-to-person

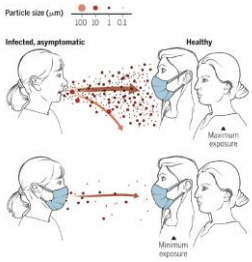
Santarpia, et al. medRxiv 2020.03.23.20039446.

Environmental Contamination of Hospital Airborne Isolation Rooms



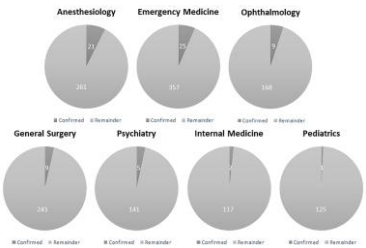
Chia et al. Nat Commun. 2020 May 29;11(1):2800. doi: 10.1038/s41467-020-16670-2.

Short-range Airborne Transmission



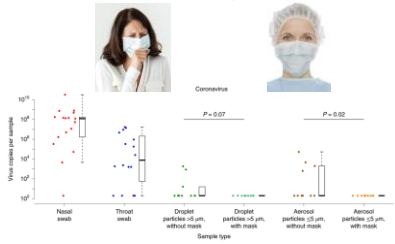
Prather et al. Science. 2020 May 27. doi: 10.1126/science.abc6197.

Physician Risk of COVID-19 Acquisition by Specialty



Breazzano et al. J Clin Invest. 2020 May 28;139587. doi: 10.1172/JCI139587.

Face Masks Reduce Shedding of Exhaled Viruses

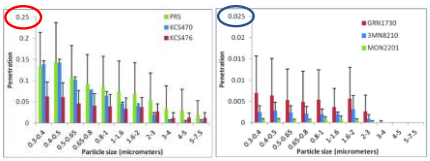


- Surgical face masks worn by individuals with respiratory infections can reduce viral transmission

Leung, et al. Nat Med. 3 Apr 2020. https://doi.org/10.1038/s41591-020-0843-2.

Personal Protective Equipment for Health Care Workers

Surgical masks **N95 respirators**



- Surgical masks provide good protection against droplets but are more permeant to smaller (sub-micron) particles than N95 respirators

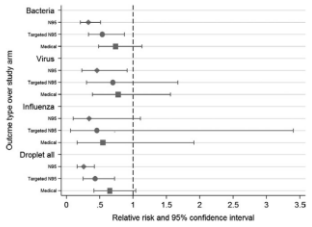
Lindsley et al. J Occup Environ Hyg 9:681-690, 2012.

Personal Protective Equipment for Health Care Workers

- 41 HCWs in Singapore were exposed to aerosol-generating procedures involving a patient who was subsequently discovered to have COVID-19; 35 were wearing surgical masks and 6 were wearing N95 masks
- None developed COVID-19

Ng, et al. Ann Intern Med. 2020 Mar 16. doi: 10.7326/L20-0175.

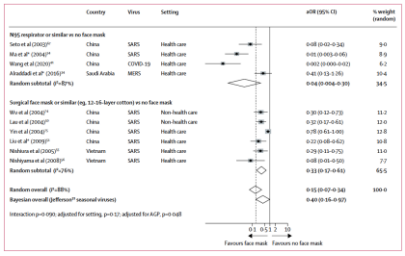
Personal Protective Equipment for Health Care Workers



- An analysis of 3591 subjects in RCTs found lower rates of lab-confirmed viral infections (RR 0.46) and droplet-transmitted infections (RR 0.26) for N95 respirators over medical masks

MacIntyre, et al. Influenza Other Respi Viruses. 2017. 11:511-517.

N95 or Surgical Masks?



Chu et al. Lancet. 2020 Jun 1. doi: 10.1016/S0140-6736(20)31142-9.

TAKE-HOME POINTS

- SARS-CoV-2 is transmissible for a few days prior to symptom onset and for several days afterwards; this complicates symptom-based case identification.
- Although NP Swab PCR is highly specific with good analytical sensitivity, a negative PCR result cannot exclude the diagnosis of COVID-19.
- Most patients with mild COVID-19 stop shedding live virus within 7d of symptom onset, but PCR positivity may persist for longer periods of time.
- Properly-fitted N95 respirators provide superior protection to aerosols compared to surgical masks, but surgical masks are considerably better than no mask and are generally effective except in settings with high aerosol risk. Universal masking in health care settings is a prudent approach to prevent institutional COVID-19 transmission.

The Washington Post

Democracy Dies in Darkness

Health & Science

To fight the spread of coronavirus, it's time to wear masks in all hospitals

By Harlan Krumholz

March 31, 2020 at 5:45 a.m. PDT

Time to stop debating the mask — and just wear them, at least inside hospitals. Even some top health systems have complicated policies about who among their employees should wear face masks and when, which is sowing confusion amid the coronavirus pandemic.

The infection of health-care workers (and patients by health-care workers) should be understood as a safety issue — that is, preventable with proper, high-quality practices. We should commit to making it a "never event." As a result, harm to a health-care worker, and by extension, to their families and friends as a result of their service on the front lines, should be a never event. It seems within our grasp to make it so.

Question-and-Answer

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