COVID-19 Clinical Bootcamp

Infection Transmission and Personal Protective Equipment (PPE)

Division of Pulmonary and Critical Care Medicine

Tuesday, March 24, 2020
Link to recorded video
Outline

- COVID-19 transmission
  *Jeff Min*

- SharePoint & UPHS PPE policies
  *Jen Ginestra*

- Novel PPE conservation
  *PPE Task Force*
COVID-19 Transmission

Jeff Min
Transmission

Initial zoonotic infection\(^1\)

Fomite-to-face\(^2\)
- Respiratory droplets
- Nasal secretions
- Fecal-oral possible\(^3\)

Large droplets (> 5µm)

Aerosol-generating procedures (< 5µm)

Transmission

RNA & protein components susceptible to degradation

SARS - degrades significantly when exposed to heat or common disinfectant solutions\(^1\)

Meteorological conditions may impact transmissibility\(^2,3\)

\(^1\)https://www.who.int/csr/sars/survival_2003_05_04/en/  \(^2\)SSRN http://dx.doi.org/10.2139/ssrn.3551767  \(^3\)https://doi.org/10.1101/2020.02.22.20025791
Transmission

- Asymptomatic reported\(^1,2\)

- Period of infectibility
  - RT-PCR+ for 1-2 wks after hospital discharge in mild-moderate sx\(^3\)
  - Similar RT-PCR viral loads between symptomatic & asymptomatic individuals\(^4\)
  - Viral culture negative after ~ 8 days in mild illness\(^5\)
  - Unclear for severe illness/higher viral load
  - CDC: consider paired nasopharynx + pharynx RT-PCR tests prior to discontinuing precautions

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\(^4\)NEJM DOI: 10.1056/NEJMc2001737  \(^5\)Preprint https://doi.org/10.1101/2020.03.05.20030502
Transmission

$R_0$: avg number of people that an infected person transmits the virus to

- Non-modifiable factors: virus type
- Modifiable factors: precautions, social distancing, etc.

Estimated for 2019-nCoV in China\(^1\): **2.68** (95% CI **2.47-2.86**)

$R_0$ estimated up to **14.8** on cruise ship *Diamond Princess*\(^3\)

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\(^1\) *Lancet* DOI: [https://doi.org/10.1016/S0140-6736(20)30260-9](https://doi.org/10.1016/S0140-6736(20)30260-9)

\(^2\) *Emerg Infect Dis.* DOI: [https://doi.org/10.3201/eid2501.171901](https://doi.org/10.3201/eid2501.171901)

\(^3\) *Journal of Travel Medicine* [https://doi.org/10.1093/jtm/taaa030](https://doi.org/10.1093/jtm/taaa030)
Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1

DOI: 10.1056/NEJMc2004973
<table>
<thead>
<tr>
<th>Clinical Setting</th>
<th>PPE Recommended</th>
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<tbody>
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<td>Emergency Department (Patient Under Investigation)</td>
<td>Patients not in acute respiratory distress but requiring treatment that may result in aerosol-generation such as nebulizer therapy:</td>
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<td>• Provide patient mask to wear on arrival to ED and place in private room</td>
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<td></td>
<td>aerosol generating procedures; do NOT need negative pressure room</td>
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<tr>
<td></td>
<td>Patients requiring ICU-level care and/or intubation and mechanical ventilation:</td>
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<td></td>
<td>gloves</td>
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<td>ventilated (Patient Under Investigation)</td>
<td>gloves</td>
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<tr>
<td>CONFIRMED COVID-19 patients</td>
<td>Priority for negative pressure room and Airborne/Respirator + Contact + Eye</td>
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<tr>
<td></td>
<td>Shield = PAPR/N95, eye shield, gown, gloves</td>
</tr>
</tbody>
</table>
Aerosol-generating procedures
Aerosol-generating medications
Noninvasive Positive-Pressure Ventilation*

An Experimental Model to Assess Air and Particle Dispersion

*Chest. 2006 Sep;130(3):730-40. DOI: https://doi.org/10.1378/chest.130.3.730
Is it airborne? A controversial topic

<table>
<thead>
<tr>
<th>Respiratory viruses</th>
<th>Transmission-based precautions</th>
<th>WHO</th>
<th>US CDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measles</td>
<td>Airborne</td>
<td></td>
<td>Airborne</td>
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<tr>
<td>Seasonal influenza</td>
<td>Droplet</td>
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<td>Droplet [66]</td>
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<tr>
<td>Avian influenza</td>
<td>Contact + Droplet</td>
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<td>Contact + Airborne [36]</td>
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<tr>
<td>MERS-CoV</td>
<td>Contact + Droplet [47,67]</td>
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<td>Contact + Airborne [49]</td>
</tr>
<tr>
<td>RSV</td>
<td>Contact + Droplet</td>
<td></td>
<td>Contact</td>
</tr>
</tbody>
</table>

Investigations indicate that outbreaks were conducted in crowded emergency departments with suboptimal infection prevention and control measures, which resulted in human-to-human transmission and environmental contamination.

1 MERS-CoV was believed to have occurred before adequate infection prevention and control procedures were applied.

Influenza
- Culturable virus detectable in 52 (39%) fine-aerosol samples among 142 cases of symptomatic influenza.
- Cough greatly increased risk of aerosol transmission, however, culturable virus was still detected in 48% of sampling in which no cough was observed.
- Viral RNA was positive in 47 influenza subjects: > 4 μm: 35%, 1-4 μm: 23%, <1 μm: 43%.
- However, viable virus was only detected in 2 of 21 subjects with influenza.

References:
COVID is stable in aerosols

Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-Cov-1
DOI: 10.1056/NEJMc2004973
Lessons from Singapore
Why conflicting evidence? Consider probability

**THE SIZE AND THE DURATION OF AIR-CARRIAGE OF RESPIRATORY DROPLETS AND DROPLET-NUCLEI**

By J. P. DUGUID, M.B., B.Sc., from the Department of Bacteriology, Edinburgh University

<table>
<thead>
<tr>
<th>Minutes</th>
<th>19-20</th>
<th>29-30</th>
<th>59-60</th>
<th>74-75</th>
<th>89-90</th>
<th>119-120</th>
<th>149-150</th>
<th>359-360</th>
<th>599-600</th>
<th>1799-1800</th>
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J Hyg (Lond). doi: [10.1017/s0022172400019288](https://doi.org/10.1017/s0022172400019288)
Take-home points

‣ Be mindful of aerosol-generating procedures/medications

‣ Observational evidence supports contact + droplet precautions for routine patient care

‣ But experimental data shows potential for airborne transmission

‣ PPE recommendations evolving based on additional data & availability of equipment

‣ Emphasis remains on preventing fomite-to-face transmission
SharePoint & UPHS PPE Policies
Jen Ginestra
SharePoint Resources

Access on UPHS Network: here
Access on VPN: here

PPE guidelines, videos
Occupational Health Information
Clinical Guidelines
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|                                                      | • Special Respiratory Precautions = wear N95 or PAPR during provision of aerosol generating procedures¹; do NOT need negative pressure room |
|                                                      | **Patients requiring ICU-level care and/or intubation and mechanical ventilation:**  
|                                                      | • Airborne/Respirator + Contact + Eye Shield = PAPR/N95, eye shield, gown, gloves  
|                                                      | • Negative pressure room (if available)                                                                                                                                 |
|                                                      | **If available, negative pressure rooms and airborne precautions should be prioritized for patients with extremely high suspicion for COVID-19** |
| Non-ICU inpatient (Patient Under Investigation)     | • Standard + Droplet + Contact = surgical mask, eye shield, gown, gloves  
|                                                      | • Private room  
|                                                      | • Special Respiratory Precautions = wear N95 or PAPR during provision of aerosol generating procedures¹; do NOT need negative pressure room |
| ICU inpatients and/or intubated/mechanically ventilated (Patient Under Investigation) | • Airborne/Respirator + Contact + Eye Shield = PAPR/N95, eye shield, gown, gloves  
|                                                      | • Negative pressure room (if available)                                                                                                                                 |
| CONFIRMED COVID-19 patients                         | Priority for negative pressure room and Airborne/Respirator + Contact + Eye Shield = PAPR/N95, eye shield, gown, gloves |

¹ For aerosol generating procedures.
# Current Patient Care PPE Recommendations (3/24/20)

<table>
<thead>
<tr>
<th>Work Spaces</th>
<th>Droplet + Social distancing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-PUI</td>
<td>Droplet</td>
</tr>
<tr>
<td>PUI ED</td>
<td>Droplet + Contact</td>
</tr>
<tr>
<td>PUI Ward</td>
<td>Droplet + Contact</td>
</tr>
<tr>
<td>PUI ICU</td>
<td>Airborne + Contact + Eye Shield</td>
</tr>
<tr>
<td>Confirmed</td>
<td>Airborne + Contact + Eye Shield</td>
</tr>
<tr>
<td>Aerosol Generating Procedures (PUI or confirmed)</td>
<td>Airborne + Contact + Eye Shield</td>
</tr>
</tbody>
</table>

SUBJECT TO CHANGE: Updated as of 3/24/20, check SharePoint for additional updates
<table>
<thead>
<tr>
<th>Non-PUI</th>
<th>RRT (respiratory)</th>
<th>Droplet + Contact + Eye Shield</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Code and/or Intubation</td>
<td>Droplet + Contact + Eye Shield</td>
</tr>
<tr>
<td>PUI</td>
<td>RRT (any)</td>
<td>Droplet + Contact + Eye Shield</td>
</tr>
<tr>
<td></td>
<td>Code and/or Intubation</td>
<td>Airborne + Contact + Eye Shield</td>
</tr>
<tr>
<td>Confirmed COVID-19 +</td>
<td>RRT (any)</td>
<td>Airborne + Contact + Eye Shield</td>
</tr>
<tr>
<td></td>
<td>Code and/or Intubation</td>
<td>Airborne + Contact + Eye Shield</td>
</tr>
</tbody>
</table>

**Nurse Clinical Coordinators (NCCs)** bring eye shields, surgical masks, N95s to all RRTs/codes

**Nursing Subject Matter Experts (SMEs)** bring N95s, assist with donning, doffing, transport

**LUCAS** mechanical CPR device may be available to limit personnel exposure during compressions

SUBJECT TO CHANGE: Updated as of 3/24/20, check SharePoint for additional updates
Universal Masking: Extended Use of Facemasks

Starting 3/25/20

- Surgical mask provided on entry to hospital
- Same mask for one shift
  - Do not need to be changed btw patients
  - Kept on throughout shift
- Avoid touching, repositioning
  - Every time touched, hand hygiene
- Removed and discarded if soiled

Preservation for reuse
- Do not touch outer surface
- Fold mask w/ outer surface facing in
- Place mask in unsealed bag
- Perform hand hygiene

See DOH website, SharePoint for details
Improper doffing can result in exposure
PUTTING ON PERSONAL PROTECTIVE EQUIPMENT

1. PERFORM HAND HYGIENE
2. PUT ON GOWN
3. PUT ON MASK, N95 RESPIRATOR, OR PAPR
4. PUT ON EYE PROTECTION (UNLESS WEARING A PAPR)
5. PUT ON GLOVES

REMOVING PERSONAL PROTECTIVE EQUIPMENT

1. REMOVE GLOVES
2. REMOVE EYE PROTECTION (UNLESS WEARING A PAPR)
3. PERFORM HAND HYGIENE
4. REMOVE GOWN
5. REMOVE MASK, N95 RESPIRATOR, OR PAPR
6. PERFORM HAND HYGIENE
Helping You Wear it Right

Application

1. Remove the respirator from its packaging and hold with straps facing upward. Place the bottom strap under the center flaps next to the ‘ATTENTION’ statement.

2. Fully open the top and bottom panels, bending the nosepiece around your thumb at center of the foam. Straps should separate when panels are opened. Make certain the bottom panel is unfolded and completely opened.

3. Place the respirator on your face so that the foam rests on your nose and the bottom panel is securely under your chin.

4. Pull the top strap over your head and position it right on the back of the head. Then, pull the bottom strap over your head and position it around your neck and below your ears.

5. Adjust for a comfortable fit by pulling the top panel toward the bridge of your nose and the bottom panel under your chin. Make certain hair, facial hair, jewelry and clothing are not between your face and the respirator as they will interfere with fit.

6. Place your fingers at both hands at the top of the metal nosepiece. Using two hands, mold the nose area to the shape of your nose by pushing inward while moving your fingertips down both sides of the nosepiece. Note: Always use two hands when molding the nosepiece. Pinching the nosepiece with one hand may result in improper fit and less effective respirator performance.

Removal

Can be performed using one or both hands

1. One hand

2. Two hand

3. One hand

4. Two hand

Perform a User Seal Check

Check the seal of your respirator each time you use the respirator.

Place one or both hands completely over the middle panel. Inhale and exhale sharply. Be careful not to disturb position of the respirator. If air leaks around your nose, re-adjust the nosepiece as described in Step 6. If air leaks around respirator edges, adjust panels and position of straps and make certain respirator edges fit snugly against the face. If you cannot achieve a proper seal, do not enter the contaminated area. See your supervisor.

Without touching the respirator facepiece, slowly lift the bottom strap from around your neck up over your head.

Lift off the top strap. Do not touch the respirator.

Store or discard according to your facility’s infection control policy.
Wear It Right

3M™ Respirators

3M™ 1860/1860S Health Care N95 Particulate Respirator and Surgical Mask

APPLICATION:

1. Cup the respirator in your hand with the nosepiece at fingertips, allowing the head straps to hang freely below hand.
2. Position the respirator under your chin with the nosepiece up.
3. While holding the respirator in place, pull the top strap over your head so it rests high on the back of your head.
4. While continuing to hold the respirator firmly in place, pull the bottom strap over your head and position it around your neck, below your ears. Untwist the straps. Position the respirator low on your nose.
5. Using both hands, mold the nosepiece to the shape of your nose by pushing inward while moving your fingertips down both sides of the nosepiece. Note: Always use two hands when molding nosepiece. Pinching with one hand may result in improper fit and less effective respirator performance.

REMOVAL:

1. Without touching the respirator, slowly lift the bottom strap from around your neck up and over your head.
2. Lift off the top strap. Do not touch the respirator.
3. Store or discard according to your facility’s infection control policy.

POSITIVE PRESSURE FIT CHECK

6. The respirator must be checked before each use. To perform the fit check, place both hands completely over the respirator, being careful not to disturb the position, and exhale sharply. If air leaks around your nose, adjust the nosepiece as described in step 5. If air leaks at respirator edges, adjust the straps back along the sides of your head. Perform fit check again if an adjustment is made. If you cannot achieve a proper fit, see your supervisor. Do not enter area requiring respirator use.
Doffing N95

First, tilt your head forward.

Then use 2 hands to grab the bottom strap.

Pull to the sides, then over your head.

Pull to the sides, then over your head.

Which will let the mask fall forward.

Do NOT touch outside of mask
Dispose of or store mask for reuse
Doffing Gloves

Careful NOT TO SNAP the gloves off

DO NOT touch your hands to bare skin

Perform hand hygiene
Powered Air Purifying Respirator (PAPR)

Biological airborne isolation protection

Components

- PAPR Helmet (with Lens Cuff)
- Battery
- Belt

Detailed overview: onsite,
PAPR Donning

1. Hand hygiene
2. Secure battery
3. Don gown
4. Feed cord
5. Plug cord
6. Confirm LEDs
7. Place PAPR
8. Adjust ratchet (clockwise)
9. Position helmet
10. Tie gown
11. Don gloves

Detailed overview: onsite, VPN
PAPR Doffing

1. Sanitize gloves
2. Remove gown & gloves
3. Hand hygiene
4. Exit room
5. Hand hygiene
6. Don gloves
7. Remove PAPR
8. Disinfect PAPR & battery
9. Remove gloves
10. Hand hygiene

Detailed overview: onsite, VPN
PAPR Doffing

1. **Loosen** rear headband by turning ratchet *counterclockwise*
2. **Turn** front clip to horizontal position.
3. Grasp one or both sides of lens near flappers and **pull away from face** and discard.
4. **Disconnect** the battery by pushing down on the black button and pull cord out.
5. **Remove** and dispose of comfort strips.
6. **Clean** outside and inside surfaces with alcohol, bleach, hydrogen peroxide, or ammonia wipes.

Detailed overview: onsite,
PAPR Donning/Doffing Instructional Video
PAPR Training

- For MICU faculty and staff
- Every **Tuesday at 2pm**
- Founders 9 MICU or Donner 3 MICU
- Attend 1 week before going on service

Contact **Brian Anderson** or **George Anesi**

prior to attending to confirm location and attendance

Todd Barton working on setting up PAPR training for medicine residents separately on as needed basis
Eye Protection

- CDC: “goggles or a disposable face shield that covers the front and sides of the face”

- Personal eyeglasses and contact lenses are NOT considered adequate eye protection

- Reusable eye protection (e.g., goggles) must be cleaned and disinfected prior to reuse.

- Disposable eye protection should be discarded after use.
Minimizing Contamination at Work

‣ **Surfaces**
  - Wash hands frequently, before leaving hospital, on arrival home
  - Use sanitizing wipes on computer keyboards, WOW handles, mouses, etc.
  - Sanitize contact stethoscope ear buds
  - Don’t sit in COVID+ rooms

‣ **Attire**
  - Work-only clothes or scrubs
    (Dulles 3, Ravdin basement)
  - DO NOT wear your white coat, launder jackets
  - Avoid long sleeves, ties, jewelry, watches

‣ **Accessories**
  - Be mindful of your ID badge
  - AVOID cell phone use in patient rooms
  - Sanitize with wipes or UV box (HUP MICU) periodically + at end of day

Instagram credit: Megan Burke (cardiology)
Minimizing Contamination at Home

- Change / shower before leaving work or immediately upon arrival home
  - Working on MICU call room availability for changing/showering
- Launder clothes (including work jackets) on highest possible temperatures
- Sanitize home surfaces your work clothes came into contact with
- Sanitize items you took to work (phone charger, laptop, etc)
COVID-19 Exposure Management

High Risk Exposure
- Prolonged close contact (within 6 feet, for at least 10 minutes) with COVID-19 patient when neither patient nor HCP is masked
- Performing aerosolizing procedures on COVID-19 patient without full PPE including eye protection

→ Work exclusion for 14 days + active monitoring ←

Medium Risk Exposure
- Wearing partial PPE providing care with symptomatic COVID-19 patient
- Providing care without PPE for asymptomatic patient who converts positive within 7 days

→ Work exclusion for 7 days + active monitoring ←

Low Risk Exposure
- Providing direct care to a COVID-19 patient with recommended full PPE including eye protection
- Working on a floor/unit/practice or unit with known or suspected COVID-19 cases with no PPE

→ No work exclusion + self-monitoring for 14 days ←

HCP with fever or respiratory symptoms suggestive of COVID-19 disease cannot work.

If at work: PUT ON A SURGICAL MASK.
- Notify your supervisor to arrange coverage for your shift/rotation.
- Report to Occ Health (weekday) or the ED (nights/weekends/holidays).

If at home: DO NOT COME TO WORK.
- Notify your supervisor to arrange coverage for your shift/rotation.
- Contact your PCP or Penn Medicine OnDemand (215-615-2222, or schedule through My Penn Medicine App) for evaluation.

Discuss any exposures with infection control and check <a href="SharePoint">SharePoint</a> for most updated information.
Discussion

‣ Experience with PAPRs
‣ Experience with COVID patients
‣ Minimizing exposure at home
‣ Challenges, tips, tricks?
‣ Questions?
Novel PPE Conservation

Roger Kim
Christopher Chesley
Joshua Brotman
Hari Shankar
Kevin Ma
N95 decontamination for purpose of reuse

- Ultraviolet germicidal irradiation (UVGI)
- Hydrogen peroxide vapor (HPV)
- Microwave oven generated steam (MGS)
- Ethylene oxide (EtO)
- Bleach wipes

- Others
  - Moist heat incubation/pasteurization
  - Liquid hydrogen peroxide
  - Hydrogen peroxide gas plasma
UVGI
Novel ideas for PPE conservation

System-wide
- Lines outside of patient rooms
- Early assessment for Foley catheter placement
- Consolidation of lab draw times
- Elimination of MRSA/VRE contact precautions for non-COVID patients

Provider-level
- Bundling of invasive procedures (intubation, central, A-line, etc.)
- Consolidation of meds
- No repeat exams by trainees/attendings
- Limitation of nebs, NIPPV, HFNC unless absolutely necessary
- Reduction of imaging studies
- E-ICU/tele-ICU
IMPROVED EXTERNAL VENT/ IV PUMP SETUP

VENT MONITOR CAN ATTACH TO ANY HORIZONTAL BAR.

Inside the room

Outside of the room
Remaining Questions

- Reuse of masks after COVID+ patient room
- Reuse of masks after PUI patient room
- Where to store masks after use (paper bag, centralized drop location)
- UV cleaning logistics
Ways to help

‣ Next Bootcamp 3/31 - call for fellows
  • Clinical presentation, disease course, testing
  • Critical care for the COVID patient
  • Treatment review
  • Additional topics/sessions TBD

‣ UPHS Blood Drive
  • Redcrossblood.org, Sponsor code: HUP

‣ PPE donations
  • SupplyChainLeadBox@pennmedicine.upenn.edu
  • Drop off at security booth outside Gates entrance

Interested in helping? Have any comments or suggestions?