Penn Medicine

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

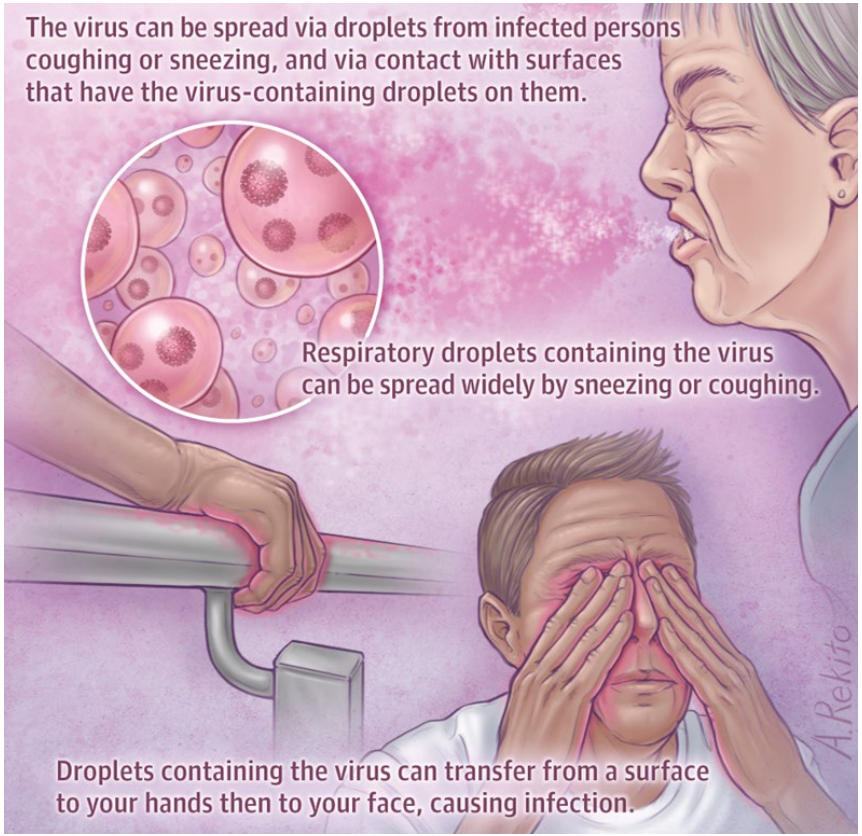
Initial zoonotic infection[1]

Fomite-to-face[2]

- Respiratory droplets
- Nasal secretions
- Fecal-oral possible[3]

Large droplets (> 5µm)

Aerosol-generating procedures (< 5µm)



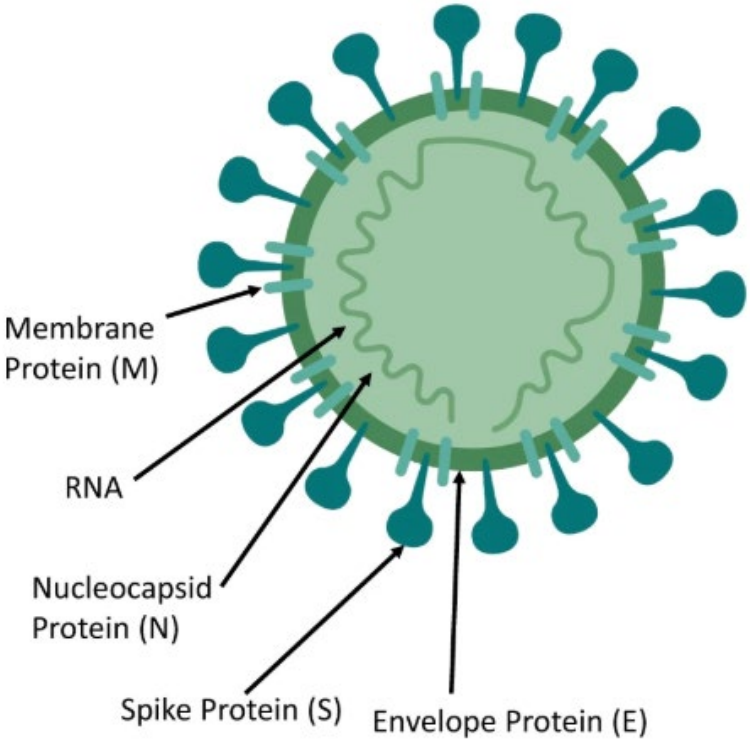
[1]JAMA doi:10.1001/jama.2020.3072 [2]JAMA doi:10.1001/jama.2020.4269 [2]JAMA doi:10.1001/jama.2020.3204

Transmission

RNA & protein components susceptible to degradation

SARS - degrades significantly when exposed to heat or common disinfectant solutions[1]

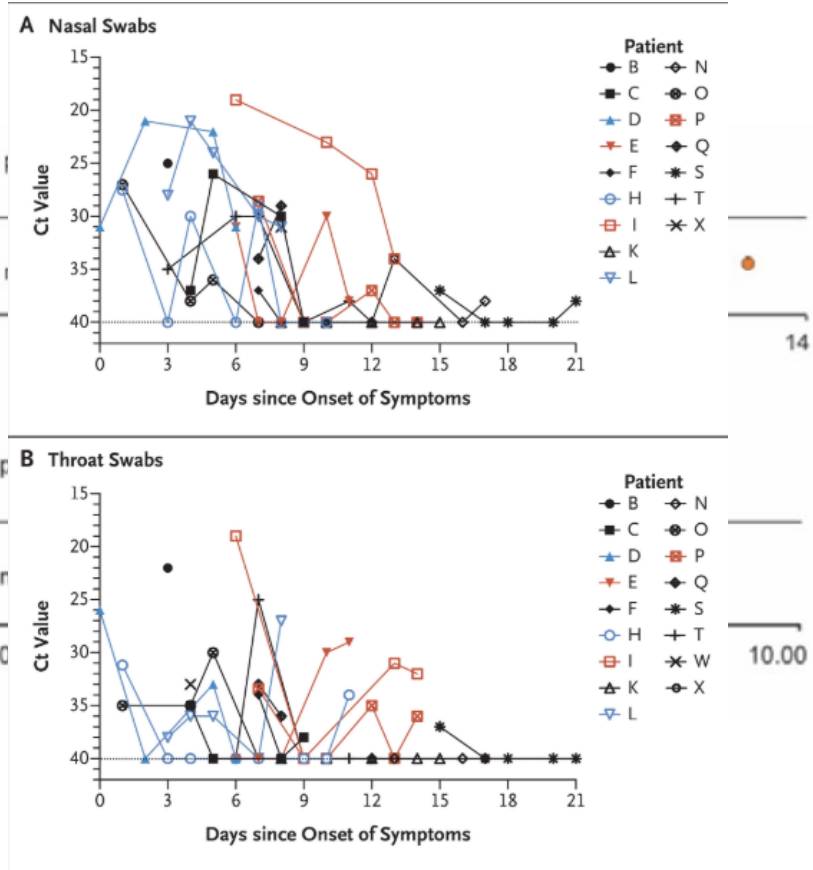
Meteorological conditions may impact transmissibility[2,3]



[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



[1]JAMA doi:10.1001/jama.2020.2565 [2]NEJM DOI: 10.1056/NEJMc2001468 [3]JAMA doi:10.1001/jama.2020.2783
[4]NEJM DOI: 10.1056/NEJMc2001737 [5]Preprint https://doi.org/10.1101/2020.03.05.20030502

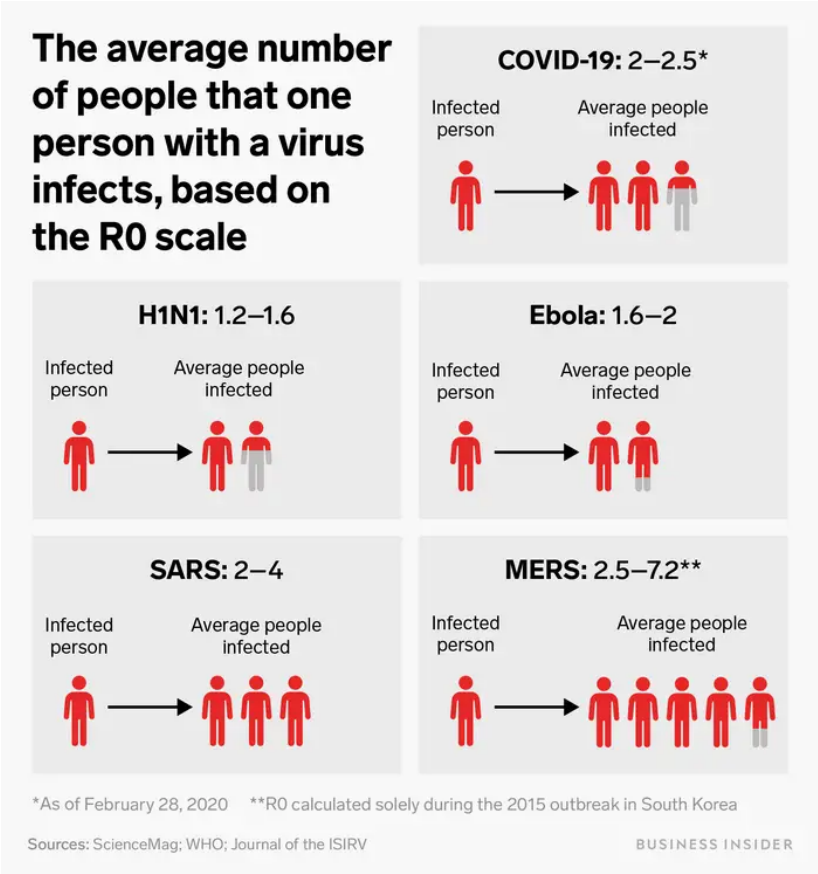
Transmission

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

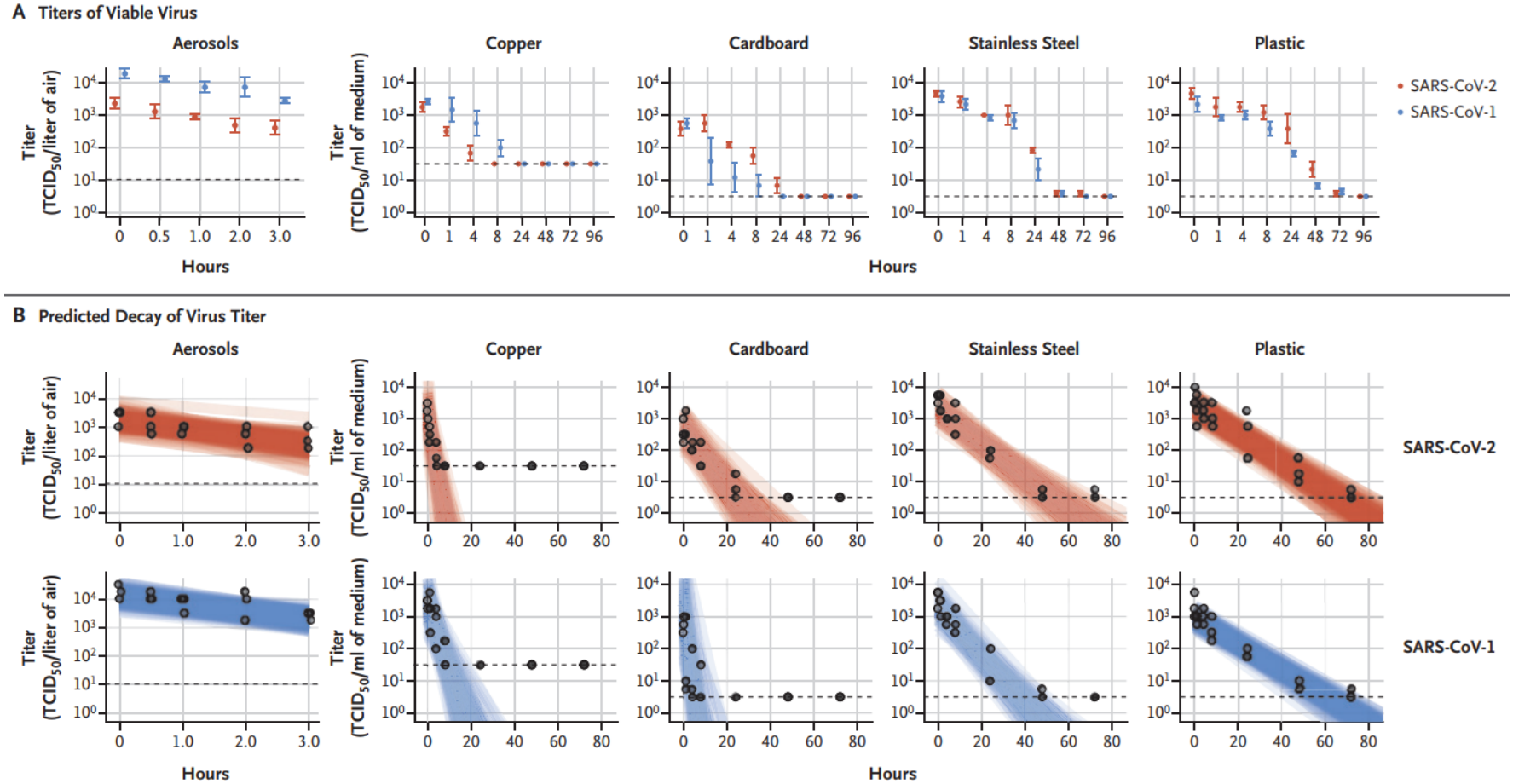
- Non-modifiable factors: virus type
- Modifiable factors: precautions, social distancing, etc.

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]



[1]Lancet DOI:https://doi.org/10.1016/S0140-6736(20)30260-9 [2]Emerg Infect Dis. DOI: https://doi.org/10.3201/eid2501.171901
[3]Journal of Travel Medicine 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

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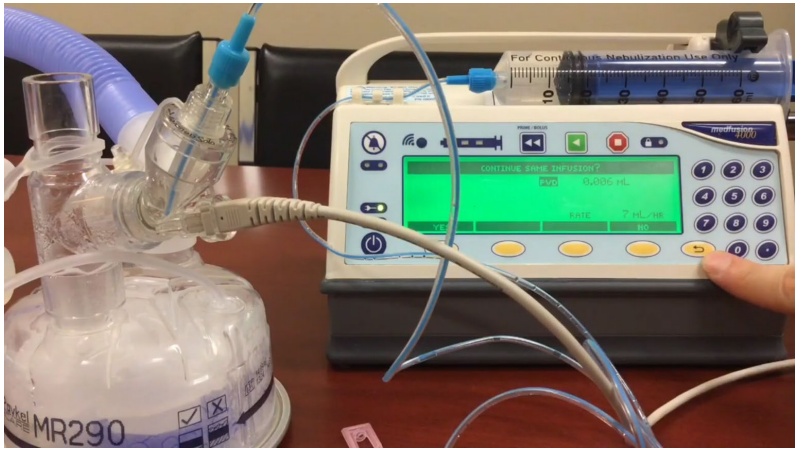
Clinical Setting	PPE Recommended
Emergency Department (Patient Under Investigation)	**Patients not in acute respiratory distress but requiring treatment that may result in aerosol-generation such as nebulizer therapy**: • Provide patient mask to wear on arrival to ED and place in private room • Standard + Droplet + Contact = surgical mask, eye shield, gown, gloves • Special Respiratory Precautions = wear N95 or PAPR during provision of aerosol generating procedures[1]; 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 procedures[1]; 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

UPHS Sharepoint, 3/19/2020 (check for updates (VPN))

Aerosol-generating procedures

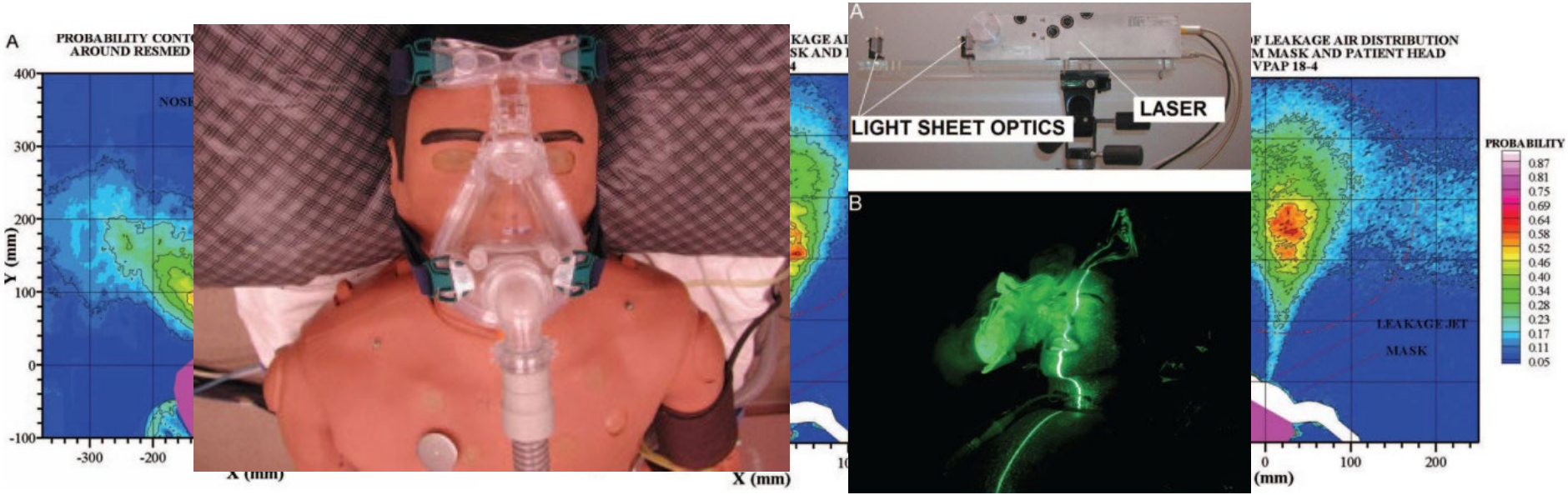
Aerosol-generating medications

VELETRI®
epoprostenol for Injection



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[1]

MERS-C

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Investigati
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Respiratory viruses	Transmission-based precautions	
	WHO	US CDC
Measles	Airborne	Airborne
Seasonal influenza	Droplet	Droplet [66]
Avian influenza	Contact + Droplet	Contact + Airborne [36]
MERS-CoV	Contact + Droplet [47,67]	Contact + Airborne [49]
RSV	Contact + Droplet	Contact

) fine-

ol
s was still
no cough

:ts[4]

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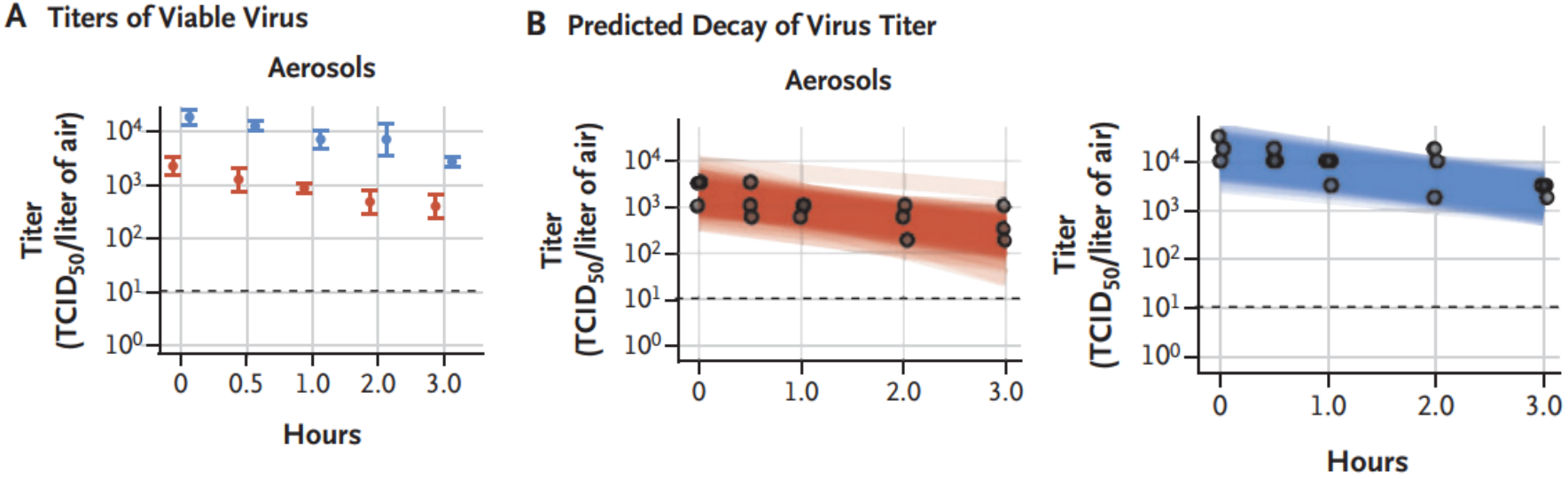
[1]Curr Opin Infect Dis. doi: 10.1097/QCO.0000000000000563. [2]WHO MERS Global Summary and Assessment of Risk
[3]Proc Natl Acad Sci U S A. doi: 10.1073/pnas.1716561115. [4]PLoS One. doi: 10.1371/journal.pone.0015100.

COVID is stable in aerosols



Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-Cov-1
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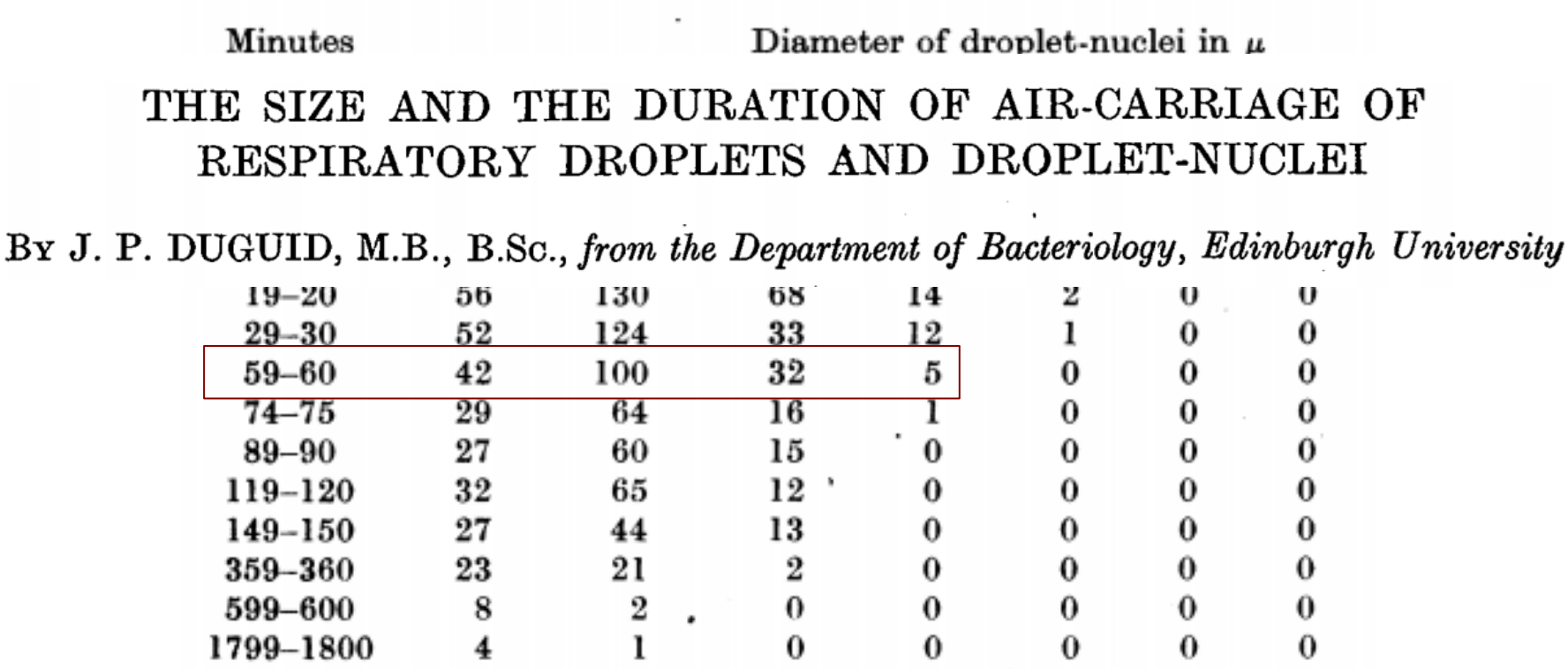
Lessons from Singapore

JAMA. doi:10.1001/jama.2020.3227

Why conflicting evidence? Consider probability



Minutes | Diameter of droplet-nuclei in μ

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*

19–20	56	130	68	14	2	0	0
29–30	52	124	33	12	1	0	0
59–60	42	100	32	5	0	0	0
74–75	29	64	16	1	0	0	0
89–90	27	60	15	0	0	0	0
119–120	32	65	12	0	0	0	0
149–150	27	44	13	0	0	0	0
359–360	23	21	2	0	0	0	0
599–600	8	2	0	0	0	0	0
1799–1800	4	1	0	0	0	0	0

J Hyg (Lond). doi: 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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UPHS Sharepoint, 3/19/2020 (check for updates (VPN))

Current Patient Care PPE Recommendations (3/24/20)

Work Spaces		Droplet + Social distancing
Non-PUI		Droplet
PUI	**PUI ED**	Droplet + Contact
	PUI Ward	Droplet + Contact
	PUI ICU	Airborne + Contact + Eye Shield
Confirmed		Airborne + Contact + Eye Shield
Aerosol Generating Procedures (PUI or confirmed)		Airborne + Contact + Eye Shield

SUBJECT TO CHANGE: Updated as of 3/24/20, check SharePoint for additional updates

Current RRT/Code PPE Recommendations (3/24/20)

Non-PUI	**RRT (respiratory)**	Droplet + Contact + Eye Shield
	Code and/or Intubation	Droplet + Contact + Eye Shield
PUI	**RRT (any)**	Droplet + Contact + Eye Shield
	Code and/or Intubation	Airborne + Contact + Eye Shield
Confirmed COVID-19 +	**RRT (any)**	Airborne + Contact + Eye Shield
	Code and/or Intubation	Airborne + Contact + Eye Shield

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

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

Coronavirus Disease 2019 (COVID-19)

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

Department of Public Health
CITY OF PHILADELPHIA

- **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 

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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

Wearing Your 3M™ Aura™ Health Care Particulate Respirator and Surgical Mask 1870+

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 high 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 fingertips from 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.

7

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 the 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.**

Removal

Can be performed using one or both hands

1

One hand Two hand

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

2

One hand Two hand

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

3

Store or discard according to your facility's infection control policy.

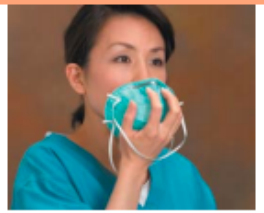
Wear It Right

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.**

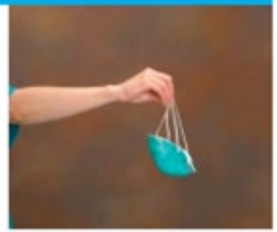
POSITIVE PRESSURE FIT CHECK

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.

REMOVAL:

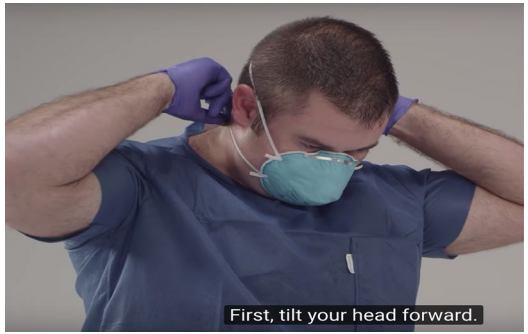
1 Without touching the respirator, slowly lift the bottom strap from around your neck up and over your head.

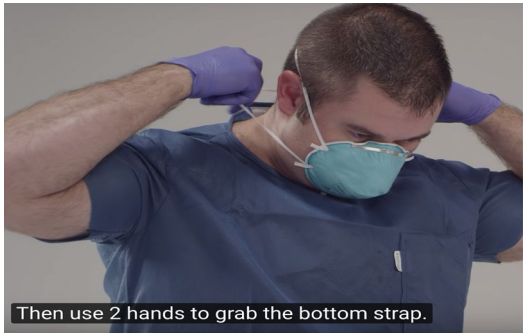
2 Lift off the top strap. Do not touch the respirator.

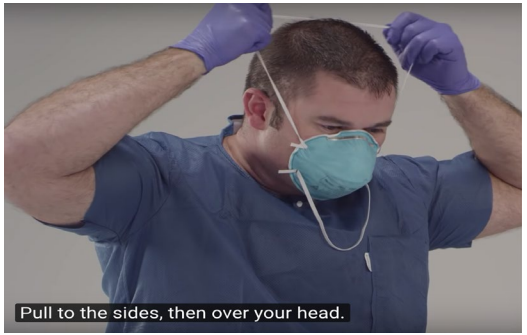


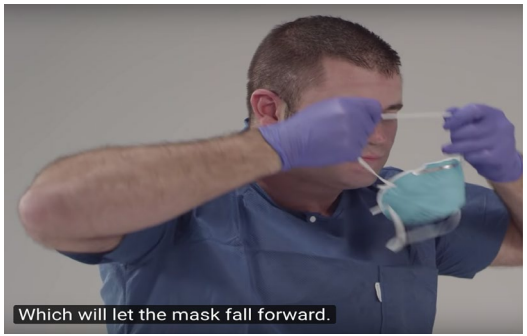
3 Store or discard according to your facility's infection control policy.

Doffing N95









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)

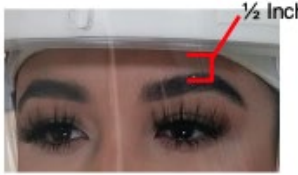
Battery

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



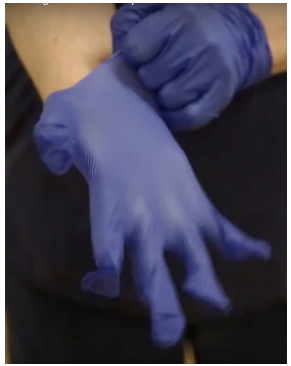
Detailed overview: onsite, VPN

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

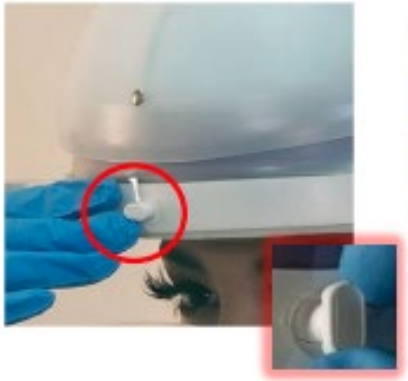







Detailed overview: onsite, VPN

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

- **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
- **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

Instagram credit: Megan Burke (cardiology)

Minimizing Contamination at Home

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

Coronavirus Disease 2019 (COVID-19)

- 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 maked
- 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 SharePoint 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

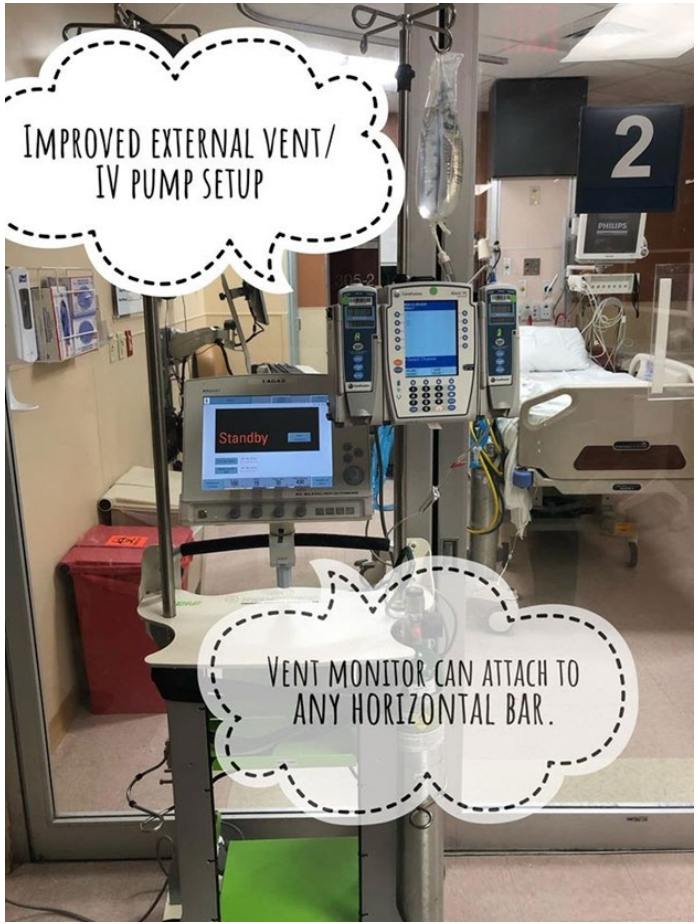
Novel ideas for PPE conservation

System-wide

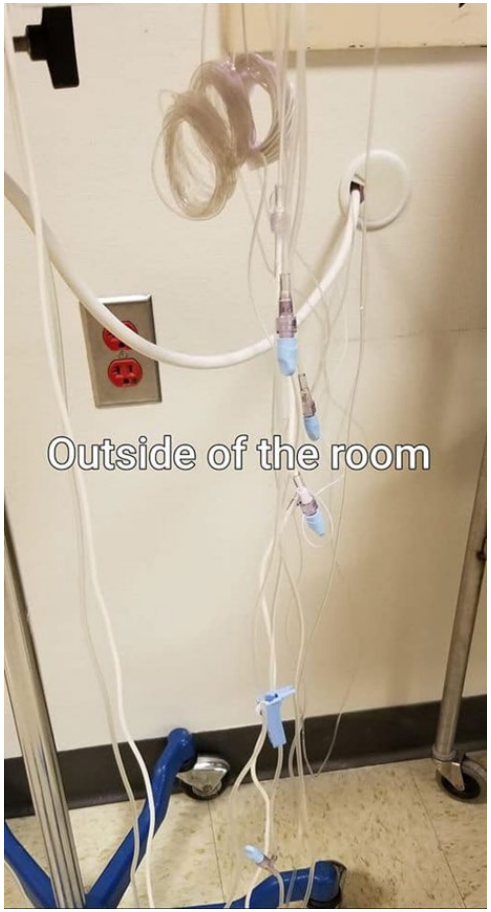
- Lines outside of patient rooms
- Early assessment for Foley catheter placement
- Consolidation of lab draw times
- Elimination of MRSA/VRE contact precautions for non-COVID patients

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
Standby
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?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