PPE: Safety, Evidence and Guidelines

04.17.2020
Overview

Safe clinical practice: Utilizing The Right PPE Every Time

Transmission of SARS-CoV-2: Science and Literature

PPE Guidelines: Evidence based; CDC and Local Health Departments Recommendation
Transmission of SARS-CoV-2
Severe Acute Respiratory Syndrome Coronavirus 2

- Early during the outbreak, this organism was first thought to spread via the airborne route
- After subsequent research, it was found that this virus spreads similar to influenza, through droplets and contact with contaminated surfaces and fomites
- Wearing a procedural mask, eye protection, gown and gloves while caring for suspect/confirmed COVID-19 patients provides adequate protection from the virus
- N95s and PAPRs provide additional protection against this virus during aerosol-generating procedures
- Frequent hand hygiene and disinfection of surfaces is also important to stop the spread of this virus
# SARS-CoV-2: Science of Aerosol vs Droplet

<table>
<thead>
<tr>
<th>What We Know</th>
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</thead>
<tbody>
<tr>
<td>- PPE is only one part of an overall infection prevention strategy</td>
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</table>
| - A successful strategy includes a 3-tiered approach:  
  - **Reduce**: enact visitor restrictions, cancel or delay visits and elective procedures, implement telemedicine, control entry points, limit HCW visits, control testing sites  
  - **Protect**: universal source control (masking), hand hygiene, PPE, environmental cleaning, engineering controls  
  - **Detect**: universal source control (symptom and temperature screening), laboratory testing |
| - The type of PPE used should match the mode of transmission |
| - SARS-CoV-2 is transmitted primarily through droplets and contact. |
| - Aerosol-generating procedures (AGPs) are considered high-risk for SARS-CoV-2 transmission |
| - PPE is a much talked about and emotional issue |

**Where everyone agrees:**  
- Gloves, Gown, Eye protection  
- Some sort of respiratory protection

SARS-CoV-2: Aerosol

• Early studies biased against detection of small airborne particles
• Even if aerosols present, unknown if the virions are infectious
• Experimental study evaluated virus stability in aerosols and on surfaces
  • Virus remained viable in aerosols for 3 hours
  • Virus remained viable on surfaces for up to 3 days
• Provides theoretical evidence virus can survive in droplet nuclei after AGP
• Department of Homeland Security:
  • Aerosolized virus detected in patient rooms; infectious virus not found in air samples; concluded plausible but unconfirmed
• Cruise ships—virus found up to 17 days after ship vacated, ? Infectious
• Limited data that virus may be spread by conversation and exhalation without cough
• CDC and ECDC hedge: N95 or equivalent during AGP; N95 preferred, surgical mask acceptable

Much criticism of New England Journal of Medicine study

- Device does not simulate real life, replicate human cough
- Assumes patients generate aerosols equivalent to those of a highly efficient 3 jet collision nebulizer, no room air exchanges, no surgical mask efficacy
- SARS-CoV-1 not found in air samples in rooms of infected patients
- Small studies so far show SARS-CoV-2 not found in hospital rooms of COVID-19 patients
- SARS-CoV-2 not transmitted to 35 HCWs wearing surgical masks during AGPs in severely ill patients with COVID-19
- Evidence for environmental cleaning and HH, NOT aerosol transmission

**SARS-CoV-2: Droplet**

- **World Health Organization recommends surgical masks:**
  - Analyzed 75,465 cases of COVID-19 in Wuhan and found no aerosol transmission

- **Public Health Agency of Canada recommends surgical masks:**
  - Loeb, et. al. compared medical masks vs. N95 in HCWs in meta analysis
  - No difference in lab confirmed viral infection OR 1.06 (95% CI 0.9-1.25)
  - No difference in clinical respiratory viral illness OR 1.49 (95% CI 0.98-2.28)

- **Public Health England:**
  - Recommends N95 in “hot spots” where AGPs regularly performed if COVID and/or ROCOVID pts present (ICU, OR, ED resuscitation bays, L&D during 2nd and 3rd stage of labor)
  - Opinion: “Using a higher level of PPE than is required is a form of misuse”

- **Iran**
  - Collected air samples on 44 COVID pts (22 intubated, 22 on O2 masks) with air impingers located 2-5 meters from patient’s bed
  - 10 samples per pt room; performed RT-PCR; all air samples negative

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SARS-CoV-2: Droplet

- Singapore (JAMA study): all air samples negative; 87% of surfaces positive for patient C

<table>
<thead>
<tr>
<th>Patient</th>
<th>Days of illness when samples were collected</th>
<th>Presence of symptoms during sampling</th>
<th>Symptoms</th>
<th>Disease severity</th>
<th>Before/after routine cleaning</th>
<th>Cycle threshold value from clinical samples</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>4, 10</td>
<td>Yes, both days</td>
<td>Cough, fever, shortness of breath</td>
<td>Moderate</td>
<td>After</td>
<td>31.31 (day 3); 35.33 (day 9)</td>
</tr>
<tr>
<td>B</td>
<td>8, 11</td>
<td>Yes on day 8; asymptomatic on day 11</td>
<td>Cough, fever, sputum production</td>
<td>Moderate</td>
<td>After</td>
<td>32.22 (day 8); not detected (day 11)</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>Yes</td>
<td>Cough</td>
<td>Mild</td>
<td>Before</td>
<td>25.69 (day 4)</td>
</tr>
</tbody>
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SARS-CoV-2: Droplet

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Table 1. Sampling Time Points in Relation to Patient Illness and Clinical Cycle Threshold Values

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What do we do at NM?

- Gloves, Gown, Eye protection, Surgical mask for care of COVID and ROCOVID patients not requiring AGPs
- Same but N95 if COVID or ROCOVID patient on a unit where AGPs regularly performed

https://jamanetwork.com/ by a Northwestern Memorial Health Care User on 04/14/2020
https://doi.org/10.1016/j.scitotenv.2020.138401
SARS-CoV-2: Aerosol vs Droplet

Is our strategy working?

[Graphs and charts showing data on Total Patients w/Results, Positive Patients, % Positive, Patient Lab Result by Result Date, Labs, and Tests Performed by Day]
Aerosol-Generating Procedure (AGP)

What is an Aerosol-Generating Procedure?

- Any medical or patient care procedure that results in the production of airborne particles (aerosols)
- AGPs can produce airborne particles <5 microns (μm) in size which can remain suspended in the air, travel over a distance and may cause infection if they are inhaled
- AGPs create the potential for airborne transmission of infections that may otherwise only be transmissible by the droplet route
- AGPs lead to a greater risk of transmission for HCW

How to reduce the risk of AGPs?

- Avoid performing
- Limit Health Care Workers present
- Perform in an Airborne Infection Isolation Room (AIIR)
  - If not available, perform in a room with the door closed
  - All entry into the room requires indicated PPE for the next 70 minutes
- Wear appropriate PPE
  - N95/PAPR
  - Gown, gloves, eye protection
**Aerosol-Generating Procedure (AGP)**

**Process for generating list of AGPs:**
- Referenced CDC & WHO guidance
- Solicited opinion of national IP experts
- Solicited opinion of local experts in Pulmonary/Critical Care and Anesthesia
- Ongoing review and consideration based on input from local leaders

### NM List of AGPs

<table>
<thead>
<tr>
<th>AGP Category</th>
<th>Procedure Examples</th>
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<tbody>
<tr>
<td>Intubation and extubation</td>
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<tr>
<td>Airway exchange</td>
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<tr>
<td>Non-invasive ventilation, exchange and removal of an artificial airway</td>
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<tr>
<td>Tracheotomy, bedside tracheostomy, and tracheostomy care</td>
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<tr>
<td>Cardiopulmonary resuscitation (CPR) and ambu resuscitation</td>
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<tr>
<td>Mechanical ventilation, Manual ventilation before intubation</td>
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<tr>
<td>Bronchoscopy</td>
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<tr>
<td>Non-bronchoscopic bronchoalveolar lavage (NB-BAL)</td>
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<tr>
<td>Open airway suctioning (no risk if in-line suctioning)</td>
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<tr>
<td>Autopsy</td>
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<tr>
<td>Non-invasive ventilation:</td>
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<tr>
<td></td>
<td>Continuous positive airway pressure (CPAP)</td>
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<td></td>
<td>Bi-level positive airway pressure (BiPAP)</td>
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<td></td>
<td>High-flow nasal cannula</td>
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<tr>
<td>Obstetrics and Neonatology</td>
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<td>Obstetrics 2nd stage of labor through delivery</td>
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<tr>
<td>Neonatal L&amp;D emergency response</td>
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<tr>
<td>Respiratory therapy procedures:</td>
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<tr>
<td></td>
<td>Nebulizer treatments (no risk if in-line) – albuterol, Duoneb®, 3% saline</td>
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<td></td>
<td>Metaneb®</td>
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<td></td>
<td>Sputum induction</td>
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<td>Penatmidine</td>
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<td>Endoscopic procedures:</td>
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<td></td>
<td>Laryngoscopy</td>
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<td></td>
<td>Transesophageal echocardiogram (TEE)</td>
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<td></td>
<td>Fiberoptic endoscopic evaluation of swallowing (FEES)</td>
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<tr>
<td></td>
<td>Esophagogastroduodenoscopy (EGD)</td>
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<tr>
<td></td>
<td>Upper GI endoscopy, including endoscopic retrograde cholangiopancreatography (ERCP)</td>
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<tr>
<td>Surgical procedures:</td>
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<tr>
<td></td>
<td>Transection of airway</td>
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<tr>
<td></td>
<td>Laryngeal procedures</td>
</tr>
</tbody>
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NM Personal Protective Equipment (PPE) Guidelines

- NM Campus
  - PPE: Universal Masking

- Everyone Else
  - PPE: Universal Masking

- COVID-19 or Suspected COVID-19
  - PPE: Dependent Upon Risk of AGP
    - ICU Care or AGP: PPE: N95
    - Routine Care: PPE: Isolation Mask

- PPE: Universal Masking
PPE Resources

- Clinical Guidelines
- Employee Resources
- PPE Resources
- Command Center Updates
- FAQs
- By the Numbers

PPE Guidelines – What to Use and When to Use It - April 13
- PPE Frequently Asked Questions - April 7
- Safe PPE Use and Re-use - April 13
- PPE Donning and Doffing Instructions
- N95 Respirator Seal Testing - April 9
  - N95 Respirator Donning and Seal Testing - Specific Models
    - 3M Aura 1870+ N95 Respirator - April 1
    - 3M Aura 1860_18605 N95 Respirator - April 1
    - 3M Aura 8210 N95 Respirator - April 1
    - Halyard (Formally Kimberly-Clark) N95 Respirator - April 1
- Universal Masking - Overview - April 3
- IDPH - Guidance on the Use of Masks by the General Public - April 9

Inpatient and ED PPE Recommendations
Clinical Care of the ROCOVID or COVID patient

Usual COVID PPE = Procedural mask, gown, gloves, face shield (preferred) or goggles
N95 COVID PPE = N95 or PAPR at all times + gown, gloves, face shield (preferred) or goggles

<table>
<thead>
<tr>
<th>Clinical Scenario</th>
<th>Usual COVID PPE</th>
<th>N95 COVID PPE</th>
<th>Procedural / Surgical Mask &amp; Gloves</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical team transporting patient - Patient not intubated</td>
<td>X</td>
<td></td>
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</tbody>
</table>

- Patient should don a mask
- Patient should wear a clean gown or cover with a clean sheet
- May continue to wear N95 if donned prior to patient transport

Northwestern Medicine
Guidelines for Safe Use and Re-Use of PPE

The top priorities for your safety and that of our patients is to conserve and use the right PPE at the right time so that we have enough for weeks and months to come.

- Eye protection may be worn continuously.
- Full face shields are preferred, as they provide mask and N95 respirator protection.
- Disinfect face shield or goggles whenever removed, using gloves and approved hospital-grade wipe. Allow surface of eye protection to dry. A film may be left on surface rinse with a wet paper towel. Dispose if no longer clean, or if cracked or damaged.

- User must perform a seal check (see instructions below) upon donning an N95 respirator.
- N95 respirators are reserved for specific patient care. See PPE guidelines for specific instructions.
- N95 respirators may be used continuously by the same healthcare worker for multiple patients for multiple days, and stored in a labeled paper bag.
- Wear a full face shield to reduce N95 contamination.
- Replace N95 respirator after performing any aerosol generating procedure (AGP)*, even if full face shield is worn.
- Facial hair should be shaved in order to fit an N95 respirator.
- Replace N95 if it becomes contaminated, soiled, damaged, wet and/or hard to breathe through.

Positive pressure seal check: Place both hands completely over the respirator being careful not to disturb the position of the mask and ensure no air can enter. Exhale forcefully. You should not feel any air leaking if the fit is successful.

Negative pressure seal check: Inhale quickly while pressing down on the sides of the respirator to prevent air from entering. Pouch-style respirators should collapse slightly when negative pressure is created.

- Procedure masks may be used continuously by the same healthcare worker for multiple patients, and may be usable beyond one day. If removed during the day, store in a clean, dry paper bag, do not touch surface and reapply carefully with hand hygiene.
- Wear a full face shield to reduce mask contamination.
- If procedure mask becomes contaminated, soiled, damaged, torn or wet, it should be disposed of and replaced with a clean mask.
- Masks may not be pulled down and worn below nose/mouth or on forehead.

- PAPR use is reserved for aerosol generating procedures for staff who cannot wear an N95.
- PAPR hoods may be worn continuously by the same person for a shift for multiple patients, then disinfected and stored in the appropriate location.
- Hood should be replaced if any damage is detected.

Follow contact isolation sign.
- Remove gown and dispose after each patient’s care.
- Take care with removal to not contaminate yourself. Perform hand hygiene.

Your safety depends on careful attention to donning and hand hygiene. Take your time.

*See COVID Taskforce report for list of AGPs. Includes labor & delivery.

Sources: CDC, IDPH, NMI Infection Prevention 4.10.2020 08:50
Frequently Asked Questions

• Why do guidelines keep changing?

• Should I cover my N95 with a surgical mask?

• Will we test all patients coming to the hospital as part of their standard of care?

• How long can I wear the N95? How long can I wear the procedure mask?

• Why are we asking all visitors and staff to be masked all the time?

• Can we transfer COVID patients to Marianjoy and other rehab and post-acute settings
### Open Forum

<table>
<thead>
<tr>
<th>IP On-Call Pager 24/7</th>
<th>IP Directors &amp; Medical Directors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Region: 312.695.9196</td>
<td><strong>System Director</strong> – Christina Silkaitis</td>
</tr>
</tbody>
</table>
| West Region: 630.255.1293 | **Central**: Gina Dolgin (director)  
- Dr. Teresa Zembower & Dr. Maureen Bolon |
| North/Northwest Region: 312.695.9483 | **West**: Anessa Mikolajczak (director)  
- **CDH**: Dr. Luis Manrique  
- **Delnor/Marianjoy**: Dr. Steven Lewis  
- **Kish/VW**: Dr. Bob Manam |
| | **North and Northwest**: Heather Voss (director)  
- **LFH**: Dr. Stephen Grohmann  
- **Northwest Region**: Dr. Irfan Hafiz |

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**Ask the Experts...**