COVID-19 PANDEMIC: LESSONS LEARNED

Epidemiology and Infection Control

2019-novel Coronavirus

COVID-19

Carlene A. Muto MD, MS, FSHEA

University of Virginia Health System

Division of Infectious Diseases, Hospital Epidemiology and Infection Prevention
COVID-19 Dashboard – 10/28/20

Cases = 44,159,482   Deaths = 1,169,562
US Cases = 8,800,316   Deaths = 226,982
VA COVID-19 cases

https://www.vdh.virginia.gov/coronavirus/key-measures/
Testing for COVID
Screening vs. Diagnostic testing

Screening:
Performed in absence of symptoms
Predict future disease, identify risk factors
Detect early (preclinical) disease

• Diagnostic:
  – Response to known symptom, sign, condition
  – Directs management, treatment of condition
COVID-19 Testing

Viral Testing:

• PCR
  – RNA amplification
• Ag testing
  – Parts of the virus (spikes, envelopes, membranes, etc.)

• Immune response
What do the diagnostic tests for COVID-19 detect?

**Virus – Acute infection**
- Viral RNA detected by NAAT/RT-PCR (molecular testing)
- COVID-19 viral antigen

**Immune response – Antibody – Past infection**
- Antibodies against COVID-19 antigen (IgM, IgG, IgA) (serology testing)
COVID-19 Testing and Timing

Incubation Period

Communicable Illness
May or may not have symptoms

Convalescent period

Detection of Antibodies

14 days

10 days

SARS-CoV-2 RNA Detection

RNA can persist for weeks to months. Not likely representing communicable disease
Infection Prevention

- Social Distancing
- Disinfect Hands
- Wear a Mask
Infection Prevention (Healthcare)

**Team Member PPE**

- Elastomeric Half Mask Respirator: Cleaning
- Elastomeric Half Mask Respirator: Cleaning
- Elastomeric Half Mask Respirator: Guidance
- Homemade Mask Request Form
- How to Wear Your Mask Sign

**Environmental PPE**

- General
  - Nursing Practice Standards: IVs
  - Policy Matrix
  - PPE and Supply Ordering and Stock

**Donning and Doffing**

- Donning and Doffing Checklist: Am
- Donning and Doffing Checklist: Ext
- Donning and Doffing Checklist: Impala
- Donning and Doffing Checklist: Invision

**Universal Masking and Eye Protection**

- Team
- Patients
- SAS and OPSC Patients

**PPE N95**

- N-95 Mask Doffing, Donning, and Storage for Perc
- N-95 Mask Doffing, Donning, and Storage for Perc
- N-95 Collection Sites for Decontamination and Reus
- N95 Doffing and Collection for Decontamination at
- N95 Instructions for Decontamination and Re-use
- N95 Mask Doffing, Donning, and Storage for Perso
- N95 Mask Doffing, Donning, and Storage for Perso
- N95 Mask Type 8210: Special Precautions
- N95 Mask Use for COVID Screened Negative Patie
- N95 Seal Check

**Eye and Head Protection**

- Cleaning of Eye Protection
- Surgical/Procedural Re-Usable Head Coverings

**Isolation Precautions**

- Infection Control for Postmortem Care
- Isolation Precautions Discontinuation for COVID-19 and Patient Transfer from SPU FAQ
- Isolation Precautions Discontinuation for COVID-19: Inpatient and Outpatient
- Isolation Precautions for PUI/COVID-19+ Patient: CT Radiology
- Isolation Precautions for PUI/COVID-19+ Patient: Fluoroscopy
- Isolation Precautions for PUI/COVID-19+ Patient: Patient: Inpatient, ED, Procedure Areas
- Isolation Precautions for PUI/COVID-19+ Patient: Invasive Cardiology
- Isolation Precautions for PUI/COVID-19+ Patient: Neuro IR
- Isolation Precautions for PUI/COVID-19+ Patient: Operating Room
- Isolation Precautions for PUI/COVID-19+ Patient: SAS
- Isolation Precautions for PUI/COVID-19+ Patients: MRI Scans
- Isolation Signs for PUI/COVID-19+ Patients: Inpatient, ED, Procedure Areas
- Isolation Signs for PUI/COVID-19+ Patients: Outpatient
- Modified Contact Precautions: NON-COVID Patients
Infection Prevention (Healthcare)

**Inpatient**

**Contact, N95 and Eye Protection**
For aerosol generating procedures, negative pressure is required.

1. **Gown**
2. **N95 Mask/Respirator**
3. **Eye Protection**
4. **Gloves**

**Donning/Doffing Coach Required**

Patients who are intubated, trach or require aerosolizing procedures:
- Contact and airborne precautions with eye protection
  - Private room
  - Negative pressure with doors closed
  - Fitted N95 mask, gown, gloves and eye protection

Patients not intubated or requiring aerosolizing procedures:
- Contact and droplet precautions with eye protection
  - Private room with doors closed
  - Regular mask, gown, gloves and eye protection

**Outpatient**

**Contact, Droplet and Eye Protection**
For aerosolizing procedures, N95 is required

1. **Gown**
2. **Procedure Mask**
3. **Eye Protection**
4. **Gloves**

**Alert**
Enhanced Respiratory Precautions Required

Patients who are intubated, trach or require aerosolizing procedures:
- Contact and airborne precautions with eye protection
  - Private room
  - Negative pressure with doors closed
  - Fitted N95 mask, gown, gloves and eye protection

Patients not intubated or requiring aerosolizing procedures:
- Contact and droplet precautions with eye protection
  - Private room with doors closed
  - Regular mask, gown, gloves and eye protection
Personal Protective Equipment - PPE
COVID-19 PPE

CDC PPE recommendations – HCP who enter the room of a patient with suspected or confirmed SARS-CoV-2 infection should adhere to Standard Precautions and use a NIOSH-approved N95 or equivalent or higher-level respirator (or surgical mask if a respirator is not available), gown, gloves, and eye protection.

1. Respirator or Facemask
   • N95 respirator or facemask
2. Eye Protection
   • Goggles
   • Disposable face shield
3. Gloves
4. Gowns
5. Patient placement
   • Single-person room

N95 Surgical Mask
Provide Infection Prevention Supplies

- **Hand Hygiene Supplies:**
  - Alcohol-based hand sanitizer (≥62% alcohol)
    - Place in patient-care areas
      - Ideally both inside and outside of the room
    - Place in common areas
  - Soap and paper towels at sinks

As supply was exhausted, HH products came from alternative sites. Cheers!

- **Personal Protective Equipment (PPE):**
  - Assess current PPE supply
  - Monitor daily PPE burn rate
    - PPE burn rate calculator

Mask Types

What mask do I wear and when?
## Mask Types

**Surgical N95 versus Surgical Mask**

<table>
<thead>
<tr>
<th>Surgical N95</th>
<th>Surgical Mask</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce exposure to small and large airborne droplets</td>
<td>Help block large-particle droplets, splashes, sprays, or splatter</td>
</tr>
<tr>
<td>Tight fitting</td>
<td>Loose-fitting - Do not prevent leakage</td>
</tr>
<tr>
<td>Filter out at least 95% of particles</td>
<td>No filtration of small aerosolized particles transmitted by coughs, sneezes, or certain medical procedures.</td>
</tr>
<tr>
<td>Fluid resistant</td>
<td>Fluid resistant</td>
</tr>
<tr>
<td>NIOSH approved</td>
<td>FDA cleared</td>
</tr>
</tbody>
</table>
CDC – Wear a NIOSH-approved N95 or equivalent or higher-level respirator (or surgical mask if a respirator is not available)

If shortages exist, N95 should be prioritized for high risk procedures (aerosol generating or anatomic regions where viral loads might be higher (e.g., nose, throat, oropharynx, respiratory tract).

Cloth face coverings are NOT PPE and should not be worn for the care of patients with suspected or confirmed COVID-19 or other situations where use of a respirator or facemask is recommended.
### Symptoms of COVID-19

- Fever or chills
- Cough
- Shortness of breath or difficulty breathing
- Fatigue
- Muscle or body aches
- Headache
- New loss of taste or smell
- Sore throat
- Congestion or runny nose
- Nausea or vomiting
- Diarrhea

### Aerosol generating procedures (AGPs)

- Open suctioning of airways
- Sputum induction
- Cardiopulmonary resuscitation
- Endotracheal intubation and extubation
- Non-invasive ventilation (e.g., Bipap, CPAP)
- Bronchoscopy
- Manual ventilation
- Nebulizer administration
- High flow O2 delivery
Why do we wear surgical face mask for routine care but N95 for COVID suspected or confirmed

- Risk of COVID transmission can change with changes in the patient’s condition
- Suspected or Confirmed COVID cases often have respiratory symptoms
  - Patients with respiratory symptoms have a greater risk of generating aerosols
  - HCW have a greater likelihood of respiratory tract exposure in patients with respiratory symptoms
  - Respiratory tract may have higher COVID viral loads
    - Nose, throat, oropharynx, respiratory tract

This close-up view of a sneeze filmed at 2000 frames per second (duration 0.25 sec) shows it’s a hot, moist, turbulent gas cloud containing air and mucosalivary droplets that travel as far as 26 feet (7-8 meters). The physics of sneezes and coughs have implications for respiratory pathogen transmission and mask and respirator design.


https://www.youtube.com/watch?v=piCWFgwysu0
Bottom Line on Masks

• In general, surgical mask provide protection against COVID.

• We switch to N95s in patients that are suspected or confirmed of having COVID-19 as they either have respiratory symptoms or may develop respirator symptoms.

• Patients with respiratory symptoms have a higher likelihood of generating aerosols which would increase risk of exposure.
Discontinuation of Isolation

A test-based strategy is no longer recommended (except as noted below) because, in the majority of cases, it results in prolonged isolation of patients who continue to shed detectable COVID RNA but are no longer infectious.

**Symptom-Based Strategy for Discontinuing Transmission-Based Precautions**

- **Patients with mild to moderate illness who are not severely immunocompromised:**
  - At least **10 days** have passed since symptoms first appeared (or date of their first +) and
  - At least 24 hours have passed since last fever without the use of fever-reducing medications and
  - Symptoms (e.g., cough, shortness of breath) have improved

- **Patients with severe to critical or who are severely immunocompromised:**
  - At least **10 days** and up to **20 days** have passed since symptoms first appeared (or date of their first +) and
  - At least 24 hours have passed since last fever without the use of fever-reducing medications and
  - Symptoms (e.g., cough, shortness of breath) have improved
  - Consider consultation with infection control experts
What if you don’t have enough?

N-95 Mask
Out-of-Stock
Extended use refers to the practice of wearing the same N95 respirator for repeated close contact encounters with several patients, without removing the respirator between patient encounters.

Re-use refers to the practice of using the same N95 respirator by one HCP for multiple encounters with different patients but removing it (i.e. doffing) after each encounter.

https://www.youtube.com/watch?v=oHHvAiucg_s
N95 Decontamination and Reuse
UVA N95 supply concern

- N-95 masks are not approved for routine decontamination and reuse as standard of care.
- Maybe considered as a crisis capacity strategy
  - FDA granted Emergency Use Authorization (EUA)

- UV, HPV, and moist heat could be used for mask decontamination.
- CDC supported decontamination methods were evaluated at UVA

<table>
<thead>
<tr>
<th>Disinfection Method Utilized in JEFF Study (repeated 3X per FFR)</th>
<th>Results on Various Unknown FFR Makes and Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultraviolet germicidal irradiation (UVGI) 15-min @ 254nm (only one side of FFR faced lamp, not straps)</td>
<td>No observable physical change</td>
</tr>
<tr>
<td>Ethylene oxide 1-hr 100% EtO Sterilizer</td>
<td>No observable physical changes</td>
</tr>
<tr>
<td>Hydrogen Peroxide Gas Plasma ~55-min, 59% H2O2, 45°C-50°C</td>
<td>Filter penetration exceeded 5% on multiple samples</td>
</tr>
<tr>
<td>Hydrogen Peroxide vapor 15-min dwell, 125-min total cycle time, 8 g/m³ concentration</td>
<td>No observable physical changes</td>
</tr>
</tbody>
</table>

N95 Reuse – UV-C Disinfection at UVA
Switch to Hydrogen Peroxide Vapor (HPV) Battelle

Go to Battelle website – https://www.battelle.org
- Click BATTELLE CCDS™ (PPE) decontamination for reuse
- Fill out form
- Free processing and shipping via Cardinal Health or Fed/Ex
- Multiple Processing Centers in Virginia and other states

Bad news - Grant funding for processing is expiring
COVID-19 – When will it end?

Fauci: ‘We’re Nowhere Near Herd Immunity’ In The U.S.
COVID-19 Vaccines and Herd Immunity

\[ R_0 = \text{Average # of 2ndary cases that would result from each case of a disease} \]

<table>
<thead>
<tr>
<th>Disease</th>
<th>( R_0 )</th>
<th>Herd Immunity Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diphtheria</td>
<td>6-7</td>
<td>85%</td>
</tr>
<tr>
<td>Measles</td>
<td>12-18</td>
<td>83-94%</td>
</tr>
<tr>
<td>Mumps</td>
<td>4-7</td>
<td>75-86%</td>
</tr>
<tr>
<td>Pertussis</td>
<td>12-17</td>
<td>92-94%</td>
</tr>
<tr>
<td>Polio</td>
<td>5-7</td>
<td>80-86%</td>
</tr>
<tr>
<td>Rubella</td>
<td>6-7</td>
<td>83-85%</td>
</tr>
<tr>
<td>Smallpox</td>
<td>5-7</td>
<td>80-85%</td>
</tr>
<tr>
<td>MERS-CoV</td>
<td>4-5</td>
<td>75-80%</td>
</tr>
<tr>
<td>Influenza 1918</td>
<td>4</td>
<td>75%</td>
</tr>
<tr>
<td>SARS-CoV-1</td>
<td>3</td>
<td>70%</td>
</tr>
<tr>
<td>SARS-CoV-2 (COVID)</td>
<td>2.63 (mean)</td>
<td>62%</td>
</tr>
<tr>
<td>Ebola</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>Seasonal Influenza</td>
<td>1.3</td>
<td>23%</td>
</tr>
</tbody>
</table>
COVID-19 Vaccines and Herd Immunity $R_0 = 2.6$

- For Herd Immunity – ~62% of the population needs to be immune
- Vaccines are imperfect and alone may not provide enough immunity to achieve herd immunity
- We do not have data on vaccine efficacy but we can see what % of population would need to be vaccinated at different efficacies.

For vaccine: $X (1-hf)$

$h = $ vaccine efficacy
$f = $ vaccine coverage (# needed to be vaccinated)

<table>
<thead>
<tr>
<th>$R_0$</th>
<th>$h$ (%)</th>
<th>$f$ (%)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.6</td>
<td>30</td>
<td>&gt;100</td>
<td>Vaccine alone – not enough</td>
</tr>
<tr>
<td>2.6</td>
<td>50</td>
<td>&gt;100</td>
<td>Vaccine alone – not enough</td>
</tr>
<tr>
<td>2.6</td>
<td>62</td>
<td>100</td>
<td>Vaccine has to be $\geq 62%$ efficacious</td>
</tr>
<tr>
<td>2.6</td>
<td>75</td>
<td>83</td>
<td>Assuming an efficacy of 75%, and an $R_0$ of 2.6, 83% of the population would need to be vaccinated to achieve herd immunity! YIKES!</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
<td>88</td>
<td>Higher $R_0$s require a greater % of population to be immunized</td>
</tr>
<tr>
<td>4</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>99</td>
<td>63</td>
<td>As vaccine efficacy increases, less people would need to get vaccinated If vaccine was near perfect (h=99%), 63% of the population would need to be vaccinated</td>
</tr>
</tbody>
</table>
Last Thought

Wear a MASK!!!

Carlene A. Muto M.D., M.S.
University of Virginia Health System
Division of Infectious Diseases
Hospital Epidemiology and Infection Prevention
cam4r@Virginia.edu
Office Phone: (434) 982-4426