COVID-19: Lessons Learned

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Associate Medical Director of Infection Prevention
UIM 2020
Disclosures

- None
Outline

• Current state
• Symptoms/Clinical presentation
• Diagnosis
• Treatment
• Prevention
Current State

https://coronavirus.jhu.edu/map.html
Current State – Alleghany County

Slide curtesy of Judy Martin, MD from CHP
Lots of New Research

Symptoms

- Cough – 50%
- Fever – 43%
- Myalgia – 36%
- Headache – 34%
- Dyspnea – 29%
- Sore throat – 20%
- Diarrhea – 19%
- Nausea/vomiting – 12%
- Loss of smell or taste – 8%
- Abdominal pain – 8%
- Rhinorrhea – 6%

- Not all patients have fever
- Symptoms are similar to other respiratory viral pathogens
- Range in disease severity

## Asymptomatic Infection

Asymptomatic persons may account for 40% to 45% of SARS-CoV-2 infections

<table>
<thead>
<tr>
<th>Cohort</th>
<th>Tested, n</th>
<th>SARS-CoV-2 Positive, n (%)</th>
<th>Positive but Asymptomatic, n (%)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iceland residents (6)</td>
<td>13,080</td>
<td>100 (0.8)</td>
<td>43 (43.0)</td>
<td>R</td>
</tr>
<tr>
<td>Vo, Italy, residents (7)</td>
<td>5,155</td>
<td>102 (2.0)</td>
<td>43 (42.2)</td>
<td>R, L</td>
</tr>
<tr>
<td>Diamond Princess cruise ship passengers and crew (8)</td>
<td>3,711</td>
<td>712 (19.2)</td>
<td>331 (46.5)</td>
<td>–</td>
</tr>
<tr>
<td>Boston homeless shelter occupants (9)</td>
<td>408</td>
<td>147 (36.0)</td>
<td>129 (87.8)</td>
<td>–</td>
</tr>
<tr>
<td>New York City obstetric patients (11)</td>
<td>214</td>
<td>33 (15.4)</td>
<td>29 (87.9)</td>
<td>L</td>
</tr>
<tr>
<td>U.S.S. Theodore Roosevelt aircraft carrier crew (12)</td>
<td>4,954</td>
<td>856 (17.3)</td>
<td>~500 (58.4)</td>
<td>E</td>
</tr>
<tr>
<td>Japanese citizens evacuated from Wuhan, China (2)</td>
<td>565</td>
<td>13 (2.3)</td>
<td>4 (30.8)</td>
<td>L</td>
</tr>
<tr>
<td>Greek citizens evacuated from the United Kingdom, Spain, and Turkey (14)</td>
<td>783</td>
<td>40 (5.1)</td>
<td>35 (87.5)</td>
<td>L</td>
</tr>
<tr>
<td>Charles de Gaulle aircraft carrier crew (13)</td>
<td>1,760</td>
<td>1,046 (59.4)</td>
<td>~500 (47.8)</td>
<td>E</td>
</tr>
<tr>
<td>Los Angeles homeless shelter occupants (10)</td>
<td>178</td>
<td>43 (24.2)</td>
<td>27 (62.8)</td>
<td>–</td>
</tr>
<tr>
<td>King County, Washington, nursing facility residents (15)</td>
<td>76</td>
<td>48 (63.2)</td>
<td>3 (6.3)</td>
<td>L</td>
</tr>
<tr>
<td>Arkansas, North Carolina, Ohio, and Virginia inmates (16)</td>
<td>4,693</td>
<td>3,277 (69.8)</td>
<td>3,146 (96.0)</td>
<td>–</td>
</tr>
<tr>
<td>New Jersey university and hospital employees (17)</td>
<td>829</td>
<td>41 (4.9)</td>
<td>27 (65.9)</td>
<td>–</td>
</tr>
<tr>
<td>Indiana residents (18)</td>
<td>4,611</td>
<td>78 (1.7)</td>
<td>35 (44.8)</td>
<td>R</td>
</tr>
<tr>
<td>Argentine cruise ship passengers and crew (19)</td>
<td>217</td>
<td>128 (59.0)</td>
<td>104 (81.3)</td>
<td>–</td>
</tr>
<tr>
<td>San Francisco residents (29)</td>
<td>4,160</td>
<td>74 (1.8)</td>
<td>39 (52.7)</td>
<td>–</td>
</tr>
</tbody>
</table>

E = estimated from incomplete source data; L = longitudinal data collected; R = representative sample.
* A dash indicates that the study did not have a representative sample, collected no longitudinal data, and did not require estimation of missing data.
† Clarified via e-mail communication with coauthor.

Presymptomatic SARS-CoV-2 Infections and Transmission in a Skilled Nursing Facility

89 Residents of Facility A on March 13
- 6 were hospitalized (all tested positive for SARS-CoV-2 in hospital)
  - 1 was discharged home
- 2 were hospitalized before testing (both found to be positive during hospitalization)
  - 1 did not have data available
  - 1 declined to be tested (1 found to be positive postmortem)

82 Residents on March 13

76 were tested on March 13
- 23 were positive
  - 12 were asymptomatic
  - 9 had typical symptoms
  - 2 had atypical symptoms
  - 1 had typical symptoms
- 1 who previously tested positive was negative
- 52 were negative

Risk Factors

COVID-19 CASES, HOSPITALIZATION, AND DEATH BY RACE/ETHNICITY

FACTORS THAT INCREASE COMMUNITY SPREAD AND INDIVIDUAL RISK

<table>
<thead>
<tr>
<th></th>
<th>Crowded Situations</th>
<th>Close / Physical Contact</th>
<th>Enclosed Space</th>
<th>Duration of Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate ratios</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>compared to White, Non-Hispanic Persons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>American Indian or Alaska Native, Non-Hispanic persons</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASES^1</td>
<td>2.8x higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOSPITALIZATION^2</td>
<td>5.3x higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEATH^3</td>
<td>1.4x higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Asian, Non-Hispanic persons</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASES^1</td>
<td>1.1x higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOSPITALIZATION^2</td>
<td>1.3x higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEATH^3</td>
<td>No Increase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Black or African American, Non-Hispanic persons</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASES^1</td>
<td>2.6x higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOSPITALIZATION^2</td>
<td>4.7x higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEATH^3</td>
<td>2.1x higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hispanic or Latino persons</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASES^1</td>
<td>2.8x higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOSPITALIZATION^2</td>
<td>4.6x higher</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>DEATH^3</td>
<td>1.1x higher</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Race and ethnicity are risk markers for other underlying conditions that impact health — including socioeconomic status, access to health care, and increased exposure to the virus due to occupation (e.g., frontline, essential, and critical infrastructure workers).

**Actions to Reduce Risk of COVID-19**

- Wearing a mask
- Social distancing (6 ft goal)
- Hand hygiene
- Cleaning and disinfection

Data source: COVID-19 case-level data reported by state and territorial jurisdictions. Case-level data include about 80% of total reported cases. Numbers are unadjusted rate ratios.


Risk Factors

DOI: http://dx.doi.org/10.15585/mmwr.mm6936a5external icon.
Healthcare Workers

- Antibody positive: 6%
  - Asymptomatic: 29% in the preceding months
  - No prior COVID-19 diagnosis: 69%

- Lower prevalence among personnel who reported always wearing a face covering
  - Always - 6%, Not always - 9%

Risk Factors – Severe Disease

**Increased Risk:**
- Increased age
- Cancer
- Chronic kidney disease
- COPD (chronic obstructive pulmonary disease)
- Immunocompromised state from solid organ transplant
- Obesity – BMI >30
- Heart disease - heart failure, coronary artery disease, or cardiomyopathies
- Sickle cell disease
- Type 2 diabetes mellitus

**Possible Increased Risk:**
- Asthma
- Cerebrovascular disease
- Cystic fibrosis
- Hypertension
- Immunocompromised state from blood or bone marrow transplant, immune deficiencies, HIV, use of corticosteroids, or other immunosuppressants
- Neurologic conditions
- Liver disease
- Pregnancy
- Pulmonary fibrosis
- Smoking
- Thalassemia
- Type 1 diabetes mellitus

Complications

- ARDS – 20%
- Mechanical Ventilation 12-24%
- Arrhythmias – 17%
- Acute cardiac injury
- Cardiomyopathy
- Thromboembolic events
- Inflammatory conditions
  - Guillain-Barré syndrome
  - Multisystem inflammatory syndrome in children (MIS-C)
- Secondary Infections
- Long-term sequelae
  - fatigue (53%) , dyspnea (43%), joint pain (27%), and chest pain (22%)

https://www.cdc.gov/mis-c/hcp/
## Diagnosis

<table>
<thead>
<tr>
<th>Test</th>
<th>Clinical Use</th>
<th>Specimen</th>
<th>Performance</th>
</tr>
</thead>
</table>
| NAAT/RT-PCR       | Active infection  | Respiratory tract specimens – especially NP swabs | • High sensitivity  
• High specificity  
• False negatives early in disease  
• False positives are rare  
• Performance depends on quality of specimen  
• Prolonged positivity after infection |
| Serology          | Prior infection   | Blood                         | • Variable sensitivity & specificity  
• Takes days to weeks to develop antibodies  
• Cross reactivity with other coronaviruses?  
• Unknown protective immunity               |
| Antigen tests     | Active infection  | Nasal & NP swabs              | • Limited data  
• Lower sensitivity than RT-PCR  
• Rapid, point of care testing              |

Prolonged positivity is not necessarily a sign of ongoing infectiousness

Retesting

Occasionally performed for:
• Clinical suspicion, asymptomatic screening, disposition requests, isolation discontinuation

UPMC Experience:
• >30,000 initial tests
• 485 were repeated
• Initial Positive (n=74)
  – Subsequent positive 47%
  – Negative 53%
• Initial Negative (n=418)
  – Positive 3.6% (n=15)
  – Subsequent negative 96%
Treatment

Recommended:
- Remesivir
- Corticosteroids

Not Recommended:
- Hydroxychloroquine +/- azithromycin
- Tocilizumab
- Sarilumab
- Lopinavir-ritonavir

Under Investigation:
- Vitamin C
- Therapeutic anticoagulation

Original Investigation | Caring for the Critically Ill Patient

Effect of Hydrocortisone on Mortality and Organ Support in Patients With Severe COVID-19
The REMAP-CAP COVID-19 Corticosteroid Domain Randomized Clinical Trial

DOI: 10.1056/NEJMoa2021436

EUA:
- Convalescent Plasma
Prevention

Case Identification/Contact Tracing

Social Distancing

Hand Hygiene

Cleaning/Disinfection

Face Coverings & PPE
Universal Masking is Effective!

Association Between Universal Masking in a Health Care System and SARS-CoV-2 Positivity Among Health Care Workers

Universal HCW Masking

Community incidence

Universal HCW Masking

Community-acquired

Hospital-acquired

JAMA. Published online July 14, 2020. doi:10.1001/jama.2020.12897
Universal Masking is Effective!

Two hair stylists with COVID-19 spent at least 15 minutes with 139 clients

EVERYONE WORE FACE COVERINGS   NO CLIENTS ARE KNOWN TO BE INFECTED

WEAR CLOTH FACE COVERINGS CONSISTENTLY AND CORRECTLY TO SLOW THE SPREAD OF COVID-19

*No cases reported among all 139 customers tested had negative tests

CDC.GOV  bit.ly/MMWR71420
# Personal Protective Equipment

## Patients With COVID-19 Disease or Carriage

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COVID-19 suspected, testing pending</strong></td>
<td>✓ Droplet precautions (surgical mask)*</td>
</tr>
<tr>
<td></td>
<td>✓ Eye protection (PAPR, face shield, or goggles)</td>
</tr>
<tr>
<td></td>
<td>✓ Gown</td>
</tr>
<tr>
<td></td>
<td>✓ Gloves</td>
</tr>
<tr>
<td></td>
<td>* Airborne precautions (N95 or PAPR) should be used for aerosol-generating procedures.*</td>
</tr>
<tr>
<td><strong>COVID-19 confirmed</strong></td>
<td>✓ Airborne precautions (N95 or PAPR)*</td>
</tr>
<tr>
<td></td>
<td>✓ Eye protection (PAPR, face shield, or goggles)</td>
</tr>
<tr>
<td></td>
<td>✓ Gown</td>
</tr>
<tr>
<td></td>
<td>✓ Gloves</td>
</tr>
<tr>
<td></td>
<td>* At the direction of Infection Prevention, facilities may employ droplet precautions (surgical mask) for select patients at low risk of transmission.*</td>
</tr>
<tr>
<td><strong>Asymptomatic patients with a positive screen (nasopharyngeal PCR) for SARS-CoV-2</strong></td>
<td>✓ Airborne precautions (N95 or PAPR)*</td>
</tr>
<tr>
<td></td>
<td>✓ Eye protection (PAPR, face shield, or goggles)</td>
</tr>
<tr>
<td></td>
<td>✓ Gown</td>
</tr>
<tr>
<td></td>
<td>✓ Gloves</td>
</tr>
<tr>
<td></td>
<td>* At the direction of Infection Prevention, facilities may employ droplet precautions (surgical mask) or discontinue isolation precautions on a case-by-case basis.*</td>
</tr>
</tbody>
</table>

## COVID-19 is Not Suspected or Diagnosed

<table>
<thead>
<tr>
<th>Care</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General care</strong></td>
<td>No COVID-19 related precautions required other than shift mask. Use other transmission-based precautions if other pathogens are present.</td>
</tr>
<tr>
<td><strong>Aerosol-generating procedure (see Appendix C)</strong></td>
<td>✓ Airborne precautions (N95 or PAPR)</td>
</tr>
<tr>
<td></td>
<td>✓ Eye protection (PAPR, face shield, or goggles)</td>
</tr>
<tr>
<td></td>
<td>✓ Gown</td>
</tr>
<tr>
<td></td>
<td>✓ Gloves</td>
</tr>
<tr>
<td><strong>Specified surgical procedures (see Appendix D)</strong></td>
<td>✓ Airborne precautions (N95 or PAPR)</td>
</tr>
<tr>
<td></td>
<td>✓ Eye protection (PAPR, face shield, or goggles)</td>
</tr>
<tr>
<td></td>
<td>✓ Gown</td>
</tr>
<tr>
<td></td>
<td>✓ Gloves</td>
</tr>
<tr>
<td><strong>General Inpatient care before/after an aerosol-generating procedure or surgery (Appendix C &amp; D)</strong></td>
<td>No COVID-19 related precautions required outside of the peri-operative/procedural setting other than shift mask. Use other transmission-based precautions if other pathogens are present.</td>
</tr>
</tbody>
</table>
Lists of all aerosol generating procedures and surgeries that require N95 masks for asymptomatic patients

<table>
<thead>
<tr>
<th>Potentially Aerosol-Generating Procedure</th>
<th>N95 or PAPR Recommended</th>
<th>Mitigation Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasopharyngeal swab for respiratory virus testing</td>
<td>Yes</td>
<td>Respiratory Failure and Airway Management</td>
</tr>
<tr>
<td>Intubations</td>
<td>Yes</td>
<td>AMBU bag with proximal exhalation filter before PEEP valve – UPMC Item # 0180607</td>
</tr>
<tr>
<td>Exubations</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Manual ventilation</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Prolonged face mask ventilation</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>High-flow nasal cannula</td>
<td>No</td>
<td>MAX 6 l/min consider transition to simple mask or NIV Cpap</td>
</tr>
<tr>
<td>Non-invasive ventilation for acute illness*</td>
<td>Yes</td>
<td>Filtered exhalation on circuit V 60 Cpap – UPMC Item # 10340</td>
</tr>
<tr>
<td>Non-invasive ventilation for baseline or diagnostic use*</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Breaking closed ventilation system</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Endotracheal tube repositioning</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>ETT fixation device change</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Tracheostomy management</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Appendix D: High- and Intermediate-Risk Surgeries

The following surgical and interventional procedures are those for which:
- The potential for encountering SARS-CoV-2 virus in asymptomatic patients may present a risk of aerosolization and therefore exposure risk to health care workers in the operating room.
- The risk of aerosolization of virus may not be significant, but for which airborne protection has been suggested pending further study.

Note: this procedure list is not intended to be used as a list of procedures warranting pre-operative asymptomatic screening. Please see COVID-19 Asymptomatic Testing Process for a description of procedures included in the asymptomatic screening program.

<table>
<thead>
<tr>
<th>Cardiac Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronchoscopy</td>
</tr>
<tr>
<td>Tracheostomy (open or percutaneous)</td>
</tr>
<tr>
<td>redo sternotomy cases in which the lung tissue is entered during mediastinal dissection</td>
</tr>
<tr>
<td>Thoracotomy procedures (especially redo thoracotomy) for which lung tissue is abraded during dehiscence</td>
</tr>
<tr>
<td>Primary chest cardiac surgical procedures (e.g., CABG, valve repair/replacement, LVAD implantation, heart transplantation)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heart and Vascular Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEE with sedation or requiring intubation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interventional Radiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung biopsy</td>
</tr>
<tr>
<td>Lung ablation</td>
</tr>
<tr>
<td>Thoracocentesis</td>
</tr>
</tbody>
</table>
Discontinuation of Precautions

Symptom-Based Strategy:

• Mild to Moderate Illness
  – At least 10 days have passed since symptoms first appeared 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

• Severe to Critical Illness
  – At least 10 days and up to 20 days have passed since symptoms first appeared 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

• Asymptomatic
  – At least 10 days have passed since positive test

Test-based strategy:

• Not recommended

Reinfection?

COVID-19 re-infection by a phylogenetically distinct SARS-coronavirus-2 strain confirmed by whole genome sequencing

Kelvin Kai-Wang To, Ivan Fan-Ngai Hung, Jonathan Daniel Ip, Allen Wing-Ho Chu, Wan-Mui Chan, Anthony Fung, Carol Ho-Yan Fong, Shuofeng Yuan, Hoi-Wah Lee

Author Notes

Clinical Infectious Diseases, ciaa1275, https://doi.org/10.1093/cid/ciaa1275

Genomic Evidence for a Case of Reinfection with SARS-CoV-2

Richard Tillett
Nevada Institute for Personalized Medicine; Nevada Center for Innovation in Global Health; University of Nevada, Las Vegas

Joel Sevinsky
THEMAGEN CONSULTING

Paul Hartley
University of Nevada, Reno

Published: 25 August 2020  Article history:...Show more

Assessment of the risk of SARS-CoV-2 reinfection in an intense re-exposure setting

Laith J. Abu Raddad PhD,1,2,3* Hiam Chemaitelly MSc,1,2 Housssein H. Ayoub PhD,4 Zaina Al Kanaani PhD,5 Abdullahat Al Khal MD,6 Einas Al Kuwari MD,3 Adeel A. Butt MD,3 Peter Coyle MD,3 Andrew Jeremijenko MD,3 Anvar Hassan Kalseckal MSc,3 Ali Nizar Latif MD,3 Hanan F. Abdul Rahim PhD,6 Mohamed G. Al Kuwari MD,3 Hamad Eid Al Romaihi MD,8 Sheikh Mohammad Al Thani MD,8 and Roberto Bertollini MD9
Next Steps & Ongoing Questions

• Vaccines
• Clinical trials for additional agents
• Diagnostics
• Re-infection