NOVEL CORONAVIRUS: COVID-19

KHN Grand Rounds 3-6-2020
Jeffrey Weinstein, MD, FIDSA, CPE
Chief Quality Officer, KMCS
Outline

• Perspective
• Virology of Coronaviruses
• Epidemiology of SARS-CoV-1, MERS, and SARS CoV-2*
• Clinical Manifestations
• Management
• Public Health response
• KHN Preparedness
First – Some Perspective

SARS CoV-2
100,330 cases diagnosed worldwide as of 3/6
3408 deaths worldwide to date

Influenza Viruses
3-5 million severe cases worldwide annually
300K to 650K deaths worldwide annually
18,000 deaths in the US this season
Above numbers are in non-pandemic years
Virology of Coronaviruses

- RNA Viruses
- HCoV-NL63, HCoV-229-E, HCoV-OC43, HKU1 → all cause mild URIs in immunocompetent hosts
- Our VRP only tests for these four
- All Human Coronaviruses originate in animals
Fig. 2: Animal origins of human coronaviruses.

<table>
<thead>
<tr>
<th>Genetically diverse coronaviruses</th>
<th>Natural host</th>
<th>Intermediate host</th>
<th>Human host</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCoV-NL63</td>
<td>Bat</td>
<td>?</td>
<td>HCoV-NL63</td>
</tr>
<tr>
<td>HCoV-229E</td>
<td>Bat</td>
<td>?</td>
<td>HCoV-229E</td>
</tr>
<tr>
<td>HCoV-OC43</td>
<td>Bat</td>
<td>?</td>
<td>HCoV-OC43</td>
</tr>
<tr>
<td>SARS-CoV</td>
<td>Rodent</td>
<td>?</td>
<td>SARS-CoV</td>
</tr>
<tr>
<td>MERS-CoV</td>
<td>Bat</td>
<td>?</td>
<td>MERS-CoV</td>
</tr>
<tr>
<td>SADS-CoV</td>
<td>Bat</td>
<td>?</td>
<td>SADS-CoV</td>
</tr>
</tbody>
</table>

- Spillover to intermediate hosts
- Mild infection
- Severe infection
Severe Acute Respiratory Syndrome – SARS CoV-1

• First reported in February 2003 in Guangdong province of China
• Outbreak ended in July 2003 with a total of 8096 cases and 774 deaths
• Case fatality rate = 9.6%
• Rapid early spread to Hong Kong, Singapore, Vietnam, Thailand
• Subsequent spread to the US, Canada, Europe via air travel
Severe Acute Respiratory Syndrome – SARS CoV-1

How SARS Coronavirus Spread in 2003

07 Aug 2003

- Cumulative number of deaths
- Cumulative number of recovered
- Cumulative number of probable cases (not recovered)
• Older age was a strong risk factor for death
• Children under 12 had milder disease
• Four outbreaks occurred due to laboratory exposure of HCWs or researchers in China (2 with only 1 case)
• Primary host
• Intermediate host
Epidemiology - SARS

• Asian Palm Civit cats eaten as a delicacy likely source for jump to humans
• Droplet transmission human to human
• ? Fecal – oral route
• ? Airborne via “Superspreaders”
• Transmission to HCWs common in most outbreaks
• Incubation period 2-7 days average, max 10 days

• What happened to SARS??? No new cases since 2004
Middle East Respiratory Syndrome – MERS-CoV

• First reported in Saudi Arabia in 2012
• Total of 2494 lab-confirmed cases and 858 deaths
• Case fatality rate = 34%
• 100% of cases were linked to the Arabian peninsula
• Cases rapidly declining since 2016
Epidemiology - MERS
### Epidemiology - MERS

<table>
<thead>
<tr>
<th>Region</th>
<th>Country</th>
<th>Number of cases</th>
<th>Number of deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Middle East</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kingdom of Saudi Arabia</td>
<td>1853</td>
<td>750</td>
</tr>
<tr>
<td></td>
<td>United Arab Emirates</td>
<td>92</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Qatar</td>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Jordan</td>
<td>35</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Oman</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Kuwait</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Egypt</td>
<td>1</td>
<td>0</td>
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<tr>
<td></td>
<td>Yemen</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Lebanon</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Bahrain</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Iran</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td><strong>Europe</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>UK</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Germany</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>France</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Italy</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Greece</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Netherlands</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Austria</td>
<td>2</td>
<td>1</td>
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<tr>
<td><strong>Africa</strong></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Tunisia</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Algeria</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Asia</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Malaysia</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Philippines</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>South Korea</td>
<td>185</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td><strong>Americas</strong></td>
<td>United States of America</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Global</td>
<td><strong>2253</strong></td>
<td><strong>840</strong></td>
</tr>
</tbody>
</table>

*Figure 2. Distribution of confirmed MERS cases by place of probable infection, as of 24 August 2018 (n=2 253)*
• Initial cases identified in Wuhan, China
• Early cases linked to a seafood and live animal market → suggesting animal to people spread (?bats/intermediate host)

Malayan Pangolin
How does the virus spread?

• Droplet transmission – within about 6 feet
  • Sneezing/coughing
  • Patients are most contagious when symptomatic
  • Asymptomatic spread has been documented in China

• Surface to mucous membranes

• Unknown survival on surfaces
  • 2 days? 9 days?

• ? Spread via leaky sewage pipes in buildings
  • Previously demonstrated with SARS
• Sustained person to person spread within China
• Sustained person to person spread in Japan on the Diamond Princess cruise ship
• Person to person spread in other countries:
  • South Korea
  • Iran
  • Italy
  • US
China – as of 3/6/2020

Coronavirus COVID-19 Global Cases by Johns Hopkins CSSE

Total Confirmed: 80,556
Total Deaths: 3,042
Total Recovered: 53,829

Last Updated at (M/DD/YYYY): 3/6/2020, 8:33:03 AM
Japan – Diamond Princess Cruise Ship

A 3 hour tour?
Japan – Diamond Princess Cruise Ship

Not a 3 hour tour, Gilligan

<table>
<thead>
<tr>
<th>Date</th>
<th>Arrive</th>
<th>Depart</th>
<th>Port</th>
<th>80y/o patient zero</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 January</td>
<td>17:00</td>
<td></td>
<td>Yokohama, Japan</td>
<td>embarked</td>
</tr>
<tr>
<td>22 January</td>
<td>7:00</td>
<td>21:00</td>
<td>Kagoshima, Japan</td>
<td></td>
</tr>
<tr>
<td>25 January</td>
<td>7:00</td>
<td>23:59</td>
<td>Hong Kong</td>
<td>disembarked</td>
</tr>
<tr>
<td>27 January</td>
<td>7:00</td>
<td>16:00</td>
<td>Chan May, Vietnam</td>
<td></td>
</tr>
<tr>
<td>28 January</td>
<td>8:00</td>
<td>18:00</td>
<td>Ha Long Bay, Vietnam</td>
<td></td>
</tr>
<tr>
<td>31 January</td>
<td>7:00</td>
<td>17:00</td>
<td>Keelung, Taiwan</td>
<td></td>
</tr>
<tr>
<td>1 February</td>
<td>12:00</td>
<td>23:00</td>
<td>Okinawa, Japan</td>
<td>Tested positive</td>
</tr>
<tr>
<td>3 February</td>
<td></td>
<td></td>
<td>Yokohama</td>
<td></td>
</tr>
</tbody>
</table>

### Confirmed cases on Diamond Princess

<table>
<thead>
<tr>
<th>Date (JST)</th>
<th>Tested (cumulative)</th>
<th>Confirmed (cumulative)</th>
<th>Notes and ref(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 February</td>
<td></td>
<td>31</td>
<td>Berthed at the Port of Yokohama</td>
</tr>
<tr>
<td>5 February</td>
<td>102</td>
<td>20</td>
<td>Calculated from reports[2][3]</td>
</tr>
<tr>
<td>7 February</td>
<td>273</td>
<td>61</td>
<td>[3]</td>
</tr>
<tr>
<td>8 February</td>
<td>279</td>
<td>64</td>
<td>[4]</td>
</tr>
<tr>
<td>9 February</td>
<td>336</td>
<td>70</td>
<td>[5]</td>
</tr>
<tr>
<td>10 February</td>
<td>439</td>
<td>135</td>
<td>[6]</td>
</tr>
<tr>
<td>12 February</td>
<td>492</td>
<td>174</td>
<td>Calculated from reports[6][7]</td>
</tr>
<tr>
<td>13 February</td>
<td>713</td>
<td>218</td>
<td>[7]</td>
</tr>
<tr>
<td>15 February</td>
<td>930</td>
<td>285</td>
<td>Includes 73 asymptomatic cases[8]</td>
</tr>
<tr>
<td>16 February</td>
<td>1,219</td>
<td>355</td>
<td>Includes 111 asymptomatic cases[9]</td>
</tr>
<tr>
<td>17 February</td>
<td>1,723</td>
<td>454</td>
<td>Includes 189 asymptomatic cases[10]</td>
</tr>
<tr>
<td>18 February</td>
<td>2,404</td>
<td>542</td>
<td>Includes 254 asymptomatic cases[11]</td>
</tr>
<tr>
<td>19 February</td>
<td>3,011</td>
<td>621</td>
<td>Includes 322 asymptomatic cases[12]</td>
</tr>
<tr>
<td>20 February</td>
<td>3,063</td>
<td>634</td>
<td>Includes 328 asymptomatic cases[13]</td>
</tr>
</tbody>
</table>

Ship quarantined
Japan – Diamond Princess Cruise Ship

What went wrong

• Chaotic situation described by Japanese ID Specialist who visited ship
• Numerous violations of infection control principles
• Bureaucrats were in charge – no one with medical or public health training
• Quarantine “failed” – Dr. Anthony Fauci, NIAID
South Korea – as of 3/6

Total Confirmed: 6,593

Total Deaths: 42
Total Recovered: 135
South Korea

• Initial outbreak in Daegu, 150 miles from Seoul
• Shincheonji Church of Jesus
  • Secretive religious group whose leader claims immortality
  • Crowded, “enthusiastic” religious services
  • Members hide who they are from family/friends due to stigma
  • One member refused testing and may be a “Superspreader”
• Smaller outbreaks in other cities
• Criticism of late decision to screen at the Chinese border
Italy – as of 3/6

Total Confirmed: 3,858

Total Deaths: 148
Total Recovered: 414
• Largest outbreak outside of Asia
• Centered in northern region of Lombardy
• Several cities in lockdown, > 100k people on quarantine
• Patient 1 identified as a 38 yr old male
  • Developed critical illness and charges are flying that the hospital did not follow accepted infection control practices allowing spread
  • Patients pregnant wife also infected but stable

• Patient 0 not identified
• This would be the individual who brought SARS Cov-2 into Italy
• Concerns for further spread within southern Europe
United States – as of 3/6
Has the virus already been circulating in our communities?

- Woman with no travel or exposure to known cases
- Presented 2/15 to NorthBay VacaValley Hospital
- Intubated for respiratory failure, routine testing negative
- Transferred to UC Davis Medical Center 2/19
- Physicians requested PCR for SARS CoV-2
  - Declined by local and state health depts as she did not meet criteria
- CDC approved testing 2/23
- Test confirmed + 2/26
- How could she have become infected???
Has the virus already been circulating in our communities?

Travis Air Force Base
8.3 miles from Hosp
Life Care Nursing Center – Kirkland, WA

- 7 patient deaths to date
- 1 HCW hospitalized
- 50 residents/staff with symptoms of possible COVID-19

- Source???
- 35 yr old male had returned to Washington from Wuhan in January and may have started community transmission
How Contagious is it?

**POPULAR SCIENCE**

- **COVID-19** (a.k.a. coronavirus)
  - Estimate as of mid-February
- **SARS**
  - How many people will catch the disease
- **Mumps**
- **MERS**
- **Influenza**
- **Ebola**
- **Rubella**
- **Smallpox**
- **Measles**
Clinical Manifestations of COVID-19

Clinically Indistinguishable from Influenza

• Incubation period of up to 14 days, days is the mode
• Most infections are NOT SEVERE
  • 81% mild disease with no or minimal pneumonia
  • 14% severe with dyspnea/hypoxia/>50% lung involvement
  • 5% critical with respiratory failure/Shock/multi-organ dysfunction

• Symptoms
  • Fever 99%
  • Cough/dyspnea 60%
Clinical Manifestations of COVID-19

- Severe disease and deaths mainly in patients > 70 yrs old
- Mild disease in children
- Mild disease in pregnant women

- As of 3/6 100,330 cases diagnosed worldwide as of 3/6
- 3408 deaths worldwide to date

- Case fatality rate = 3.4% but this is likely an over-estimate as more serologic data becomes available
Clinical Manifestations of COVID-19

• Symptoms
  • Rare GI symptoms: nausea/diarrhea
  • Asymptomatic cases well described

• Labs
  • WBC varies, lymphopenia common
  • Sometimes elevated LFTs
  • PCT usually negative, can be elevated in critical patients
Diagnosis of COVID-19

- PCR available via CDC and some state health departments
  - As of 3/6 ODH was not up and running
  - NP, oropharyngeal swab or BAL specimen

- KHN Viral Respiratory Panel DOES NOT detect SARS CoV-2!!!
Clinical Management of COVID-19

• Supportive
  • Home for mild cases
  • Hospital if moderate to severe disease
• Do not use glucocorticoids unless needed for something else
• Remdesvir – investigational antiviral being used in China
  • Used in 1 US case under an IND application
• Lopinavir-ritonavir
  • In vitro activity vs MERS and SARS
  • Case reports for SARS CoV-2, unclear efficacy
Prevention - Personal

- WASH HANDS frequently
- Avoid those with cough
- Stay home if you are sick

For HCWs:
- Current: airborne and contact precautions
- Likely: Droplet precautions with gown, gloves, mask, eye wear
**Prevention - Personal**

**Coronavirus - How to Wash Your Hands**

1. Turn on the water with your mouth so your dirty hands don't touch the tap.
2. Gently wipe each finger with a tiny wet cloth for 1 second.
3. Use your teeth to remove any dirt from under your fingernails that you might have missed.
4. Dry your clean hands on a child's hair.
Containment Strategy

- Travelers entering US from areas with infection:
  - Symptomatic → into quarantine facilities
  - 14 day quarantine with testing before release
  - Non-US citizens disallowed
  - Asymptomatic → can return home but must self-isolate and report to local and state public health authorities
  - If they become symptomatic → call ahead to health facilities for advice
Mitigation Strategy

• Community spread is now recognized

Mitigation Strategy

• Led by Mike Pence, VP, $8.3 Billion approved 3/5
• Coordination of CDC and State and Local Health Departments
• Concerns
  • Number of test kits and turn around time
  • Quality control of initial test kits
  • Were infection prevention techniques used appropriately at quarantine facilities
  • Run on masks, hand sanitizer
  • What will the epidemic curve look like
  • Public Health infrastructure
# CDC Travel Advisories as of 3/4/2020

## Warning Level 3, Avoid Nonessential Travel

<table>
<thead>
<tr>
<th>Location</th>
<th>Update Date</th>
<th>Advisory Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 in Italy</td>
<td>March 03, 2020</td>
<td>CDC recommends that travelers avoid all nonessential travel to Italy. Read More &gt;&gt;</td>
</tr>
<tr>
<td>COVID-19 in Iran</td>
<td>March 03, 2020</td>
<td>CDC recommends that travelers avoid all nonessential travel to Iran. Read More &gt;&gt;</td>
</tr>
<tr>
<td>COVID-19 in South Korea</td>
<td>March 03, 2020</td>
<td>CDC recommends that travelers avoid all nonessential travel to South Korea. Read More &gt;&gt;</td>
</tr>
</tbody>
</table>
| COVID-19 in China       | March 03, 2020 | CDC recommends that travelers avoid all nonessential travel to the People’s Republic of China (this does not include Hong Kong, Macau, or the island of Taiwan). Read More >>

## Alert Level 2, Practice Enhanced Precautions

- **COVID-19 in Japan**
  - March 03, 2020
  - Japan is experiencing sustained community spread of respiratory illness caused by the novel (new) coronavirus. Older adults and those with chronic medical conditions should consider postponing nonessential travel.
  - Read More >>

- **Polio in Africa**
  - February 11, 2020
  - There are polio outbreaks in several countries in Africa. CDC recommends that all travelers to these countries be vaccinated fully against polio.
  - Read More >>

- **Polio in Asia**
  - January 03, 2020
  - There are polio outbreaks in several countries in Asia. CDC recommends that all travelers to these countries be vaccinated fully against polio.
  - Read More >>

- **Rubella in Japan**
  - January 03, 2020
  - There is an outbreak of rubella in Japan. Travelers to Japan should make sure they are vaccinated against rubella with the MMR (measles, mumps, and rubella) vaccine before travel.
  - Read More >>

- **Ebola in Democratic Republic of the Congo**
  - January 03, 2020
  - There is an outbreak of Ebola in the North Kivu (Kivu Nord) and Ituri provinces in the Democratic Republic of the Congo (DRC).
  - Read More >>

- **Yellow Fever in Nigeria**
  - January 03, 2020
  - A large, ongoing outbreak of yellow fever in Nigeria began in September 2017. The outbreak is now spread throughout the country. Travelers going to Nigeria should receive vaccination against yellow fever at least 10 days before travel.
  - Read More >>
Healthcare State of Emergency

- Declared in Washington
- Some counties in California and now Maryland
- Provides some regulatory relief and access to the National Stockpile of supplies
  - PPE
  - Ventilators (if needed)
  - Medications
Coronavirus Emergency Preparedness Team

• Includes Emergency Operations, ED, Infection Prevention and Control, Nursing, Medical Staff, Marketing at present

• Full blown Incident Command :
  • Employee Health
  • Pharmacy
  • EVS
  • Lab
  • Security
  • Supply Chain
  • KPN
EPIC Screening Questions at Entry Points

Coronavirus screening questions have been added to EPIC.
- The Viral Fever Screening questions have been updated to Respiratory Viral Screening questions.
- Answering yes to BOTH screening questions will trigger the Coronavirus BPA.
  - Follow the instructions outlined in the BPA.
  - Contact your closest Infection Preventionist if you have questions pertaining to Coronavirus.

Under “Steps to Follow” #4. Collect specimens for influenza and/or respiratory panel as deemed appropriate by provider.
Coronavirus Emergency Preparedness Team

• FAQs to go out to leaders and medical staff
• Partnering on calls with GDAHA/PHDMC/ODH/Premier/Dayton Children’s Hospital
• Monitoring CDC Updates and Guidance
• Taking inventory of PAPRs, negative pressure rooms
• Mock Drills to start TODAY
  • Mildly ill patient
  • Patient requiring critical care
Practical Issues – Who should be Tested

High Risk

- Living in the same household as, being an intimate partner of, or providing care in a non-healthcare setting (such as a home) for a person with symptomatic laboratory-confirmed COVID-19 infection *without using recommended precautions* for home care and home isolation
  - The same risk assessment applies for the above-listed exposures to a person diagnosed clinically with COVID-19 infection outside of the United States who did not have laboratory testing.
- Travel from Hubei Province, China
Practical Issues – Who should be Tested

Medium Risk

- Close contact with a person with symptomatic laboratory-confirmed COVID-19 infection, and not having any exposures that meet a high-risk definition.
  - The same risk assessment applies for close contact with a person diagnosed clinically with COVID-19 infection outside of the United States who did not have laboratory testing.
  - On an aircraft, being seated within 6 feet (two meters) of a traveler with symptomatic laboratory-confirmed COVID-19 infection; this distance correlates approximately with 2 seats in each direction (refer to graphic above)

- Living in the same household as, an intimate partner of, or caring for a person in a nonhealthcare setting (such as a home) to a person with symptomatic laboratory-confirmed COVID-19 infection while consistently using recommended precautions for home care and home isolation

- Travel from mainland China outside Hubei Province AND not having any exposures that meet a high-risk definition
Practical Issues – Who should be Tested

Low Risk
- Being in the same indoor environment (e.g., a classroom, a hospital waiting room) as a person with symptomatic laboratory-confirmed COVID-19 for a prolonged period of time but not meeting the definition of close contact.
- On an aircraft, being seated within two rows of a traveler with symptomatic laboratory-confirmed COVID-19 but not within 6 feet (2 meters) (refer to graphic above) AND not having any exposures that meet a medium- or a high-risk definition (refer to graphic above).

No Identifiable Risk
- Interactions with a person with symptomatic laboratory-confirmed COVID-19 infection that do not meet any of the high-, medium- or low-risk conditions above, such as walking by the person or being briefly in the same room.
9 Ways the Earth can End

1. Global warming
2. Asteroid
3. Pandemic threat
4. Fungal threat
5. Engineered disease
6. Nuclear war
7. Robot ascension
8. Overpopulation
9. Snowball effect
WHO Epidemic Curve in Wuhan, China
Johns Hopkins Epidemic Curve

- SARS vanished after the epidemic
- MERS has nearly vanished
New Technology

- https://www.youtube.com/watch?v=oG15kM0rBLQ