COVID-19 / SARS CoV-2
Situational Update on COVID-19

The Pandemic You Kept Telling Yourself Would Never Come Is Here!
No conflict of interests

BTW – I predicted this was going to happen, told my mom, but didn’t find time to rebalance my portfolio!
Conflict of Interests

• On second thought...(and a somewhat morbid thought)...I guess the pandemic keeps me in a job

• Talk about conflict of interests!
Objectives

• A little history

• Review important epidemiological features of COVID-19

• Familiarize audience with clinical presentation of disease

• Discuss infection prevention strategies and preparedness planning for epidemic
Contents

• “If you remember only one thing!”
• Basic virology
• Epidemiology
• Clinical presentation
• Radiologic finding
• Treatment
• Infection Prevention
• Preparedness
Does anybody remember...

**Influenza Pandemic 1918**
Just a Movie
Ok, not just in movies anymore...
Remember those close calls?
Normal Carnival vs Zika Carnival...Remember?
Does anybody remember...

• 1918 Spanish Flu
• ‘90s Mad Cow Disease
• 2001 Anthrax 2001
• 1999-2002 WNV
• 2003 SARS
• 2005 Brid Flu
• 2006 E coli
• 2009 H1N1 “Swine Flu”
• 2012 MERS
• 2014 Ebola
• 2016 Zika
Near Miss: A great learning opportunity, usually squandered...
Influenza Pandemic 1918

...maybe it would have been better to remember
COVID-19 / SARS CoV-2
(or lack thereof)
Wuhan, China  (“The Chicago of China”)
Wuhan, China

Capital of Hubei province

7th most populous city in China

Population 11 million

Early December 2019, outbreak of pneumonia of unknown etiology noted in Wuhan.

Initially clustered cases in South China Seafood Market

Note: NYC 8m, LA 3.8m, Chi 2.7m
South China Seafood City

Market that sells more than just seafood, also live animals including:

Chickens, pheasants, marmots, bats, snakes, donkey’s, sheep, camels, foxes, badgers, bamboo rats, hedgehogs. Organs of other animals including rabbits.
Timeline

12/31/19 (New Year’s eve!) – Chinese health officials inform WHO of a cluster of 41 cases of PNA of unknown etiology, most connected to Huanan Seafood Market. Tests negative for influenza, avian influenza, SARS, MERS, adenovirus

1/1/20 – Huanan Seafood Market closes

1/8/20 – China determines etiology is a novel coronavirus (“2019 nCoV”)

1/9/20 – Still no cases of human to human transmission

1/11/20 – China releases the genetic sequence of the nCoV

1/13/20 – 1st case outside of China detected in Thailand. Woman who had traveled from Wuhan to Thailand.
Timeline

1/14/20 - First evidence of human-to-human spread. Occurred in a family cluster. Husband worked at market, but then wife who did not have market exposure became sick.

1/15/20 – 2nd family cluster

1/16/20 – 1st patient identified in Japan. Had also traveled to Wuhan. 1st rapid diagnostic test available, and the WHO publishes the assay protocol.

1/17/20 – Thailand with 2nd nCoV case.
JFK and San Francisco airports - the only 2 airports in US with direct flights to China, and LAX start screening
Timeline

1/20/20 – Spread among healthcare workers: China announces that 14 HCWs have been infected.

- South Korea has 1st case. Chinese visitor from Wuhan. Picked up by thermal scanning at the airport.

1/21/20 – WHO notes evidence of sustained spread in China.
- Taiwan has its first case. Patient worked in Wuhan.
- 1st case in USA. Man who took indirect flight from Wuhan to Sea-Tac.
- Traveler health checks to be expanded to Chicago and Atlanta airports and plan to funnel all travelers from Wuhan to the 5 airports doing the screening.
Timeline

1/22/20 – Wuhan is placed under quarantine. Hubei province follows within days.

Public transit within Wuhan stopped.

Trains, flights, long haul buses out of Wuhan stopped.

Cars still allowed out, but closed most of the highways in and are screening people going in and out.
Totals as of 1/22/20

- China 570 total cases, 17 deaths (444 cases in Wuhan)
- Thailand 4 cases
- Hong Kong 2
- Macau 1
- Korea 1
- Japan 1
- Taiwan 1
- USA 1
Timeline

1/30/20 – **WHO declares Public Health Emergency**

1/31/20 – Trump bans foreigners from entering USA if they are coming from China (within **1 month** of unknown PNA announcement!)

2/9/20 – Death toll from 2019 novel coronavirus surpasses that of the 2002-03 SARS epidemic (within **1 month** of discovering COVID-19)

2/11/20 – WHO announces the new coronavirus infection will be called **COVID-19 (COronaVirusDisease2019)**

2/19/20 – **Italy outbreak begins**
Timeline

2/29/20 – **US reports 1st death**

3/8/20 – Italy places 60 million residents on lockdown

3/11/20 – **WHO declare the outbreak a pandemic**
Trump bans all travel from 26 European countries

3/13/20 – **US declares a national emergency**

3/17/20 – Leaked federal plan warns nCoV pandemic “will last 18 months or longer” and may come in “multiple waves” of infections.

3/19/20 – **Nearly all US states declare a state of emergency**
Déjà vu?? (in some ways COVID will remind us of SARS)
Selling masks near Vancouver airport
Empty jewelry showcases from Hong Kong and Singapore
Zurich Trade Fair
SARS Epidemic Summary

Global cost estimate of the SARS outbreak exceeds $30 billion

As scientists track mortality rates, analysts assess a different kind of casualty: international business and tourism

Economies on Empty

BY MARY CARMICHAEL

By now, everyone knows the early signs of SARS are high fever and a dry cough. But there’s a second set of symptoms: canceled business trips, the collapse of tourism and falling stock prices. SARS (and fear of the mysterious disease) has already infected economies in Asia and Canada. Now U.S. markets are starting to look a little sickly, too. Last week analysts here blamed SARS for both a domestic stock slump and the airline industry’s most recent woes. That’s got economists pondering the kinds of questions doc-
Major Concerns About HCW Protection
Timeline Comparing SARS and COVID-19 Outbreaks

• Note difference in speed of recognition and understanding of two outbreaks

• Note difference in number of cases across timelines
## WHO Pandemic Phases

<table>
<thead>
<tr>
<th>Period</th>
<th>Phase 1</th>
<th>Interpandemic Period Phase 1: No new influenza virus subtypes in humans. An influenza virus subtype that has caused human infection may be present in animals. If present in animals, the risk of human infection or disease is considered to be low.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Phase 2</td>
<td>Interpandemic Period Phase 2: No new influenza virus subtypes have been detected in humans. However, a circulating animal influenza virus subtype poses a substantial risk of human disease.</td>
</tr>
<tr>
<td>Pandemic Alert</td>
<td>Phase 3</td>
<td>Pandemic Alert Phase 3: Human infection(s) with a new subtype, but no human-to-human spread, or at most rare instances of spread to a close contact.</td>
</tr>
<tr>
<td>Period</td>
<td>Phase 4</td>
<td>Pandemic Alert Phase 4: Small clusters(s) with limited human-to-human transmission but spread is highly localized, suggesting that the virus is not well adapted to humans.</td>
</tr>
<tr>
<td></td>
<td>Phase 5</td>
<td>Pandemic Alert Phase 5: Larger cluster(s) but human-to-human spread is still localized, suggesting that the virus is becoming increasingly better adapted to humans, but may not yet be fully transmissible (substantial pandemic risk).</td>
</tr>
<tr>
<td></td>
<td>Phase 6</td>
<td>Pandemic Alert Phase 6: Pandemic phase: increased and sustained transmission in the general population.</td>
</tr>
</tbody>
</table>
Situational Update
03/03/2020

12K

80K
Situational Update
03/03/2020

TRAVEL ALERT COUNTRIES

• Level 3
  • China, South Korea, Italy, Iran
    • Widespread & ongoing
    • China & Korea US entry restrictions

• Level 2
  • Japan
    • Sustained community

• Level 1
  • Hong Kong
    • Limited community

• World – 92,818 cases/3,160 deaths (3.4%)
• China – 80,261 cases/2,947 (3.7%)
  • China accounts for 86.5% of all COVID-19 cases
• South Korea – 5,186/28 (0.5%)
• Italy – 2,502/79 (3.2%)
• Iran – 2,336/77 (3.3%)
• Japan – 293/6 (2.0%)
• France – 204/4 (2.0%)
• Germany – 196/0 (0%)
• Spain – 153/1 (0.7%)
• Singapore – 110/0 (0%)

• US – 118/9 (7.6%)
Recovered outnumber total cases in China

Situational Update

03/19/2020

81 K

165 K
Coronavirus (COVID-19) pandemic

US: (3/3) 118 -> (3/19) 13,726

COVID-19 Cases in the U.S.

Cases in U.S. 📈  Situation Summary 📈
COIVID-19 in Illinois
March 21, 2020

- 753 cases
- Ages 3 to 99
- Cook 73%
- DuPage 9%
- Lake 8%
- Will 2%
- 22 other counties have cases, but ≤ 1%
HONEY? I'M OFF TO CHECK THE MAIL!...
Remember the Sun’s corona?

Coronavirus

- Discovered in 1960, until 2002 associated with relatively mild respiratory infections
- Medium-sized, enveloped, single stranded, positive sense RNA virus
- Name comes from Corona (Latin) for crown

Spike (S) protein
Coronaviruses

• Large family of viruses
• Several causing the common cold
  • HKU1, NL63, OC43 and 229E (“human coronaviruses”)
  • Generally benign, with more severe diseases in the very young, elderly or markedly immunocompromised, with outbreaks reported in long-term care facilities
• Some circulate in animals (bats)

• MERS-CoV (1st recognized 2012) – 2,494 cases, 858 deaths (CFR 34.4%)
• SARS-CoV (1st recognized in 2003) – 8,098 cases, 774 deaths (CFR 9.6%)
- Size: 80-160 nm
- Genome: 27-32kb RNA
- Genes at 5' end specify for RNA replication proteins (error prone=mutations)
- Genes at 3' end specify structural proteins (S, N, M, E)
Phylogenetic

- Coronaviridae subfamily has two main genera:
  - Alphacoronavirus:
    - 229E and NL63
  - Betacoronavirus
    3 Lineages
    Lineage A: -OC43 and -HKU1
    Lineage B: SARS-CoV and SARS-CoV-2
    Lineage C: MERS-CoV
Already mutating
Genetic drift

Implications for immunity and vaccine development?
Results obtained from our analyses suggest that the 2019-nCoV appears to be a recombinant virus between the bat coronavirus and an origin-unknown coronavirus. The recombination occurred within the viral spike glycoprotein, which recognizes cell surface receptor. Additionally, our findings suggest that snake is the most probable wildlife animal reservoir for the 2019-nCoV based on its RSCU bias resembling snake compared to other animals. Others studies contest this.
Pangolin?

• Follow up studies implicated a mammalian intermediate host, like:
  • Civet cats for SARS
  • Camels for MERS)

• New candidate: the Pangolin
> 96%
homology
with bat
coronavirus
isolated in
Yunnan in
2013

Origin of SARS CoV 2

• Highest homology to a bat coronavirus
  BetaCoV/bat/Yunnan/RaTG13/13
• Intermediate mammal host is still unclear:

Li. et al analyzed 70 genomes from SARS CoV 2
and concluded that the Time to Most
Common Ancestor (TMRCA) between 22-24
Nov 2019, and discarded Pangolins as likely
intermediate host

JMedVirology onlinelibrary.wiley.com
Patients with COVID-19 have experienced mild to severe respiratory illness.

For more information: [www.cdc.gov/COVID19-symptoms](http://www.cdc.gov/COVID19-symptoms)
COVID-19

- It’s important to remember that most cases of COVID-19 are mild
  - 80% of cases are mild to moderate and do not require hospitalization
  - Roughly 20% of cases are severe enough to require medical attention or hospitalization
  - Of that 20%, only 5% of cases may become critically ill and require admission to ICU
Three Patterns of Disease

- Mild Disease and subclinical cases with upper respiratory symptoms
  - 99 y old resident of Kirkland nursing home, infected and cured
  - The 80% with mild disease

- Non-life threatening Pneumonia

- Severe Pneumonia with ARDS

David Heymann & Nahoko Shindo on behalf of WHO Scientific and Technical Advisory Group for Infectious Hazards. Lancet Feb 22 2020
Summary of 72,314 Cases From CCDC
Chinese Center for Disease Control and Prevention

- Disease of Adults
- Age distribution (N = 44,672)
  - ≥80 years: 3% (1,408 cases)
  - 30-79 years: 87% (38,680 cases)
  - 20-29 years: 8% (3,619 cases)
  - 10-19 years: 1% (549 cases)
  - <10 years: 1% (416 cases)
Summary of 72,314 Cases From CCDC
Chinese Center for Disease Control and Prevention

- Spectrum of disease (N = 44,415)
  - Mild: 81% (36,160 cases)
  - Severe: 14% (6,168 cases)
  - Critical: 5% (2,087 cases)

- Case-fatality rate
  - 2.3% (1,023 of 44,672 confirmed cases)
  - 8.0% in patients aged 70-79 years (312 of 3,918)
  - 14.8% in patients aged ≥80 years (208 of 1,408)
  - 49.0% in critical cases (1,023 of 2,087) (amongst the 5% with critical illness)
Summary of 72,314 Cases From CCDC
Chinese Center for Disease Control and Prevention

- Health care personnel infected
  - 3.8% (1,716 of 44,672)
  - 63% in Wuhan (1,080 of 1,716)
  - 14.8% cases classified as severe or critical (247 of 1,668)
  - 5 deaths (Case Fatality Ratio in HCW 0.29%)
Good News: 80+ has > 85% survival

Bad News: 80+ has 75x higher mortality
Summary of 72,314 Cases From CCDC
Chinese Center for Disease Control and Prevention

- No deaths in patients < 9 years of age
- Case fatality Ratio (CFR) by co-morbidities
  - 10.5% Cardiovascular dz
  - 7.3% DM
  - 6.3% Chronic respiratory diseases
  - 6.0% HTN
  - 5.6% CA
- Comorbidities 2-3 x greater mortality
COVID-19 Case Fatality Rates

Varies from study to study

- 2.3% 72,000 cases reported in large Chinese study
- 3.4% WHO estimate on 3/4/2020 (shortly before declaring COVID-19 a pandemic)
- 1.4% in modeling studies including asymptomatic serologic positive cases

- Current state – Globally 4.4%
- Current state – Italy 9.5%
  - Overwhelmed health care system, many elderly patients
- Current state – USA 1.5%
  - Not yet overwhelmed health care system

- Influenza = 0.1%
Clinical Presentation

<table>
<thead>
<tr>
<th>Clinical Feature</th>
<th>Percentage (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>77-98%</td>
</tr>
<tr>
<td>Cough</td>
<td>68-82%</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>31-55%</td>
</tr>
<tr>
<td>Sputum Production</td>
<td>26-56%</td>
</tr>
<tr>
<td>Myalgia</td>
<td>11-52%</td>
</tr>
<tr>
<td>Headache</td>
<td>8-34%</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>2-8%</td>
</tr>
<tr>
<td>Median Age</td>
<td>41-56 years</td>
</tr>
<tr>
<td>Underlying Co-Morbidities</td>
<td>25-51%</td>
</tr>
</tbody>
</table>

- Other less common symptoms: Sore throat, hemoptysis, nausea, abdominal; pain, anorexia. Note LACK of upper respiratory (rhinorrhea, congestion, sinus) symptoms
- Diarrhea and nausea occurred in some patients BEFORE fever and lower respiratory signs and symptoms
<table>
<thead>
<tr>
<th>Study</th>
<th>Diarrhea (N/%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical characteristics of COVID-19 patients with digestive symptoms in Hubei, China: a descriptive, cross-sectional, multicenter study. (204 pts) American Journal of Gastroenterology.</td>
<td>29/14.2%</td>
</tr>
<tr>
<td>Clinical Features of 69 Cases with Coronavirus Disease 2019 in Wuhan, China. (69 pts) CID 3/16/20</td>
<td>10/14%</td>
</tr>
<tr>
<td>Clinical Characteristics of Coronavirus Disease 2019 in China (1099 pts) NEJM 2/28/20</td>
<td>42/3.8%</td>
</tr>
<tr>
<td>Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China (138 pts) JAMA 2/7/2020</td>
<td>14/10.1%</td>
</tr>
<tr>
<td>Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study (99 pts) Lancet 1/29/20</td>
<td>2/2%</td>
</tr>
<tr>
<td>Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. (41 pts) Lancet 1/24/20</td>
<td>1/3%</td>
</tr>
<tr>
<td>TOTAL = 1650</td>
<td>98/5.9%</td>
</tr>
</tbody>
</table>
445 close contacts of first 10 travel-related COVID-19 cases in the USA

Symptomatic secondary attack rate
- All close contacts: 0.45% (95% CI 0.12-1.6%)
- Household contacts: 10.5% (95% CI 2.9-31.4%)

Active Monitoring of Persons Exposed to Patients with Confirmed COVID-19 — United States, January–February 2020

Rachel M. Burke, PhD1; Claire M. Midgley, PhD1; Alissa Dratch, MPH2; Marty Fenstersheib, MD3; Thomas Hauck, MS4; Michelle Holshue, MPH5,6; Isaac Ghinai, MBBS6,7; M. Claire Jarashow, PhD8; Jennifer Lo, MD9; Tristan D. McPherson, MD6,10; Sara Rudman, MD11; Sarah Scott, MD6,12; Aron J. Hall, DVM1; Alicia M. Fry, MD1; Melissa A. Rolfes, PhD1

COVID-19 tested positive for SARS-CoV-2. This yielded a symptomatic secondary attack rate of 0.45% (95% confidence interval [CI] = 0.12–1.6%) among all close contacts, and a symptomatic secondary attack rate of 10.5% (95% CI = 2.9–31.4%) among household members. Both
Figure 2: (A) The proportion of cases having developed symptoms to COVID-19 by days after infection (i.e., the cumulative distribution function of the incubation period). (B) The proportion of cases infected by an index case who have developed symptoms by a given number of days after the day of symptom onset of the index case (i.e., the cumulative distribution function of the serial interval). The maximum-likelihood estimates for the parametric distribution of the cumulative distribution function are shown, along with 1000 parametric bootstrap estimates of the cumulative distribution function. We estimate the median incubation period of COVID-19 is 4.8 days (95%CI, 4.2, 5.4). 5% of the cases who develop symptoms will do so by 1.6 days (95% CI, 1.3, 2.0) after infection, and 95% by 14.0 days (12.2, 15.9). We estimated that the median serial interval of COVID-19 is 5.4 days (95% CI, 4.4 to 6.5). 5% of the infected who develop symptoms will do so by 1.3 days (95% CI, 0.9 to 1.9) after symptom onset of the index case, and in 95% by 14.3 days (95% CI, 11.1 to 17.6).
Clinical Presentation

**Incubation period**
- 2-14 days (2 days fastest reported in family outbreaks)
- Median 5 days
- 95th percentile 12.5 days

**Hospitalization Cases**
- 7 days to hospitalization
- 8 days Dyspnea
- 9 days ARDS (acute Respiratory Distress Syndrome)
- 10.5 days ICU admission

Huang Ch et al, Lancet Feb 15, 2020
Co-infections – Low? Medium? High?

• Sanford data: 49 +COVID, 11 coinfection (22.5%)
  • 4 rhino/entero, 2 RSV, 1 each metapneumovirus, parainfluenza, coronavirus, parainfluenza 1, parainfluenza 3

• China 20 Pediatric infections: 20 +COVID, 8 coinfection (40%)
  • 4 mycoplasma, 2 Flu B, 1 each Flu A, RSV, CMV

• China: in Qingdao 30 +COVID, 24 coinfections (80%) vs in Wuhan 38 +COVID, 1 coinfection (2.65%) (p<0.0001)
  • As measured by IgM serologies

• China: Wuhan 210 +COVID, 1 coinfection (0.6%)
Laboratory Findings

- **Lymphopenia** 42-63%
- Leukopenia 9-25%
- Leucocytosis 24-30%
- Elevated Transaminases 37%

- **Other findings:**
  - Increases LDH
  - Increased D-dimer
  - Thrombocytopenia

- Most patients had normal procalcitonin
Abnormalities on Imaging Studies

**CXR – 14.7%**

**CT Chest – 76.4%**

### Clinical characteristics of 2019 novel coronavirus infection in China

**Radiologic findings**

<table>
<thead>
<tr>
<th>Abnormalities on chest X-ray – No./total No. (%)</th>
<th>162/1099 (14.7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground-glass opacity</td>
<td>55/1099 (5.0)</td>
</tr>
<tr>
<td>Local patchy shadowing</td>
<td>77/1099 (7.0)</td>
</tr>
<tr>
<td>Bilateral patchy shadowing</td>
<td>100/1099 (9.1)</td>
</tr>
<tr>
<td>Interstitial abnormalities</td>
<td>12/1099 (1.1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Abnormalities on chest CT – No./total No. (%)</th>
<th>840/1099 (76.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground-glass opacity</td>
<td>550/1099 (50.0)</td>
</tr>
<tr>
<td>Local patchy shadowing</td>
<td>409/1099 (37.2)</td>
</tr>
<tr>
<td>Bilateral patchy shadowing</td>
<td>505/1099 (46.0)</td>
</tr>
<tr>
<td>Interstitial abnormalities</td>
<td>143/1099 (13.0)</td>
</tr>
</tbody>
</table>
Diagnostic Testing  (evolution over a 1 month period)

• 4 specimens: NP + OP + Sputum + Serum
  • 2 upper respiratory specimens
  • 1 lower respiratory
  • 1 serum
• 3 or 4 specimens: NP + OP + Serum +/- Sputum
• 3 Specimens: NP + OP + Serum
• 2 Specimens: NP + Serum
• 1 Specimen: NP only

(and you wondered why recommendations/guidance kept changing!)
Diagnostic Test

- CDC – Real time reverse transcriptase PCR
- (originally) Specimens:
  - NP
  - OP
  - Sputum
  - Serum
  - 5+ day turn-around-time (TAT)
- Loyola – Abbott labs
  - NP swab only
  - Same day TAT
- Loyola (future) – Cepheid
  - NP swab
  - 1 hr TAT
Criteria for evaluation as PUI
(Person Under Investigation)

• Fever + S&S lower respiratory AND **Wuhan (China)** or close contact with COVID
• Fever + S&S lower respiratory AND **Hubei province (China)** or close contact with COVID
• Fever + S&S lower respiratory AND **mainland China** or close contact with COVID
• Fever + S&S lower respiratory AND **China, South Korea, Italy, Iran, Japan** or close contact with COVID
• Fever + S&S lower respiratory AND **China, South Korea, Italy, Iran, Japan, France, Spain, Germany** or close contact with COVID
• Fever + S&S lower respiratory AND **China, South Korea, Italy, Iran, Japan, France, Spain, Germany, Portugal, Ireland, Norway, Sweden, Iceland, Czechia, Slovakia, Austria, Poland, Greece, Hungary, Switzerland, Lithuania, Latvia, Estonia, Denmark, Netherlands, Belgium, Luxembourg, UK** or close contact with COVID

(and you wondered why recommendations/guidance kept changing!)
Treatment and Vaccines

- No completed clinical trials
- No apparent benefits of steroids
- Multiple candidate therapies
  - See Coronavirus Central for additional details
  - Preliminary evidence
    - Remdesivir
    - Chloroquine phosphate
    - Lopinavir/Ritonavir + Hydroxychloroquine
    - Lopinavir/Ritonavir + Ribavirin
- Several candidate vaccines in development
  - Expected will take > 1-1.5 years
Transmissibility

• Transmissibility = Reproductive Number or R0
• R0 number of new cases generated by each case
• WHO estimates for COVID-19: 1.4-2.5
• 12 published studies:
  • R0 between 1.4 and 6.49
  • Mean 3.28
  • Median 2.79

• Unlike SARS, no established cases of “Super Spreaders” or hypertransmitters
SARS “Hypertransmitters”

FIGURE 2. Probable cases of severe acute respiratory syndrome, by reported source of infection* — Singapore, February 25–April 30, 2003

* Patient 1 represents Case 1; Patient 6, Case 2; Patient 35, Case 3; Patient 130, Case 4; and Patient 127, Case 5. Excludes 22 cases with either no or poorly defined direct contacts or who were cases translocated to Singapore and the seven contacts of one of these cases.

### Reproductive Number (R0) and CFR of other Viral & Historic Diseases

<table>
<thead>
<tr>
<th>Disease or Epidemic</th>
<th>Reproductive Number (Case Fatality Rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measles</td>
<td>12-18 (15%)</td>
</tr>
<tr>
<td>Smallpox</td>
<td>5 (30%)</td>
</tr>
<tr>
<td>SARS</td>
<td>2-5 (15%)</td>
</tr>
<tr>
<td>COVID-19</td>
<td>1.4-3.28 (3.4%)</td>
</tr>
<tr>
<td>1918 Pandemic Influenza</td>
<td>1.80 (2.5%)</td>
</tr>
<tr>
<td>2009 Pandemic H1N1</td>
<td>1.46 (0.4%)</td>
</tr>
<tr>
<td>Seasonal Influenza</td>
<td>1.28 (0.1%)</td>
</tr>
</tbody>
</table>
Ebola: How Contagious & Deadly?
Other Infectious Diseases
How Contagious & Deadly?
Other Infectious Diseases
How Contagious & Deadly?

Estimated range for COVID-19
The coronavirus did not escape from a lab

- The persistent myth SARS-CoV-2 was made by scientists and escaped from a lab in Wuhan or was released by the US in China can be put to bed
  - Comparison of the genome of SARS, MERS and SARS-CoV-2, and the milder “human coronaviruses” HKU1, NL63, OC43 and 229E

- "Our analyses clearly show that SARS-CoV-2 is not a laboratory construct or a purposefully manipulated virus,"
Infection Control Basics

• Hand Hygiene
• Don’t touch your face (done on average 150-200 times/day)
• Clean surfaces (especially high-touch surfaces & stethoscopes)
• Use appropriate PPE
  • Not too much, not too little
  • When needed
  • Correct donning and doffing technique (have someone watch you)
• Stay home if/when you are sick

EPIDEMIC ADD ONs
• Schools, bars, restaurants, social clubs, etc. all shut down
• Social distancing (Distant socializing)
• No travel, no groups > 10 people, telecommuting if possible
Coronavirus Disease 2019 (COVID-19)

- Clean your hands often
- Cover coughs and sneezes
- Avoid close contact
- Wear a facemask if you are sick
- Stay home if you’re sick
- Clean and disinfect
Transmission: Droplet vs. Airborne?

Droplet:
Ebola, Flu,
most other respiratory viruses

Airborne:
COVID-19 ??
Measles, TB
Transmission: Droplet vs. Airborne?

Airborne mainly provoked by aerosol generating procedures (AGP)

Virus isolated from
- Nasopharynx
- Sputum
- Bronchial washings
- Serum
- Feces

Transmission

• Contact
• Droplet
• Airborne mainly with AGP

Stay Tuned:
• Feces
• Asymptomatic shedding
CONTACT + DROPLET + EYE PROTECTION PRECAUTIONS

NO VISITORS WITHOUT PRIOR APPROVAL

STOP

Keep Door Closed

Wash hands upon entering
Use sanitizer or soap & water

Wear an isolation Gown & Gloves when entering

Wear a Regular Face Mask

ONLY STAFF NECESSARY FOR CARE ALLOWED ENTRY TO ROOM

Remove gown, gloves, face mask and wash your hands upon leaving the patient’s room

ELEVATED PRECAUTIONS FOR AEROSOL GENERATING PROCEDURES

EXAMPLES INCLUDE OBTAINING NASAL OR ORAL PHARYNGEAL SWABS, ADMINISTERING NEBULIZER, BIPAP, CPAP, NONINVASIVE HEATED HIGH FLOW NASAL CANNULA DEVICES, INTUBATION

Wear an N95 Face Shield
OR a PAPR

Keep Door Closed

ONLY STAFF NECESSARY FOR PROCEDURE TO BE IN ROOM
Donning & Doffing of PPE

SEQUENCE FOR PUTTING ON PERSONAL PROTECTIVE EQUIPMENT (PPE)

The type of PPE used will vary based on the level of precautions required, such as standard and contact, droplet or airborne respiratory isolation precautions. The procedure for putting on and removing PPE should be tailored to the specific type of PPE.

1. GOWN
   - Fully cover torso from neck to knees, arms to end of wrists, and wrap around the back
   - Fasten back of neck and waist

2. MASK OR RESPIRATOR
   - Secure ties or elastic bands at middle of head and neck
   - Fit flexible band to nose bridge
   - Fit snug to face and below chin
   - Fit-check respirator

3. GOGGLES OR FACE SHIELD
   - Place over face and eyes and adjust to fit

4. GLOVES
   - Extend to cover wrists of isolation gown

USE SAFE WORK PRACTICES TO PROTECT YOURSELF AND LIMIT THE SPREAD OF CONTAMINATION

- Keep hands away from face
- Limit surfaces touched
- Change gloves when turns or heavily contaminated
- Perform hand hygiene

HOW TO SAFELY REMOVE PERSONAL PROTECTIVE EQUIPMENT (PPE)

EXAMPLE 1

There are a variety of ways to safely remove PPE without contaminating your clothing, skin, or mucous membranes with potentially infectious materials. There is one example. Remove all PPE before exiting the patient room except a respirator, if worn. Remove the respirator after leaving the patient room and closing the door. Remove PPE in the following sequence:

1. GLOVES
   - Outside of gloves are contaminated
   - If your hands get contaminated during glove removal, immediately wash your hands or use alcohol-based hand sanitizer
   - Use a gloved hand, grasp the sides of the other gloved hand
   - Hold gloved hand in hand, gently remove the glove from the hand
   - Hold removed glove in gloved hand
   - Slide fingers of ungloved hand under remaining glove at wrist and pull off second glove over first glove
   - Discard gloves in waste container

2. GOGGLES OR FACE SHIELD
   - Outside of goggles or face shield are contaminated
   - If your hands get contaminated during goggles or face shield removal, immediately wash your hands or use alcohol-based hand sanitizer
   - Use a gloved hand and gently remove goggles or face shield from the head by lifting head band or ear pieces
   - If the band is removed, place in designated receptacle for reprocessing. Otherwise, discard in a waste container

3. GOWN
   - Outer front and sleeves are contaminated
   - If your hands get contaminated during gown removal, immediately wash your hands or use alcohol-based hand sanitizer
   - Clean gown, taking care that doves don't contact your body when handling the tie
   - Pull gown away from neck and shoulders, reaching inside of gown only
   - Turn gown inside out
   - Fold or roll into a ball and discard in a waste container

4. MASK OR RESPIRATOR
   - Face of respirator is contaminated — DO NOT TOUCH
   - If your hands get contaminated during mask/respirator removal, immediately wash your hands or use alcohol-based hand sanitizer
   - Remove respirator from mouth, nose, or face
   - Discard in a waste container

5. WASH HANDS OR USE AN ALCOHOL-BASED HAND SANITIZER IMMEDIATELY AFTER REMOVING ALL PPE

PERFORM HAND HYGIENE BETWEEN STEPS IF HANDS BECOME CONTAMINATED AND IMMEDIATELY AFTER REMOVING ALL PPE

EXAMPLE 2

Here is another way to safely remove PPE without contaminating your clothing, skin, or mucous membranes with potentially infectious materials. Remove all PPE before exiting the patient room except a respirator, if worn. Remove the respirator after leaving the patient room and closing the door. Remove PPE in the following sequence:

1. GOWN AND GLOVES
   - Gown and gloves and the outside of gloves are contaminated
   - Grasp the gown in the front and pull away from your body to tuck in the sides, tucking outside of gown only with gloved hand
   - While removing the gown, fold and roll the gown inside out into a handle
   - As you are removing the gown, pull off your gloves after same time, only touching the inside of the gloves and gown with your bare hands. Place the gown and gloves into a waste container

2. GOGGLES OR FACE SHIELD
   - Outside of goggles or face shield are contaminated
   - If your hands get contaminated during goggles or face shield removal, immediately wash your hands or use alcohol-based hand sanitizer
   - Remove goggles or face shield from the head by lifting head band or ear pieces
   - If the item is reusable, place in designated receptacle for reprocessing. Otherwise, discard in a waste container

3. MASK OR RESPIRATOR
   - Front of respirator is contaminated — DO NOT TOUCH
   - If your hands get contaminated during mask/respirator removal, immediately wash your hands or use alcohol-based hand sanitizer
   - Remove respirator from mouth, nose, or face
   - Discard in a waste container

4. WASH HANDS OR USE AN ALCOHOL-BASED HAND SANITIZER IMMEDIATELY AFTER REMOVING ALL PPE

PERFORM HAND HYGIENE BETWEEN STEPS IF HANDS BECOME CONTAMINATED AND IMMEDIATELY AFTER REMOVING ALL PPE
Preparedness Planning Priorities

• Ascertain continuity plans so medical center can stay open and provide care
• Establishing our own capability for testing at an appropriate scale
• Maximizing our stock of supplies (masks, gowns, ventilators if feasible)
• Assessing our isolation capabilities (capacity for airborne precautions patients) and augmenting as able
• Establishing a plan to protect our most at risk patients from virus exposure
• Establishing a plan to minimize staff exposure and infection
• Establish policies for what is to be done if staff members are exposed, suspected sick without clear exposure/travel history, confirmed infected, etc.
COVID-19 Preparedness Response

- Trinity Incident Command
- Loyola Medicine Incident Command
- LUMC Incident Command

- Meeting regularly
  - Twice daily (or more) Loyola IC meetings
  - Daily Trinity COVID-19 Briefing

- Creating resources
  - Coronavirus Central

- Assessing supplies
COVID-19 Preparedness Response

• Providing communication/updates
  • Many lost in translation (deleted and unread emails)
  • Not a consistent message
    • CDC and IDPH recommendations have changed frequently, sometimes on a daily basis
    • Many recommendations contingent on capability (testing) and/or supplies (masks...)

• Visitor restrictions
  • No visitors to acute care
  • Single screened person can accompany patient in ambulatory care (if fails screen will be asked to wait in car)

• Networking with other Chicagoland (and beyond) medical centers

• Preparing surge capacity
  • Cancelation of many routine clinic visits, surgeries, yearly fit testing...

• OBT testing center

• Fever Clinic / ED Annex
COVID-19 Preparedness Response

- COVID Units
  - 4T
  - 4SICU
  - 4PedsICU
  - 4Peds IMC Unit
- Drive by COVID-19 testing
- **COVID-19 Testing capacity**
  - CDC vs DPH/IDPH: 5-7 days. Very limited approval
  - DPH/IDPH: 2-5 days. Very limited approval
  - LabCorp: 3-5 days. Limited approval
  - Viracor: 2-4 days. Limited approval.
  - On site Loyola Testing: 1 day. Increasing approvals (*Abbott* 5-7 hour run)
  - Future on site: Rapid Testing (same day pre-op...) (*Cepheid* 45 min run)
COVID-19 Preparedness Response

• Screening patients prior to clinic appointments and upon entry to medical center, ED, immediate care and clinics...

• Coronavirus Hot Line

• Parada pager ->
  • COVID pager ->
  • ED and hospitalists COVID reviews and approvals (for ED and inpatient)
  • COVID Command / Infection Control (for ambulatory care)

• ED tent for surge capacity for triage and/or testing
Alternatives to face-to-face triage and visits

• Reduce unnecessary healthcare visits and prevent transmission of respiratory viruses in our facility
• Instruct patients to use available advice lines, patient protocols, on-line self-assessment tools, or call and speak with office/clinical staff if they become ill
• Identify staff to conduct telephonic and telehealth interactions with patients. Dev protocols so staff can triage & assess patients quickly
• Determine algorithms to identify which patients can be managed by telephone and advise them to stay home, and which patients need to be sent for emergency care or come to the facility
• Instruct patients that if they have respiratory symptoms they should call before they leave home, so staff can be prepared to care for them when they arrive
• Telemedicine
COVID Exposures, Infection, Leave and RTW

• Recommendations have changed as CDC recs have changed
  • Originally all recs used the 14 day time period, now some recs use a 7 day time period
  • Recommendations also incorporate status if epidemic has big local impact

• Example:
  • Initial recs: Exposure to known or suspected COVID: everyone 14 day furlough
  • Current recs:
    • Suspected COVID: Works with monitoring for symptoms x 14 days or until suspect status is known (then adjust accordingly)
    • Known COVID: Depends on type of exposure; High- or moderate-risk exposure furlough x 14 days (let us know if you develop symptoms), Low-risk exposure will work with monitoring for symptoms

• See Loyola Medicine Announcements/emails and postings on Coronavirus Central for updates.
Strategies to Determine When HCW May Return to Work in Healthcare Settings

• **Test-based strategy.** Exclude from work until
  • Resolution of fever without the use of fever-reducing medications and
  • Improvement in respiratory symptoms (e.g., cough, shortness of breath), and
  • Negative results of an FDA Emergency Use Authorized molecular assay for COVID-19 from at least two consecutive nasopharyngeal swab specimens collected ≥24 hours apart (total of two negative specimens).
  • NOTE: we are NOT using this strategy out of limited testing capacity (needs at least 3 tests/case)

• **Non-test-based strategy.** Exclude from work until
  • At least 3 days (72 hours) have passed since recovery defined as resolution of fever without the use of fever-reducing medications and improvement in respiratory symptoms (e.g., cough, shortness of breath); and,
  • At least 7 days have passed since symptoms first appeared

• But with regard to additional recs when HCW does, in fact, RTW – they do NOT need to wear a mask for an additional 14 days (my bad):
Return to Work Practices and Work Restrictions for HCWs

• After returning to work, HCP should:

• Wear a facemask at all times while in the healthcare facility until all symptoms are completely resolved or until 14 days after illness onset, whichever is longer

• Be restricted from contact with severely immunocompromised patients (e.g., transplant, hematology-oncology) until 14 days after illness onset

• Adhere to hand hygiene, respiratory hygiene, and cough etiquette in CDC’s interim infection control guidance (e.g., cover nose and mouth when coughing or sneezing, dispose of tissues in waste receptacles)

• Self-monitor for symptoms, and seek re-evaluation from occupational health if respiratory symptoms recur or worsen
Re-Use of masks and Re-Processing Masks

- Work in progress
- CDC has given guidelines for re-use of clean, non-contaminated masks
- Paper bags staff can label with their name and store mask
- We and many institutions examining idea of disinfecting (heat, UV light) and re-use of masks

- Much more on coronavirus Central:
  - Manuscripts, posters, guidance for screening, initial evaluation, who to test, How to collect specimen, and much. much more
Summary

- Novel Betacoronavirus, most likely from bats
- COVID-19:
  80% Mild, 15-20% Severe or Critical
  1% Asymptomatic (but may be higher)
  Incubation: 5d (2-24d)
- Most Frequent Symptoms:
  Fever, Cough and Dyspnea
- Complications: ARDS and Shock
- Lab: Lymphopenia
- CT abnormalities in \( \frac{3}{4} \) of hospitalized patients
- Case Fatality Rate: 2.3%-3.4%
  (older adults and those with comorbid conditions)

(to human via mammalian intermediate host)

(maybe less if true number of infected persons proves to be much higher 2/2 asymptomatic cases)
Infection Control Summary

- Hand Hygiene
- Don’t touch your face (done on average 150-200 times/day)
- Clean surfaces (especially high-touch surfaces & stethoscopes)
- Use appropriate PPE
  - Not too much, not too little
  - When needed
  - Correct donning and doffing technique (have someone watch you)
- Stay home if/when you are sick
- Contact + Droplet + Eye protection +/- Airborne (for AGP)
The End