What Churches Need to Know About COVID-19

Frederick Southwick, M.D.
Professor of Medicine
Infectious Diseases
What can happen when someone becomes infected with SARS-CoV-2?
Ms M. is a middle-aged woman who serves as a respiratory therapist at medical facility (not UF Health).

6 days before hospitalization she was exposed to a 3 COVID-19 positive patients while changing tracheostomy tubes (produces aerosols). Only wearing a surgical mask

3 days later she was turned away from Diabetes clinic because of a fever.

4 days after exposure – fever, fatigue, chills, and a dry hacking cough

5 days – walked to the kitchen, became very short of breath O2 sat 83%

6th day admitted – 102.6 F, and O2 sat 88% CXR pneumonia, +PCR, 4L O2

Day 2 hospital – RR 38 O2 sat 88% 100% to MICU, intubated, 70% oxygen pO2 = 74, Required proning to improve oxygenation

Day 3-16 – shock, kidney failure, Day 6 received IV convalescent plasma, 48 hours after improved.

Day 17 extubated, now undergoing rehabilitation for severe weakness
Consequences of her infection

• Acute Respiratory Distress Syndrome
• Shock (BP 70 systolic)
• Renal failure (no urine output)
• She nearly died
• This is not a rare experience. Ask any doctor or nurse in a large metropolitan hospital.
Know the symptoms of COVID-19

1099 patients

Guan NEJM 2020,

Additional symptoms
- Headache
- Nausea and Vomiting
- Diarrhea and Abdominal pain
- Loss of smell and taste
<table>
<thead>
<tr>
<th>Condition</th>
<th>Case Fatality %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Mortality</td>
<td>0.5-3.5 (influenza 0.1)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>7.3</td>
</tr>
<tr>
<td>Hypertension</td>
<td>6.0</td>
</tr>
<tr>
<td>Cardiovascular disease</td>
<td>10.5</td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>6.3</td>
</tr>
<tr>
<td>Obesity</td>
<td>?</td>
</tr>
<tr>
<td>Cancer</td>
<td>5.6</td>
</tr>
</tbody>
</table>
Mortality by age group (Chang Chinese CDC weekly report 2-11-20, image courtesy of Dr. John Brooks CDC USA)
Summary SARS-Cov-2 Clinical Manifestations and Outcome

• Fever, dry cough, shortness of breath, fatigue, myalgias, headache, diarrhea, abdominal pain, loss of smell and taste
• Hypoxia the main medical problem due to ARDS, shock & organ failure can also develop
• Case fatality rate = 0.5-3.5% which is 5-35 x higher than influenza
• Diabetes, HTN, CVD, COPD, Cancer, and Obesity higher mortality
• Age a key risk factor: over age 80 15-25% mortality
What’s Causing This Deadly Disease?
Seven Human Coronaviruses (HCoVs)

Common Coronaviruses (low pathogenicity, viral URIs)
- HCoV-229E
- HCoV-NL63
- HCoV-OC43
- HCoV-HKU1

Other Coronaviruses (higher pathogenicity)
- SARS-CoV - 2004
- MERS-CoV - 2013
- SARS-CoV-2 - 2019

Disease caused by SARS-CoV-2 = COVID-19
(A neutral name without geography to reduce racism & blame)
The Virus

• SARS-CoV-2 is 96.2% identical at the whole-genome level to a bat coronavirus isolate RaTG13

• Related to SARS-CoV 2004

• Bat coronaviruses mutate and chance mutations adapted to humans

• Intermediate mammalian host Pangolin sold at live Chinese markets
Virus Structure

S or surface protein forms Knobs
Tolerates marked mutations
Bind to ACE-2 receptors on bronchial epithelial cells
Bind with high affinity to human cells.
Intracellular virion replicates in the cytoplasm

- Binds human ACE-2 Receptors
- Endocytosed
- RNA replicated using replicase
- Proteins transcribed and assembled in Endoplasmic reticulum
- Nuclear capsid with RNA assembled in cytoplasm
- Viral assembly and vesicle formation
- Exocytosis and release.
Pre-symptomatic

Droplets with virions

24-48 h

From Infectious Diseases: A clinical short course, McGraw-Hill Lange Series 2020
Symptomatic
Droplets
with virions

From Infectious Diseases: A clinical short course, McGraw-Hill Lange Series 2020
How does the virus spread?
Transmission

- Primarily Respiratory Secretions
  - **Droplets** associated with coughing or land on surfaces (survival for hours to days, up to 3 days on stainless steel, plastic).
- Stool – found in stool but difficult to culture, but no cases observed
- Perinatal – not observed

Singing causes aerosols

Estimates 40-60% Asymptomatic
Large gatherings can be very dangerous

Superspreaders: Case 31 South Korea - 1,160 people

This patient had by far the most contacts initially traced by the Korean Center for Disease Control

from REUTERS GRAPHICS
Transmission

- Infected host can infect 2.0-2.7 others ($R_0$) highly infectious
- 10% of close contacts develop the disease
- 80-85% contracted within the family (family clusters)
Initial Point Source Outbreak (Huanan Market)

- Early cases from the market
- Within 10 days the majority were person to person spread outside of the market.
Rapid spread of Covid-19 by symptom onset date and reporting province:

- **December 31, 2019**: 14 counties in 1 province
- **January 10, 2020**: 113 counties in 20 provinces
- **January 20, 2020**: 627 counties in 30 provinces
- **January 31, 2020**: 1,310 counties in 31 provinces
- **February 12, 2020**: 1,605 counties in 31 provinces

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China CDC Weekly 2020; 2:113-122
Daily death tolls are now at their peak or falling in many western countries.
Doubling time slowed in Florida & Alachua County

Florida Cases of 4–27-20

Doubling 12.0 days

Alachua County 4-27

Doubling Time 14.5 days

3-20 2.21 days
Summary SARS-Cov-2 Epidemiology

- Transmission by droplets and fomites (beware of superspreaders)
- Droplets can travel up to 6 ft (sneezes farther), masks for everyone.
- Began as a common source outbreak in a live animal fish market in Huanan, China
- Worldwide cases increased from 1.4 million on April 9th to 7 million
- Rapid intervention is the key to reducing cases (Pandora’s Jar)
- U.S. Leads the world in cases (2 million) and in deaths (110,000)
SARS-CoV-2 Diagnosis and Prevention
Highly Specific
Highly Sensitive (10 virions)
Problem of sampling (70-80% sensitive)

Positive = truly positive
Negative = 20-30% chance false
Role of Antibody testing

- By 7-14 days into infection IgG and IgM antibodies begin to be produced
- Peak antibody production by 28 days
- IgG antibody may persist for years
- A marker for past infection
- Helpful for assessing activity in specific locations
- Assessment of herd immunity
- Probably protective
- Problem of many inaccurate testing kits.

From Assay Genie
COVID-19 VACCINE

- Identify the ideal antigen target
  - S Protein
- What is the best adjuvant?
- Human trials to prove efficacy

MINIMUM 18 months
1. Isolation - All infected individuals avoid contact with others and wear masks - distance maintained over 6 ft.
2. Quarantine - individuals in contact with the infected patient agree to avoid contact with others for 14 days
3. Social distancing of those > 70 yo
4. Social distancing of the entire population
5. Closing of schools and Universities

Imperial College COVID-19 Response Team Report March 16, 2020
Suppression (1-5)
Reduce \( R < 1 \)
Mitigation (1, 2, 4)
Reduce to slow \( R > 1 \)

How do we stop the spread?
Imperial College
COVID-19 Response
Team Report
March 16, 2020

(A) Surge critical care bed capacity

Critical care beds occupied per 100,000 of population

- Do nothing
- Case isolation, household quarantine and general social distancing
- School and university closure, case isolation and general social distancing

No intervention

(B) Magnified view

Critical care beds occupied per 100,000 of population

Suppression (Green)

Mitigation (Orange)

ICU Beds
ILI (% of Physician Visits for ILI)

Total Fever Readings

A. Miller
Clin Inf Dis
2018:67

Kinsa

98.6
Trends in Ro by State

- Better
- Worse

Probability of Ro <1
15% for Florida
Estimate Ro = 1.2

Imperial College Modeling for the U.S.
Increases in mobility increased Ro 1.2
Effects of Mobility on Daily Deaths Due to COVID-19

Mobility unchanged

Moderate Increase 20%

Mobility Increase 40%
Transmission

- Infected host can infect 2.0-2.7 others ($R_o$) highly infectious
- 10% of close contacts develop the disease
- 80-85% contracted within the family (family clusters)
Visualizing Speech-Generated Oral Fluid Droplets with Laser Light Scattering

TO THE EDITOR: Aerosols and droplets generated during speech have been implicated in the person-to-person transmission of viruses, and there is current interest in understanding the mechanisms responsible for the spread of Covid-19 by these means. The act of speaking generates oral fluid droplets that vary widely in size, and these droplets can harbor infectious virus particles. Whereas large droplets fall quickly to the ground, small droplets can dehydrate and linger as "droplet nuclei" in the air, where they behave like an aerosol and thereby expand the spatial extent of emitted infectious particles. We report the results of a laser light-scattering experiment in which speech-generated droplets and their trajectories were visualized.

The output from a 532-nm green laser operating at 2.5-W optical power was transformed into a light sheet that was approximately 1 mm thick and 150 mm tall. We directed this light sheet through slits on the sides of a cardboard box measuring 53 x 46 x 62 cm. The interior of the box was painted black. The enclosure was positioned under a high-efficiency particulate air (HEPA) filter to eliminate dust.

When a person spoke through the open end of the box, droplets generated during speech traversed approximately 50 to 75 mm before they encountered the light sheet. An iPhone 11 Pro video camera aimed at the light sheet through a hole (7 cm in diameter) on the opposite side of the box recorded sound and video of the light-generated droplets and to qualitatively describe the effect of a damp cloth cover over the mouth to curb the emission of droplets.

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Laser Light-Scattering Experiment Showing Speech-Generated Droplets.
Face Shields
• Block droplets
• Comfortable
• Reusable
• You can see her face!
Other preventative measures

- Screen all participants
  - Who should be tested? It depends
  - Syndromic and epidemiology questions
  - Temperature (ideally monitored 2 x daily, scan at entry)
- Gatherings should be as small as possible (50-100 max)
  - 1/50 individuals on average are infected
  - Larger the crowd the more likely it will include infected individuals
- Distancing of 6 ft
- High ceiling rooms, the larger the better.
- Ventilation - bring air from outside in (3 volumes/hour or higher)
- Plastic barriers if area where frequent face to face interactions
- Outside is best! Few documented cases of spread from outside
Zone Approach

- **Red** > 1% of population infected ie > 100/100,000
- **Yellow** < 1% or below 100/100,000
- **Green** < 1/60,000 or 1.7/100,000
Summary SARS-Cov-2 Prevention

- PCR is the test of choice for determining whether or not someone is actively infected
- Ab levels indicate past infection +/- protection
- Vaccine is 18 months away until then nonpharmacologic methods
- Shelter at home reduced the Ro to <1 in Florida temporarily
- Increased movement = increase Ro. Now at 1.2 Rising on West Coast
- Screening with temperature and syndrome inquiry
- Masks or Face Shields for everyone in public closed spaces
- Distancing of 6 ft
- Large high ceiling spaces with good ventilation
- Outdoors when possible.