7:00-7:05 PM – Welcome and introductions
Adam Ratner, New York University

7:05-7:30 PM – COVID-19 in New York City
Mary Foote, NYC Health Department

7:30-8:00 PM – Stewardship in the COVID-19 era
Priya Nori, MD, Montefiore Medical Center

8:00-8:30 PM – COVID-19 immunity and vaccine trials
Mark Mulligan, MD, New York University
UPDATE: COVID-19 IN NEW YORK CITY

Mary Foote, MD, MPH
Senior Health Security Specialist / Health Systems Planning and Strategies Lead (ICS)
NYC Department of Health and Mental Hygiene

July 13, 2020

Disclaimer: Our understanding of COVID-19 is evolving rapidly. This presentation is based on our knowledge as of July 13, 2020.
WHERE WE ARE NOW

• More than 13 million cases and 572,000 deaths due to COVID-19 confirmed worldwide.

• Many U.S. states implementing face covering requirements and other restrictions after seeing increased transmission.

• New York City (NYC) began Phase Three of reopening on July 6.

• Current NYC response strategy: continue suppression measures and monitor impact of reopening.
COVID-19 TRANSMISSION WORLDWIDE

>13 million cases
>572,000 deaths
7/13/20

New York Times. Coronavirus map: tracking the global outbreak
CHANGE IN NUMBER OF NEW CASES IN THE U.S. IN THE PAST TWO WEEKS

7/13/20

CUMULATIVE CASES AND DEATHS, U.S.  
7/9/20

> 3.4 million cases  
(≈26% of confirmed global cases)

> 137,000 deaths  
(≈24% of reported global deaths)

COVID-19, NYC
7/12/20

Figures show number of daily COVID-19 cases, hospitalizations, and deaths

Cumulative counts:
• Cases: 215,924
• Hospitalizations: 55,451
• Confirmed deaths: 18,670
• Probable deaths: 4,613

NYC Health Department. COVID-19: data.
https://www1.nyc.gov/site/doh/covid/covid-19-data.page
DAILY TESTING FOR COVID-19

NUMBER OF PEOPLE TESTED DAILY BY DATE

PERCENT OF PEOPLE WITH POSITIVE RESULTS BY DATE

• During suppression, it will be important to identify and exclude health care personnel (HCP) who have had worksite exposures to COVID-19.

• Prevention of health care exposures must take asymptomatic and presymptomatic transmission of COVID-19 into account.

• In this context, NYC issued Health Advisory #20 with recommendations for HCP on:
  • Personal protective equipment (PPE)
  • Identifying COVID-19 exposures in the workplace
  • Exclusion after a workplace exposure

• Aligned with updated Centers for Disease Control and Prevention (CDC) guidance:

NYC Health Department. Health Advisory #20.
• Everyone entering health care facilities should wear a face covering or mask.

• In addition to masks, the CDC now recommends that all HCPs use eye protection (goggles or a face shield) for all patient encounters.

• N95 respirator or higher should be worn for any procedure that can generate aerosols.
  • Given ongoing N95 shortages in NYC, prioritize respirators for aerosol-generating procedures (e.g., intubation, suctioning, high-flow oxygen, nebulizer) or locations where they often occur (e.g., ICU).

• For evaluation of patients with possible or confirmed COVID-19, clinicians are still advised to use gloves, gown, face mask (or N95 respirator), and eye protection.
• Asymptomatic HCP with a workplace exposure to a patient, visitor, or other HCP with confirmed COVID-19 should be excluded for 14 days.

• Exposure is defined as any of the following:
  • HCP did not wear a face mask/respirator and spent ≥ 15 minutes within 6 feet of a person with confirmed COVID-19.
  • HCP did not wear eye protection and spent ≥ 15 minutes within 6 feet of a person with confirmed COVID-19 who was not wearing a face covering/mask.
  • HCP did not wear all recommended PPE (gloves, gown, N95 respirator, and eye protection) during a procedure that can generate aerosols.

NYC Health Department. Health Advisory #20.  
TEST, TRACE, AND TAKE CARE

- Make COVID-19 testing a part of routine care in all settings.
- Report cases diagnosed using a point-of-care (POC) diagnostic test.
  - Reporting Central or the Provider Access Line 866-692-3641.
- Tell patients to expect a call from Trace if they test positive.
  - Include accurate phone number in lab requisition forms.
- Patients with positive result should isolate for 10 days from start of symptoms or from date of positive result if asymptomatic.
• Contact tracers will interview cases to elicit close contacts and assess need for services (e.g., hotel, meds).
• Trace is required to maintain patient confidentiality.
• Cases and contacts will be monitored daily by phone, text.
• Trace program is not a public benefit under public charge test.
• See Letter to Providers: COVID-19 Test and Trace Corps.
NY STATE GUIDANCE: QUARANTINE AFTER OUT-OF-STATE TRAVEL

- Per NY State Executive Order 205 issued 6/24, restrictions began 6/25.
- Travelers required to quarantine 14 days after leaving states with a seven-day rolling average of:
  - Positive COVID-19 diagnostic test rate > 10/100,000 residents OR > 10%
- As of 7/13: AL, AR, AZ, CA, DE, FL, GA, ID, IA, KS, LA, MS, NV, NC, OK, SC, TN, TX, UT
- Does not apply to passing through a state for <24 hours during travel
- Action taken in conjunction with New Jersey and Connecticut
- Quarantine requirements:
  - Individual must not be in public
  - Self-quarantine from other family members
  - Additional detail available in New York State Guidance
- Travelers will receive phone reminders to quarantine
- Exemptions for first responders and essential workers

**EXEMPTIONS:**
ESSENTIAL WORKERS AND FIRST RESPONDERS

- Exemptions are specified for different duration of travel to NY State:
  - Short term — traveling to NYS for <12 hours
  - Medium term — traveling to NYS for <36 hours
  - Long term — traveling to NYS for >36 hours

- All advised to minimize contact with others, self-monitor for COVID-19 symptoms, wear face covering, observe hand and other hygiene practices.

- Long-term — also advised to
  - Seek diagnostic testing within 24 hours of arrival
  - Maintain social distancing, self-monitoring, expanded hygiene practices ≥ 14 days
  - Avoid extended periods in public or in congregate settings ≥ 7 days

- Additional industry-specific guidance may apply (consult employer).

EXEMPTIONS: HEALTH CARE PERSONNEL

- HCP may return to work within 14 days of travel to a state with significant community spread if furloughing would cause staff shortages that impact operations and HCP:
  - Are asymptomatic.
  - Received COVID-19 diagnostic testing within 24 hours of arrival in New York.
  - Self-monitor twice a day.
  - Receive temperature monitoring and symptom checks at the beginning of each shift, and at least every 12 hours during a shift.
  - Wear a face mask while working.
- HCP should be assigned to patients at low risk of severe complications.
- HCP should maintain self-quarantine when not at work.
- This guidance does not apply to nursing homes.

QUESTIONS?
Antimicrobial Stewardship in the COVID-19 Era

July 13, 2020

Priya Nori, MD
Montefiore/Einstein Antimicrobial Stewardship Program

MontefioreID
BronxASP

http://www.einstein.yu.edu/departments/medicine/divisions/infectious-diseases/antimicrobial-stewardship/
Disclosures & Disclaimers

- No financial disclosures
- *Institution-specific HAI rates during the pandemic (CAUTI, CLABSI, VAEs, etc.) will not be discussed*
  ✓ Local ecology, MDROs and *C. difficile* will be discussed
1. Stewardship & pandemic response
2. Antibiotic use metrics during COVID-19
   - Factors contributing to overuse
3. What is known about COVID-19 and bacterial/fungal co-infections
   - Limited published data
   - Montefiore-specific data
4. NYCDOH COVID-19 antibiogram
What do we expect re: antibiotic use and secondary infections?

Source: https://www1.nyc.gov/site/doh/covid/covid-19-data.page
Stewardship & Recent Pandemics/Outbreaks Affecting NYC

2009 H1N1
- NA inhibitor and vaccine allocation guidelines

2015 Ebola
- Travel screening, isolation protocols
- Rapid diagnosis and treatment of Falciparum malaria

2015 Legionnaire’s
- Diagnostic stewardship of urinary Ag
- Treatment guidelines
- DOH collaboration for molecular typing

2016 Zika
- Diagnostic stewardship of serologic testing and PCR

2019 Measles
- IVIG shortage mitigation and allocation guidelines
COVID-19: Making the Case for Stewardship March 2020

Antimicrobial Stewardship & COVID-19 Preparation/Response

- Collaboration w/ Epidemiology/Infection Prevention
  - Can assist w/ early case identification
  - Assist with communication
  - Opportunity to longitudinally link programs

- Diagnostic Stewardship
  - Coordinate w/ microbiology and Hospital Epidemiology for real-time interpretation of PCR test results

- Treatment
  - Assist in creating treatment guidelines
  - Anticipate & manage drug shortages
  - Assist in completing eIND and local IRB paperwork for emergency use agents (such as Remdesivir)
  - Monitor/enhance compliance w/ local treatment guidelines

Stevens MP, Patel PK, Nori P. ICHE. March 2020
What Happened to Outpatient Antibiotic Prescriptions during COVID-19?

- All-payer pharmacy claims data across 50 states, 2/16 to 4/25/20
- Sharpest declines in prescriptions for amoxicillin (-64%) and azithromycin (-63%)
- *Positive implications for AMR?*

# Inpatient Antimicrobial Utilization (Definitions)

<table>
<thead>
<tr>
<th>Antimicrobial Days of Therapy (DOT)</th>
<th>Number of days in which a patient receives a specific antimicrobial</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Days Present</strong></td>
<td>Number of days in which a patient spent any time in a specific unit or facility</td>
</tr>
<tr>
<td><strong>AU rate</strong></td>
<td>Antimicrobial Days/1000 Days Present</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AU Days Predicted (based on statistical models of nationally aggregated AU data)</th>
<th>Risk-adjusted for hospital bed #, ICU bed #, med school affiliation, location bed size, location type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standardized Antimicrobial Administration Ratio</strong></td>
<td>Observed to Predicted ratio&lt;br&gt;▶ SAAR &gt; 1 : AU higher than predicted&lt;br&gt;▶ SAAR &lt; 1 : AU lower than predicted</td>
</tr>
</tbody>
</table>

*All AU slides courtesy of K. Cowman*
ED CAP Coverage

Ceftriaxone

[Graph showing trends in Ceftriaxone usage over time, with different lines representing different EDs like DHAM ED, Weiler ED, and others.]

Montefiore

Albert Einstein College of Medicine

7/13/2020
“Atypical” Coverage
Piperacillin-tazobactam

Facility-wide Inpatient

<table>
<thead>
<tr>
<th></th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Patients initiated</td>
<td>1025</td>
<td>964</td>
<td>1072</td>
<td>1285</td>
<td>784</td>
</tr>
<tr>
<td>Average days of therapy per patient</td>
<td>3.78</td>
<td>3.84</td>
<td>3.58</td>
<td>3.82</td>
<td>3.89</td>
</tr>
</tbody>
</table>
Vancomycin

Facility-wide Inpatient

### IV Vancomycin

<table>
<thead>
<tr>
<th></th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Patients initiated</td>
<td>1453</td>
<td>1317</td>
<td>1416</td>
<td>1413</td>
<td>929</td>
</tr>
<tr>
<td>Average days of therapy per patient</td>
<td>2.62</td>
<td>2.73</td>
<td>2.45</td>
<td>2.51</td>
<td>2.62</td>
</tr>
</tbody>
</table>
### Ceftriaxone

#### Facility-wide Inpatient

<table>
<thead>
<tr>
<th># of Patients initiated</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1906</td>
<td>1598</td>
<td>2088</td>
<td>2167</td>
<td>1011</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average days of therapy per patient</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.73</td>
<td>2.67</td>
<td>2.67</td>
<td>2.67</td>
<td>2.71</td>
</tr>
</tbody>
</table>

Albert Einstein College of Medicine
HANYS AU Dashboard by NYS Region

Piperacillin-Tazobactam

Ceftriaxone
Patient and Provider Factors Contributing to Antibiotic Overuse

• Severe COVID-19 indistinguishable from traditional sepsis and septic shock
  > Unstable hemodynamics, elevated inflammatory markers, persistent fevers, impressive CXRs
• HCW strain, fatigue, fear of the unknown
  > Deployment of non-traditional staff/staffing ratios
• Rationing of PPE and time spent with patients
  ➢ We did not experience shortages of most broad-spectrum antimicrobials
## How Did This Happen?

<table>
<thead>
<tr>
<th>Pre-Pandemic</th>
<th>Pandemic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prospective audit &amp; feedback</td>
<td>ASP staff diverted to other functions (testing, clinical trials, EAP, EUA, etc.)</td>
</tr>
<tr>
<td>Formulary restrictions</td>
<td>Relaxed/lifted</td>
</tr>
<tr>
<td>NHSN AU submission</td>
<td>On hold</td>
</tr>
<tr>
<td>AU risk adjustment – ICU vs. Ward</td>
<td>Totally in flux</td>
</tr>
<tr>
<td>Education</td>
<td>On hold, then by zoom</td>
</tr>
<tr>
<td>Clinical pathways</td>
<td>COVID-19 Abx guidelines created in May 2020 as pandemic was winding down</td>
</tr>
</tbody>
</table>

What is Known about Super-infections and COVID-19?

- Risk factors\(^1\): severe COVID-19, prolonged hospital exposure, critical illness, intubation, indwelling catheters, combination antibiotic therapy, corticosteroids, IL-6 inhibition\(^2\), DM
- <10% of total hospitalized population\(^3\)
- Potentially terminal events\(^4\)
- Pathogenic organisms reported are often hospital-acquired/multi-drug resistant like SARS-1, MERS\(^3\)
- IDSA EIN Survey, May 11-June 3, 2020:
  > 214 physicians responded that superinfections are rarely (42%) or occasionally (44%) observed; predominantly while on mechanical/assisted ventilation (76%)

---

2. Lucas M Kimmig et al. IL6 inhibition in critically ill COVID-19 patients is associated with increased secondary infections. doi: https://doi.org/10.1101/2020.05.15.20103531
Letter to the Editor

Bacterial and fungal co-infection in individuals with coronavirus: A rapid review to support COVID-19 antimicrobial prescribing

Coronavirus Disease 2019, Superinfections, and Antimicrobial Development: What Can We Expect?
 MMC Experience

• Astute frontline ID clinicians observed clusters of co-infections in surge ICUs (including MDROs)

• **Objective**: to characterize patient factors and microbiology of bacterial and fungal co-infections at our medical center with a focus on clinical outcomes, antimicrobial use and resistance (AMR)

• Retrospective observational study of all COVID-19 patients admitted **March 1, 2020 - April 18, 2020** to MMC
  > Excluded contaminants
  > True infections only (all cases reviewed by ID specialist)
### Demographics

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Distinct Patients (N=152/4267; 3.6%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>% or IQR</td>
</tr>
<tr>
<td>Age, years, median (IQR)</td>
<td>62</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>63</td>
</tr>
<tr>
<td>Male</td>
<td>89</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>48</td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td>60</td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td>11</td>
</tr>
<tr>
<td>Asian</td>
<td>9</td>
</tr>
<tr>
<td>Other</td>
<td>12</td>
</tr>
<tr>
<td>Unknown</td>
<td>12</td>
</tr>
</tbody>
</table>
## Outcomes of Co-Infections at MMC

<table>
<thead>
<tr>
<th>Culture Source</th>
<th>N</th>
<th>% or IQR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood only</td>
<td>61</td>
<td>40%</td>
</tr>
<tr>
<td>Respiratory only</td>
<td>70</td>
<td>46%</td>
</tr>
<tr>
<td>Both blood and respiratory</td>
<td>21</td>
<td>14%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comorbidities</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Charlson Score</td>
<td>2</td>
<td>1-4</td>
</tr>
<tr>
<td>Immunocompromised*</td>
<td>84</td>
<td>55%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COVID-19 Medications</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Biologics**</td>
<td>26</td>
<td>17%</td>
</tr>
<tr>
<td>Acute steroid use</td>
<td>44</td>
<td>29%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcomes</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of stay, days</td>
<td>13</td>
<td>6-21</td>
</tr>
<tr>
<td>Still admitted at time of analysis</td>
<td>42</td>
<td>28%</td>
</tr>
<tr>
<td>Discharged alive</td>
<td>24</td>
<td>16%</td>
</tr>
<tr>
<td>Deceased</td>
<td>86</td>
<td>57%</td>
</tr>
</tbody>
</table>

*Immunocompromised = diabetes, HIV, hepatitis C, active malignancy, organ transplant, rheumatologic disease, or chronic receipt of immunosuppressive medications.

**Anakinra, Sarulimab, Tocilizumab, Leronlimab, through randomized clinical trial or compassionate use
## (+) Respiratory and Blood Cultures

<table>
<thead>
<tr>
<th></th>
<th>Respiratory N=91</th>
<th>Blood N= 82</th>
</tr>
</thead>
<tbody>
<tr>
<td>N % or IQR</td>
<td>N % or IQR</td>
<td></td>
</tr>
<tr>
<td>Time between (+) culture and</td>
<td>6 2-8</td>
<td>7 3-14</td>
</tr>
<tr>
<td>SARS-CoV-2 PCR, days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients with (+) culture</td>
<td>4 4%</td>
<td>17 22%</td>
</tr>
<tr>
<td>prior to (+) SARS-CoV-2 PCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients with positive</td>
<td>2 2%</td>
<td>22 26%</td>
</tr>
<tr>
<td>culture and SARS-CoV-2 PCR,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>same day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multidrug-resistant</td>
<td>17 19%</td>
<td>7 9%</td>
</tr>
<tr>
<td>organism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number w/ CVC</td>
<td>-</td>
<td>44 54%</td>
</tr>
</tbody>
</table>
CONS bacteremias increased >2x in this timeframe

<table>
<thead>
<tr>
<th>Source</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal</td>
<td>6</td>
<td>7%</td>
</tr>
<tr>
<td>Genitourinary</td>
<td>7</td>
<td>9%</td>
</tr>
<tr>
<td>Catheter</td>
<td>19</td>
<td>23%</td>
</tr>
<tr>
<td>Respiratory</td>
<td>11</td>
<td>13%</td>
</tr>
<tr>
<td>Oral pharyngeal</td>
<td>2</td>
<td>2%</td>
</tr>
<tr>
<td>Skin</td>
<td>5</td>
<td>6%</td>
</tr>
<tr>
<td>Multiple sources</td>
<td>25</td>
<td>30%</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>2%</td>
</tr>
<tr>
<td>Unknown</td>
<td>5</td>
<td>6%</td>
</tr>
</tbody>
</table>
## Clinical Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Respiratory*</th>
<th>Blood*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Care Admission</td>
<td>85</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>93%</td>
<td>40%</td>
</tr>
<tr>
<td>Ward Admission Only</td>
<td>6</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>7%</td>
<td>48%</td>
</tr>
<tr>
<td><strong>Intubated</strong></td>
<td><strong>86</strong></td>
<td><strong>46</strong></td>
</tr>
<tr>
<td></td>
<td><strong>95%</strong></td>
<td><strong>56%</strong></td>
</tr>
<tr>
<td>Max Lab Values, median</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WBC, k/uL</td>
<td>20.6</td>
<td>15.7</td>
</tr>
<tr>
<td></td>
<td>15.9-29.7</td>
<td>10.9-24.7</td>
</tr>
<tr>
<td>CRP, mg/dL</td>
<td>31.2</td>
<td>19.3</td>
</tr>
<tr>
<td></td>
<td>20.9-41.8</td>
<td>0-37.3</td>
</tr>
<tr>
<td>PCT, ng/mL</td>
<td>1.9</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>0.4-10.9</td>
<td>0-9.9</td>
</tr>
<tr>
<td>Outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Length of stay, days</strong></td>
<td><strong>15</strong></td>
<td><strong>12</strong></td>
</tr>
<tr>
<td></td>
<td><strong>9-21</strong></td>
<td><strong>3-24</strong></td>
</tr>
<tr>
<td>Still admitted</td>
<td>30</td>
<td>23</td>
</tr>
<tr>
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<td>17</td>
</tr>
<tr>
<td></td>
<td>9%</td>
<td>21%</td>
</tr>
<tr>
<td><strong>Deceased</strong></td>
<td><strong>53</strong></td>
<td><strong>42</strong></td>
</tr>
<tr>
<td></td>
<td><strong>58%</strong></td>
<td><strong>51%</strong></td>
</tr>
</tbody>
</table>

*percent or IQR
Microorganism Summary
**blaNDM, class B Carbapenemase-Producing *E. cloacae*: Bad Bugs… Still No Drugs**

<table>
<thead>
<tr>
<th></th>
<th>Patient 1</th>
<th>Patient 2</th>
<th>Patient 3</th>
<th>Patient 4</th>
<th>Patient 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td>Female</td>
<td>Male</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td>68</td>
<td>57</td>
<td>63</td>
<td>63</td>
<td>54</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td>Black/African American</td>
<td>Hispanic/Latino</td>
<td>Black/African American</td>
<td>Hispanic/Latino</td>
<td>Hispanic/Latino</td>
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<tr>
<td><strong>NDM risk factors</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Blood culture d0</strong></td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td><strong>blaNDM, class B carbapenemase gene confirmation</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>Deceased day 34</td>
<td>Deceased day 24</td>
<td>Deceased day 6</td>
<td>Deceased day 39</td>
<td>Discharged to chronic vent facility day 44, then readmitted</td>
</tr>
</tbody>
</table>

---

**Table Note:**

- Blood culture d0: Day 0 blood culture results.
- NDM risk factors: Presence of non-NDM risk factors.
- Outcome: Days until resolution or death.
### Microorganisms and Antibiotics

<table>
<thead>
<tr>
<th>Microorganisms</th>
<th>Intubation &amp; CVC</th>
<th>Preceding Abx</th>
<th>Targeted Abx</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. albicans (peritoneal fluid and urine - catheter)</td>
<td>Y</td>
<td>Ceftriaxone Doxycycline Ampicillin Micafungin Fluconazole Piperacillin-tazobactam</td>
<td>Tigecycline*** Ceftazidime-Avibactam Aztreonam</td>
</tr>
<tr>
<td>C. albicans, E. faecalis, S. epi (blood)</td>
<td>Y</td>
<td>Azithromycin Ceftriaxone Vancomycin Piperacillin-tazobactam Gentamicin Fluconazole</td>
<td>Tigecycline***</td>
</tr>
<tr>
<td>C. albicans (blood)</td>
<td>Y</td>
<td>Ceftriaxone Azithromycin Vancomycin Cefepime Piperacillin-tazobactam</td>
<td>Tigecycline*** + Gentamicin</td>
</tr>
<tr>
<td>CR E. cloacae (respiratory)</td>
<td>Y</td>
<td>Vancomycin Piperacillin-tazobactam Cefepime Micafungin</td>
<td>Ceftazidime-Avibactam Aztreonam</td>
</tr>
<tr>
<td>CR E. cloacae (blood)</td>
<td>Y</td>
<td>Ceftriaxone Doxycycline Piperacillin-tazobactam Vancomycin Cefoxitin Linezolid</td>
<td>Tigecycline*** Gentamicin Aztreonam Ceftazidime-Avibactam</td>
</tr>
<tr>
<td>CR K. pneumoniae** (blood)</td>
<td>Y</td>
<td>CR E. cloacae (resp)</td>
<td>MSSA (resp)</td>
</tr>
<tr>
<td>E. aerogenes x 2* (blood)</td>
<td>Y</td>
<td>CR E. cloacae (blood)</td>
<td>C. koseri (resp)</td>
</tr>
<tr>
<td>CR E. cloacae (Resp)</td>
<td>Y</td>
<td>CR E. cloacae (blood)</td>
<td>CR E. cloacae, P. aeruginosa (resp)</td>
</tr>
<tr>
<td>S. capitis (blood)</td>
<td>Y</td>
<td>CR E. cloacae (resp)</td>
<td>CR E. cloacae (urine – catheter)</td>
</tr>
<tr>
<td>CR E. cloacae (Resp)</td>
<td>Y</td>
<td>CR E. cloacae (blood)</td>
<td>CR E. cloacae &amp; VRE (urine – catheter)</td>
</tr>
<tr>
<td>CR E. cloacae &amp; MRSA (resp)</td>
<td>Y</td>
<td>CR E. cloacae &amp; MRSA, S. marcescens (resp)</td>
<td>E. cloacae (blood)</td>
</tr>
</tbody>
</table>

### Notes
- **blaNDM as part of Polymicrobial Infection**
- **Targeted Abx**
  - Tigecycline***
  - Ceftazidime-Avibactam Aztreonam

### Antibiotics
- Ceftriaxone
- Doxycycline
- Ampicillin
- Micafungin
- Fluconazole
- Piperacillin-tazobactam
- Azithromycin
- Ceftriaxone
- Vancomycin
- Piperacillin-tazobactam
- Gentamicin
- Fluconazole
- Ceftriaxone
- Azithromycin
- Vancomycin
- Cefepime
- Piperacillin-tazobactam
- Vancomycin
- Piperacillin-tazobactam
- Cefepime
- Micafungin
- Ceftazidime-Avibactam
- Aztreonam
- Tigecycline***
- Gentamicin
- Aztreonam
- Ceftazidime-Avibactam
## Antibiogram: *S. aureus*

<table>
<thead>
<tr>
<th>Organism</th>
<th>Number of Isolates</th>
<th>Cefazolin</th>
<th>Clindamycin</th>
<th>Gentamicin</th>
<th>Tetracycline</th>
<th>Trimethoprim-Sulfamethoxazole</th>
<th>Vancomycin</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/1 to 4/23/2020</td>
<td>151</td>
<td>65</td>
<td>71</td>
<td>97</td>
<td>91</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td><strong>Staphylococcus aureus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2018-2019 pan-ICU</td>
<td>279</td>
<td>60</td>
<td>69</td>
<td>96</td>
<td>91</td>
<td>93</td>
<td>100</td>
</tr>
</tbody>
</table>
## Antibiogram: Gram Negatives

<table>
<thead>
<tr>
<th>Year</th>
<th>Organism</th>
<th>#</th>
<th>Amikacin</th>
<th>Aztreonam</th>
<th>Cefepime</th>
<th>Ceftriaxone</th>
<th>Cipro</th>
<th>Gentamicin</th>
<th>Meropenem</th>
<th>Pip/Tazo</th>
<th>Tobramycin</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020 (March 1 to April 23)</td>
<td><strong>P. aeruginosa</strong></td>
<td>75</td>
<td>77</td>
<td>72</td>
<td>89</td>
<td>90</td>
<td>99</td>
<td>93</td>
<td>75</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>E. cloacae</strong></td>
<td>18</td>
<td>100</td>
<td>36</td>
<td>71</td>
<td>38</td>
<td>82</td>
<td>86</td>
<td>82</td>
<td>38</td>
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<tr>
<td></td>
<td><strong>E. coli</strong></td>
<td>53</td>
<td>100</td>
<td>69</td>
<td>77</td>
<td>69</td>
<td>66</td>
<td>82</td>
<td>100</td>
<td>63</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td><strong>K. pneumoniae</strong></td>
<td>42</td>
<td>91</td>
<td>58</td>
<td>56</td>
<td>56</td>
<td>82</td>
<td>73</td>
<td>87</td>
<td>54</td>
<td>87</td>
</tr>
<tr>
<td>2018-2019 pan-ICU</td>
<td><strong>P. aeruginosa</strong></td>
<td>145</td>
<td>100</td>
<td>68</td>
<td>87</td>
<td>82</td>
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<td>78</td>
<td>72</td>
<td>99</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>E. cloacae</strong></td>
<td>86</td>
<td>100</td>
<td>91</td>
<td>80</td>
<td>58</td>
<td>85</td>
<td>86</td>
<td>93</td>
<td>59</td>
<td>83</td>
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<tr>
<td></td>
<td><strong>E. coli</strong></td>
<td>311</td>
<td>99</td>
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<td>75</td>
<td>59</td>
<td>88</td>
<td>99</td>
<td>73</td>
<td>87</td>
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<tr>
<td></td>
<td><strong>K. pneumoniae</strong></td>
<td>255</td>
<td>96</td>
<td>77</td>
<td>80</td>
<td>77</td>
<td>84</td>
<td>91</td>
<td>97</td>
<td>75</td>
<td>87</td>
</tr>
</tbody>
</table>
NYCDOH COVID-19 Antibiogram

• **Background**: collaboration between NYC health systems’ ASPs, microbiology labs, and DOH

• **Project goal**: 
  > Describe antimicrobial susceptibility changes that have occurred due to COVID (pre, pandemic peak, post)
  > Develop a treatment tool for more rational antibiotic prescribing in NYC

• **Pathogen selection**: top 5-6 pathogens (GP, GN, yeast) from respiratory and blood cultures
  > Stratified by ED vs. inpatient, inclusive of multiple isolates per patient to capture AMR and polymicrobial infections
Decrease in CDI counts despite prolonged hospitalizations, widespread antibiotic and steroid exposures, patient/staff cohorting & shared equipment

- True decrease in CDI or decrease in testing?
- Diagnostic confusion with COVID-19 associated diarrhea

Heightened hand hygiene awareness balanced with stewardship and infection prevention pitfalls

## Summary: COVID-19 Stewardship Contributions

<table>
<thead>
<tr>
<th>Function</th>
<th>Example</th>
</tr>
</thead>
</table>
| Diagnostic stewardship                            | • Testing workflows  
• Stewarding “expedited testing”  
• Interpretive criteria for serology and Ct values in clinical context |
| Shortage mitigation                                | • Prior authorization for antimicrobials, corticosteroids, HCQ, etc.     |
| Experimental treatment protocols (EUA or compassionate use) | • Remdesivir, IL-6 inhibitors, Plasma  
| Screening for clinical trials                     | • Plasma, Remdesivir, IL-6 inhibitors, etc.                             |
| Clinical pathway development                       | • COVID-19 empiric antibiotic guidelines                                |
| Monitoring toxicities                              | • HCQ +/-azithromycin, excess antibiotics                               |
| Communication/messaging                            | • Drug shortages, infection clusters & co-infections, AMR              |
• Role of stewardship in pandemic response is abundantly clear:
  > What we do best: raising the flag and alarming clusters and susceptibility patterns, communication & dissemination of information, sharing of ideas and data, harnessing pre-existing close relationships with other stewardship programs and the DOH
  > At what cost: pre-authorization, prospective audit & feedback of excesses, late creation of guidelines
Remaining Questions

- Are secondary infections terminal events?
  - Yes, must assess outcomes (mortality, LOS, need for chronic ventilatory support) in patients who did not have culture confirmed nosocomial infection but were equally ill.

- Does elevated procalcitonin predict secondary infection independent of its role as an inflammatory biomarker in COVID-19?
Acknowledgements

- **NYCDOHM & IDSNY** (Dr. Josh Nosanchuk)
- **Department of Pathology**: Wendy Szymczak, Phil Gialanella
- **Department of Pharmacy**: Mark Sinnet, Frank Sosnowski
- **IPC**: Jamie Figueredo, Ruchi Jain, Greg Weston, Inessa Gendлина, Marilou Corpuz, Meg Aldrich, Theresa Madaline
- **ID Division** lead by Liise-anne Pirofski
- **ID Fellows**
- **Department of Medicine**
- **Drs. Dana Mazo (Mount Sinai) and Matt Simon (NYP Cornell)**
References

- Lucas M Kimmig, David Wu, Matthew Gold, Natasha N Pettit, David Pitrak, Jeffrey Mueller, Aliya N Husain, Ece A Mutlu, View Gokhan M Mutlu. IL6 inhibition in critically ill COVID-19 patients is associated with increased secondary infections. doi: https://doi.org/10.1101/2020.05.15.20103531
- Cornelius J Clancy, M Hong Nguyen, Coronavirus Disease 2019, Superinfections, and Antimicrobial Development: What Can We Expect?, Clinical Infectious Diseases. , ciaa524, https://doi.org/10.1093/cid/ciaa524
NYU Grossman School of Medicine
COVID-19 IMMUNITY AND VACCINE TRIALS

Mark J. Mulligan, MD, FIDSA
Director, NYU Langone Vaccine Center
IDSNY & NYCDHMH WEBINAR, July 13, 2020
Outline

- Conflicts of Interest
- Immunity
- Vaccine Trials
- Acknowledgements

Not: monoclonal antibodies, convalescent plasma
Potential Conflicts of Interest

• USG/HHS/NIH/NIAD RESEARCH GRANT FUNDING
  – VACCINE AND TREATMENT EVALUATION UNIT (VTEU)
  – ASTRAZENECA (OXFORD) COVID-19 VACCINE TRIAL
  – LILLY SARS-COV-2 MAB EFFICACY TRIAL, PROPHYLAXIS IN NURSING HOMES
  – REGENERON SARS-COV-2 MAB EFFICACY TRIAL, PROPHYLAXIS IN HOUSEHOLDS

• USG/HHS/BARDA FUNDING
  – COVID SPECIMENS FOR MEDICAL COUNTERMEASURES

• PFIZER RESEARCH FUNDING
  – PHASE 1-2 COVID-19 MRNA VACCINE TRIAL

• LILLY RESEARCH FUNDING
  – SARS-COV-2 MAB NEUTRALIZATION POTENCY VS LIVE SARS-COV-2
  – SARS-COV-2 MAB PHASE 1 SAFETY AND EFFICACY TRIAL

• SANOFI RESEARCH FUNDING
  – VERO CELL GROWN YELLOW FEVER VIRUS VACCINE CLINICAL TRIAL

• MEISSA VACCINES, INC SCIENTIFIC ADVISORY BOARD GUEST, SARS-COV-2 VACCINE
The Virus
NYU Grossman School of Medicine

Funk at al., *Front. Pharmacol.*, 19 June 2020

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**SARS-CoV-2**

1. Virus enters oral + respiratory cells
2. Virus enters epithelium
3. Virus fuses with vesicle and its RNA is released
4. Virus assembly
5. Virus release
6. Virus ingested by antigen-presenting cell (APC)

**Immune response**

- Infected cells destroyed
- Antibodies produced
- Memory B cells and T cells created

- Anti-SARS-CoV-2 antibody
SARS-CoV-2 S1-specific antibody by isotype in ELISA

Immunity - Acute Ab response, 2 patients, first 3 weeks

NYU-VC-005

NYU-VC-006

Immunity – duration of binding Ab

13 Convalescent Patients – first six weeks

SARS-CoV-2 S1-specific antibody by isotype in ELISA

Immunity – duration of binding Ab

13 Convalescent Patients – next six weeks

SARS-CoV-2 S1-specific antibody by isotype in ELISA

Target of Ab

Spike Protein, S

Amanat et al., *Nat Med*, 2020
Immunity – development of long-lasting memory

Memory B cell Responses

- COVID-19 Covalescent
- COVID-19 Asymptomatic
- Healthy Controls
- Influenza Patients
Live virus neutralization assay

48 hr neutralization assay
SARS-Cov-2 mNeon green (Xie et al., Cell Host & Microbe, 2020)

<table>
<thead>
<tr>
<th>Dilution</th>
<th>1/20</th>
<th>1/40</th>
<th>1/80</th>
<th>1/160</th>
<th>1/320</th>
<th>1/640</th>
<th>1/1280</th>
<th>1/2560</th>
<th>1/5120</th>
<th>1/10240</th>
<th>1/20480</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NLV-2-V1</strong> DPO 28</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
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<td><strong>NLV-2-V2</strong> DPO 53</td>
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<td><img src="image13.png" alt="Image" /></td>
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<td><img src="image21.png" alt="Image" /></td>
<td><img src="image22.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>NLV-1 V1</strong> Positive control</td>
<td><img src="image23.png" alt="Image" /></td>
<td><img src="image24.png" alt="Image" /></td>
<td><img src="image25.png" alt="Image" /></td>
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<td><img src="image31.png" alt="Image" /></td>
<td><img src="image32.png" alt="Image" /></td>
<td><img src="image33.png" alt="Image" /></td>
</tr>
</tbody>
</table>

**ELISA Binding Ab vs S1**

<table>
<thead>
<tr>
<th></th>
<th>NLV-</th>
<th>DPO</th>
<th>IgM</th>
<th>IgG</th>
<th>IgA</th>
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</thead>
<tbody>
<tr>
<td>2 - V1</td>
<td>28</td>
<td>1817</td>
<td>12786</td>
<td>3209</td>
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<tr>
<td>2 - V2</td>
<td>53</td>
<td>723</td>
<td>13890</td>
<td>1762</td>
<td></td>
</tr>
</tbody>
</table>
Immunity - Duration

Long et al., *Nat Med*, 2020
Pre-existing immunity (from seasonal coronaviruses)

- T cell reactivity against SARS-CoV-2 was observed in unexposed people; however,
- the source and clinical relevance of the reactivity remains unknown.
  - Lymphocytes from 20–50% of unexposed donors display significant reactivity to SARS-CoV-2 antigen peptide pools
  - Non-spike > spike
  - CD4 > CD8
- It is speculated that this reflects T cell memory to circulating ‘common cold’ coronaviruses.
  - HCoV-OC43, HCoV-HKU1, HCoV-NL63 and HCoV-229E
- It will be important to define specificities of these T cells and assess their association with COVID-19 disease severity and vaccine responses.

Grifoni et al., Cell, 2020; Sette and Crotty, Nat Rev Imm, 2020; 3 preprints
SKETCHPAD

PHASE TWO

By Jason Adam Katzenstein
Platforms, Immunogens, moving fast

**PLATFORMS**

- Genetic – flexible, rapid, scalable
  - RNA – 1) 3/16/20 first vaccination → press release, 5/18/20 → *NEJM*, in press 7/10/20; 2) 5/4/20 → 7/1 preprint; Revision submitted
  - DNA – 4/3/20 → press release June

- Recombinant viral vector
  - Adenovirus – non-replicating
    - Chimpanzee Ad
    - Ad26
    - Ad5 – 3/16/20 first vaccination → *Lancet* 5/22/20; E1 and E3 deleted
  - VSV; RSV; replicating

- Subunit protein + Adjuvant

- Whole killed viral vaccine – chemically inactivated viral particles – Sinovac, *Science*, 5/5/20, 3 doses in macaques

**IMMUNOGENS**

- S, full-length spike (S1 + S2)
- RBD, receptor-binding domain of spike – NAB target
- other
Over 100 Vaccine Candidates in Development

A. Vaccine Platforms
- DNA
- RNA (+ LNP's)
- Protein-based (e.g. Spike)

B. Vaccine Candidates
- 14 Viral vector (replicating)
- 12 Other
- 10 DNA
- 20 RNA
- 16 Non-replicating
- 8 Inactivated
- 3 Live attenuated
- 44 Protein-based

Funk at al., *Front. Pharmacol.*, 19 June 2020
rAd-5 viral vector, Spike, single IM injection, 3 dose levels - $5 \times 10^{10}$, $1 \times 10^{11}$, $1.5 \times 10^{11}$ viral particles

Appeared safe, dose-dependent vaccine reactions, generally well tolerated.
A.E.s: fever, fatigue, headache, and muscle pain.

*Lancet* 2020; 395: 1845–54
ICS Assay for Peptide-specific CD4+ or CD8+ T cells

- Limitations of this work
  - Interim report
  - No placebo group
  - Short follow up: day 28 - ? duration
  - Pre-existing immunity, dampens immune response
  - Likely need for a booster
    - Response magnitudes low?
    - Relative to convalescent patients?
  - Choice of rAd5: When used as a vector for vaccination against HIV in humans, common pre-existing immunity to the vector was one factor associated with increased HIV acquisition

*Lancet* 2020; 395: 1845–54
Modern – NIAID mRNA - S

- stabilized spike protein – pre-fusion
- a genetic platform called mRNA (messenger RNA)
- Lipid nanoparticle
- Although RNA-based vaccines are easy to develop, none has ever been licensed.
- Has shown promise in animal model
  - prevented viral replication in the lungs of mice challenged with SARS-CoV-2
- 3/16/20 first vaccination (L Jackson, KPWRHI, Seattle; VTEU, IDCRC)
- 2 IM injections, D1 and D29
  - 25, 100, or 250 mcg

- Phase 1: press release 5/18/20
  - With 2 doses of 25 or 100 mcg, all pts made binding Ab; 8/8 made NAB
    - Magnitudes similar to convalescent patients
    - At D43, two weeks post second dose
    - At 250mcg, 3 severe reactions (of 12 pts)
      - Post second dose

- Phase 2: fully enrolled, 300 younger and 300 older adults (press release 7/8/20)
  - two vaccinations of mRNA-1273 given 28 days apart. Each participant is receiving placebo, a 50 μg or a 100 μg dose at both vaccinations.

- Phase 3: start in July expected; manufacturing completed; 30,000 ppts, 100mcg, 1:1 randomization with placebo
AstraZeneca ChAdOx1

- Developed at Oxford University’s Jenner Institute and licensed to AstraZeneca
- Non-replicating chimpanzee adenovirus expressing the spike
- Preclinical: protected macaques against lung disease - Single dose – 6 vaccinated c/w 3 controls; nasal no change (preprint)
  - In pigs, NAB boosted with second dose

- Phase 1: UK

- Phase 2: UK
  - The Oxford team has already enrolled more than 1,000 people in its UK trial

- Phase 3: US CoVPN - start in August expected; protocol not finalized; 30,000 pts, 2 doses likely
- Brazil: phase 3
Phase 1/2 Study to Describe the Safety and Immunogenicity of a COVID-19 RNA Vaccine Candidate (BNT162b1) in Adults 18 to 55 Years of Age: Interim Report

Mark J. Mulligan1*, Kirsten E. Lyke2*, Nicholas Kitchin3,a, Judith Absalon3,b, Alejandra Gurtman3,b, Stephen Lockhart3,a, Kathleen Neuzil2, Vanessa Raabe1, Ruth Bailey3,a, Kena A. Swanson3,b, Ping Li3,c, Kenneth Koury3,b, Warren Kalina3,b, David Cooper3,b, Camila Fontes-Garfias6, Pei-Yong Shi6, Özlem Türeci7, Kristin R. Tompkins3,b, Edward E. Walsh4, Robert French5, Ann R. Falsey4, Philip R. Dormitzer3,b, William C. Gruber3,b, Uğur Şahin7, and Kathrin U. Jansen3,b

- Nucleoside-modified mRNA
- Immunogen: RBD trimer
Systemic events and medication use within 7 days of vaccination

First dose
- 10, 30, 100 mcg

Second dose
- 10, 30 mcg
As there is no known antibody threshold of protection against SARS-CoV-2 infection or COVID-19 disease, human convalescent sera levels are a reasonable comparison.
Process, Organization

- **Operation Warp Speed**
  - A partnership led by US HHS to invest in and coordinate the development, manufacturing and distribution of COVID-19 diagnostics, therapeutics and vaccines.
    - Accelerating COVID-19 Therapeutic Interventions and Vaccines (ACTIV) - public-private partnership

- **COVID Prevention Network (CoVPN)** – NIH press release 7/8/20, a functional unit of Operation Warp Speed
  - will use a harmonized vaccine protocol
  - NIAID networks clinical trials infrastructure
  - HVTN, HPTN, IDCRC, ACTG + many other trial sites (> 100 US and international)
  - Vaccines and MAB
Timeline

- July: NIAID+Moderna mRNA – S – phase 3, 30,000 participants (>500M)
  - 90-100 trial sites
- August: AstraZeneca (Oxford) ChAdOx1 – S - phase 3, 30,000 participants – (1.2B)
- Soon after:
  - Janssen (Johnson & Johnson) – Ad26 - S
  - NovaVax: subunit protein S + adjuvant – (1.6B)
  - Sanofi/GSK subunit protein S + adjuvant
- Pfizer (industry funded)
  - Phase 2/3 launch in July
- Community engagement, particularly with the communities most vulnerable to COVID-19 severe outcomes, will be critical to the success of this research endeavor.
- CoVPN website: https://www.coronaviruspreventionnetwork.org
  - clinical trial participant registry: customized data collection platform to securely identify potential trial participants
COVID-19 Vaccine - NYC area trial sites

https://www.coronaviruspreventionnetwork.org

• Moderna – mRNA in LNP – S - July
  – Weill Cornell Uptown, NYC
  – Weill Cornell Chelsea, NYC
  – Meridian Clinical Research, Bronx, NYC
  – other

• AstraZeneca – Oxford – ChAdOx1 – S - August
  – U Rochester (A Falsey, national study PI)
  – NY Blood Center, Valhalla
  – Bronx Prevention Research, NYC
  – Columbia (M Sobieszczyk, national study PI)
  – NYU Langone Vaccine Center
    • Up to 5 vaccination locations:
      • Tisch – midtown Manhattan, NYC
      • Bellevue Med Center - midtown Manhattan, NYC
      • NYU Langone Health – Brooklyn, NYC
      • NYU Winthrop - Mineola, Long Island
      • VA Medical Center, midtown Manhattan, NYC
  – other
Adherence

- Non-pharmaceutical interventions
  - Effective
- As a country we can do better against this virus.
- Individual responsibility, behavior
- Leadership responsibility, policy
- Principle, to stay healthy & protect others
  - Is it essential?

- Identifying a safe and effective COVID-19 vaccine is essential.
- In the meantime, stay NY strong, and…
Thank You Team!

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Vanessa Raabe
Angelica Kottkamp
Ramin Herati
Marie Samanovic-Golden
Lilin Lai
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Mary Olson
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Robert Ulrich
Bo Shopsin
Purvi Parikh
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Ellie Carmody
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Amber Cornelius
Laura Frye
Heekoung Youn
Jane Fran
Kanika Ballani
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Juanita Erb
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Hibah Khan
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THANK YOU
Timeline

SARS-CoV-2
- Genome sequenced: 2019 (Dec) - 2020 (Jan)
- 1st vaccine batch (mRNA-1273): 2020 (Feb 7)
- Worldwide pandemic declared: 2020 (Mar 11)
- 1st clinical trial: 2020 (Mar 16)
- Vaccine in 12-18 months?: 2020 (May)

MERS
- Genome sequenced: 2012
- Outbreak (Saudi Arabia): 2014
- 1st clinical trial: 2016 (Feb)
- No vaccine - 6 years: 2020

SARS-CoV-1
- Outbreak: 2002 (Nov) - 2003 (early)
- Genome sequenced: 2003 (Apr)
- 1st clinical trial: 2005
- No vaccine - 17 years: 2020

Ebola
- Genome sequenced: 1976
- Canadian team publishes 1st vaccine: 1993
- Largest outbreak: West Africa: 2014
- 1st clinical trial: 2015
- Vaccine approved (Evebo (VSV vector)): 2019
- 15 years: 2019

Polio
- 1st Epidemic (USA): 1789
- Salk vaccine (inactivated virus): 1953-54
- Sabin vaccine (oral, live-attenuated): 1957-59
- 60 years: 1981

Funk at al., *Front. Pharmacol.*, 19 June 2020