COVID-19 Critical Care and Pulmonary Management Updates from the Frontlines

Doctors with a patient in the Montefiore Medical Center Moses Division emergency room in the Bronx
Nicholas Kristof, The New York Times

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Life and Death in the ‘Hot Zone’

Nicholas Kristof; New York Times - Sunday, April 12

Novel Coronavirus

COVID-19 is the disease caused by the novel coronavirus (SARS-CoV-2).
Angiotensin System

Angiotensin I
(No Function)

Angiotensin II
(Vasoconstriction)

Angiotensin 1-7
(Vasodilator)

+ ACE

− ACE2

ACE Inhibitors
ARBs
Glitazones
Ibuprofen

ACE-Inhibitor
Global Case Fatality Ratio

- **Worldwide**
  - 1.87 million cases
  - 116,052 deaths (6.2%)

- **United States**
  - 555,310 cases
  - 22,020 deaths (4.0%)

- **China**
  - 83,134 cases
  - 3,343 (4.0%)

- **Italy**
  - 156,363 cases
  - 19,899 deaths (12.7%)

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April 12, 2020

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https://coronavirus.jhu.edu/map.html
COVID-19 Transmission

Transmission

- ? Asymptomatic
- Pre-symptomatic 1-3 days
- Symptomatic

Total Cases 4-12-20

China

Italy

USA

New Cases 4-12-20

https://coronavirus.jhu.edu/map.html
COVID-19 Mortality in the US

- New York City
  - 103,208 cases
  - 6,898 deaths (6.7%)
- Colorado
  - 7,303 cases
  - 290 deaths (4.0%)
- Kansas
  - 1,337 cases
  - 56 deaths (4.2%)

Influenza-like Illness
April 4, 2020
Clinical Presentation

- **Incubation Period**
  - 2-14 days after exposure
  - Average 5-6 days

- **Symptoms**
  - Fever, cough, fatigue & SOB
  - GI symptoms/diarrhea
  - Loss of taste & smell

- **Hospital Admission**
  - ~5-7 days after symptom onset

**Illness Severity**

- Mild: 80%
- Severe: 14%
- Critical: 6%
Plan for a Surge of Patients & Severity

- **Healthcare providers**: 
  - Nurses and MAs
  - Respiratory therapists
  - Advanced Practice Providers (Apps)
  - Physicians

- **Increased patient numbers**: 
  - UCH ICU planned for ~5x capacity

- **Cohort COVID patients if possible**: 
  - COVID-only floors
  - COVID-only ICUs

- **PPE needs and training**: 
  - *Training for donning and doffing PPE*
  - Minimize use of PPE

- **Identify high-risk patients**: 
  - Who will be transferred to the ICU?
  - Avoid respiratory crashes and codes

- **Intubation protocol**: 
  - Early, rapid sequence intubation
  - Optimize PPE protection

- **MET and Code Team**: 
  - PPE in fanny pack
Protect Yourselves & Others!

- Infection of Healthcare Workers
  - 10% in Asia
    - Late recognition of disease
    - Improper equipment
    - Lack of training
    - Long shifts and fatigue
    - Outside hospital exposures
  - ~25% in New York City (Verbal)
  - ~25% in Seattle (Verbal)
- Scrubs, showers & shoes
- Proper PPE

Half-Face Respirator
Powered Air-Purifying Respirator -- PAPR
Diagnosis

Nasal Swab PCR
- Pre-symptomatic phase
  - 25-75% sensitive
- Early symptomatic phase (1-3 days)
  - 75-95% sensitive
- Late symptomatic phase (7-14 days)
  - PNA -- 50% sensitive
  - Minimally ill – 25% sensitive
- Repeat tests are not very helpful
  - 1.5% false negative rate

Lower Respiratory PCR
- Sputum, tracheal Aspirate or BAL
- Bronchoscopies are HIGH RISK
- Do not perform an induced sputum due to high production of aerosols

Cepheid
Xpert® Xpress SARS-CoV-2
~45 Minutes

Roche
cobas® SARS-CoV-2
~8 Hours
Triage

- Admission
  - Hypoxemia
    - $\text{SpO}_2 < 90\%$ at rest or exertion
    - RR > 24 breath/min
  - HR > 125 beats/min
  - CXR with PNA

- Triage
  - $< 6L \text{ O}_2$ Floor
  - $\geq 6L \text{ O}_2$ ICU

Risk Factors for Severe Disease
- Age > 55
- Chronic Pulmonary Disease
- Chronic Kidney Disease
- Diabetes
- Hypertension
- Cardiovascular Disease
- Immunosuppression

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*(THIS IS CRITICALLY IMPORTANT)*

- Strongly consider transfer if needing $\geq 4L \text{ O}_2$
Respiratory Emergencies Increased on the Floor

- **Response**
  - Increase RN/MA education
  - Move patients to the ICU if on $\geq 6L \text{ O}_2$ or with any respiratory difficulty
  - Deployed ViSi® Mobile Monitor to floor
Codes on Non-COVID Patients Increased

*Collateral Damage?*

- **Response**
  - Strengthened medical emergency team (MET)
  - Fanny pack with PPE for MET and Code teams
  - Deployed ViSi® Mobile Monitor to floor
Respiratory Failure

- Start with nasal cannula or mask (1-10L O₂ per min)
- **Avoid** heated high flow systems (e.g. up to 50L per min) due to increased aerosols
- **Avoid** BiPAP or CPAP due to increased aerosols

**Early intubation*******
- Highest risk procedure due to aerosol exposure
- ≥ 10L O₂ per min or respiratory insufficiency
- Use N95 or PAPR
- Rapid sequence with paralysis
  Avoid bagging if possible
Acute Respiratory Distress Syndrome (ARDS)
Cytokine Storm

- Highly activated Immune cells
- Increased inflammation & cytokines
  - Persistent Fever
  - Cytopenias/Lymphopenia
  - Ferritin
  - CRP
  - D-Dimer
  - IL-1alpha, IL-1beta,
  - IL-6
ARDS Management

Standard Management

- Low TV ventilation
  - ≤ 6 cc/kg ideal body weight
  - Keep plateau pressures < 30 cm H₂O

- High Peep Protocol

<table>
<thead>
<tr>
<th>FiO₂</th>
<th>0.3</th>
<th>0.3</th>
<th>0.3</th>
<th>0.3</th>
<th>0.4</th>
<th>0.4</th>
<th>0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>16</td>
</tr>
</tbody>
</table>

- Limit Fluids
  - Avoid fluid boluses
  - Lasix diuresis

Rescue Management

- Prone Ventilation
  - Use for FiO₂ > 60% and Peep > 10
  - 16h prone and 8h supine

- Inhaled nitric oxide or epoprostenol
- Extracorporeal Membrane Oxygenation (ECMO)
## Common Management Problems

*“Line them up right away!!”*

<table>
<thead>
<tr>
<th>Problems</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Hypercoagulability</td>
<td>- Heparin prophylaxis is critical</td>
</tr>
<tr>
<td>▪ Microvascular thrombosis</td>
<td>- CT Angio and/or Head CT</td>
</tr>
<tr>
<td>▪ Pulmonary embolism &amp; CVA</td>
<td>- Consider full anticoagulation</td>
</tr>
<tr>
<td>▪ Clotting dialysis circuits</td>
<td></td>
</tr>
<tr>
<td>- Myocarditis</td>
<td>- Limit fluids, avoid Precedex™</td>
</tr>
<tr>
<td>▪ Shock/arrhythmias</td>
<td>- Check BNP and Troponin</td>
</tr>
<tr>
<td>▪ Pulmonary edema</td>
<td>- Select/careful use of dobutamine</td>
</tr>
<tr>
<td>- $2^0$ Bacterial Infections</td>
<td>- Antibiotics</td>
</tr>
<tr>
<td>- Acute Renal Failure</td>
<td>- Continuous bedside hemodialysis</td>
</tr>
</tbody>
</table>
There are NO proven therapies!!!
*Caveat emptor!*

**Severity**

- ICU Hospitalization
  - Increasing $O_2$ needs
  - Mechanical ventilation

- Cytokine storm with $\geq 2$ of the following:
  - D-Dimer $> 1$ mcg/mL; Ferritin $> 600$ mcg/L; Persistent fever; CRP $> 100$ mg/L; IL-6 $> 3x$ upper limit of normal

**Treatment**

- 1° Hydroxychloroquine 400mg BID x 1 day, then 200 mg BID for 4 days
- 2° Lopinavir/ritonavir 400/100 ± ribavirin x 5 days

- 1° Tocilizumab – IL-6 Blocker
- 1° Sarilumab – IL-6 Receptor Blocker
Resources

➧ UCHealth Clinical Practice Documents

➧ CDC Hospital Preparedness Checklist

➧ WHO COVID Surge Planning Tools

➧ ICU Management of COVID-19
  - https://doi.org/10.1016/S2213-2600(20)30161-2

➧ Transfer or Medical Advice
  - UCHealth System: 720-848-2828 or 720-848-0000
  - University of Kansas System: 877-738-7286
Acknowledgements

- Ellen Burnham, UCH MICU Director
- Michelle Barron, UCH ID Specialist
- Marc Moss, Chief of PCCM at UC
- Ivor Douglas, Chief of PCCM at Denver Health
- Arun Kannappan, PCCM at UC – Weekly Citywide COVID Meeting
- Many other colleagues (MD/DO, APP, RN, RTT) have contributed to our efforts
Summary/Discussion
The surge is coming or has already arrived!

- Develop surge capacity
- Identify SARS-CoV-2 testing
- Cohort COVID-19 patients
- PPE - train, allocate & preserve
- Avoid respiratory emergencies
- Plan for codes
- Establish transfer criteria
  - ≥ 4L O₂ or respiratory difficulty

Goal is to prevent chaos!!