

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
 - <https://www.nytimes.com/2020/04/11/opinion/sunday/coronavirus-hospitals-bronx.html?smid=em-share>

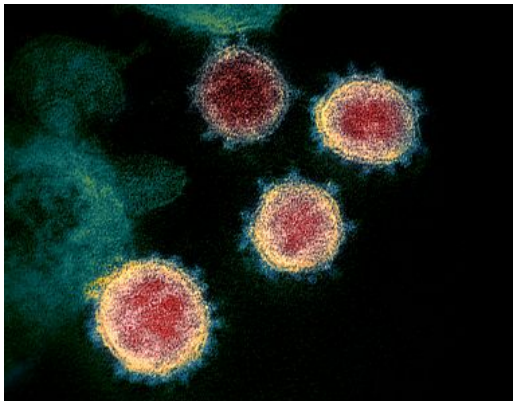


Novel Coronavirus

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

SARS-CoV-2

Transmission Electron Micrograph

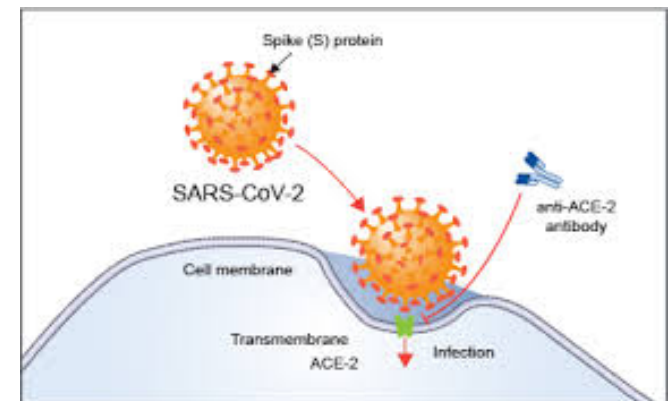


Spike Protein Molecular Structure



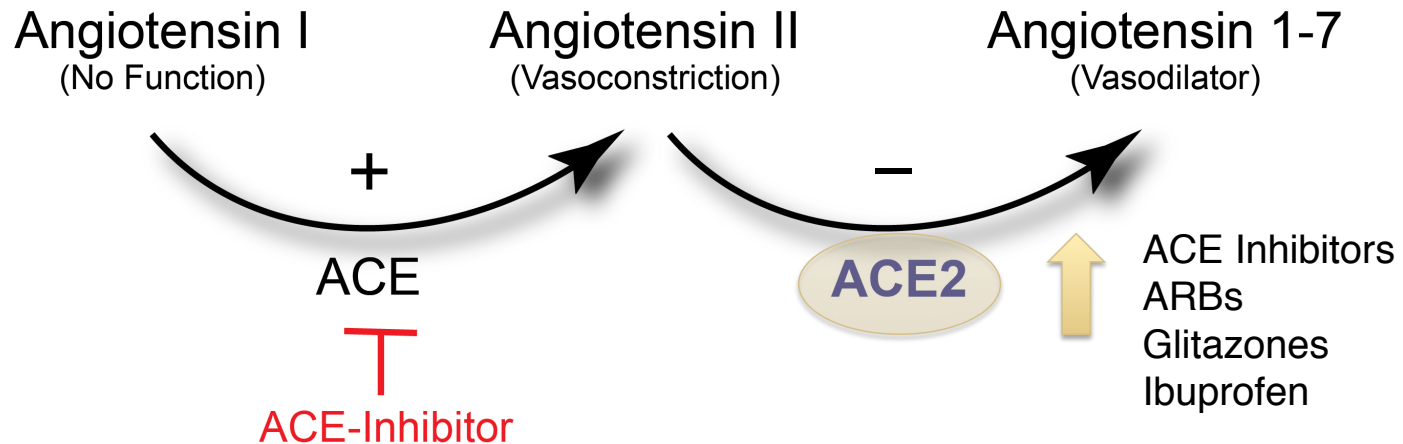
ACE2

Angiotensin Converting Enzyme 2



**10-20x Binding Affinity for ACE2
than SARS-CoV (SARS 2002 Virus)**

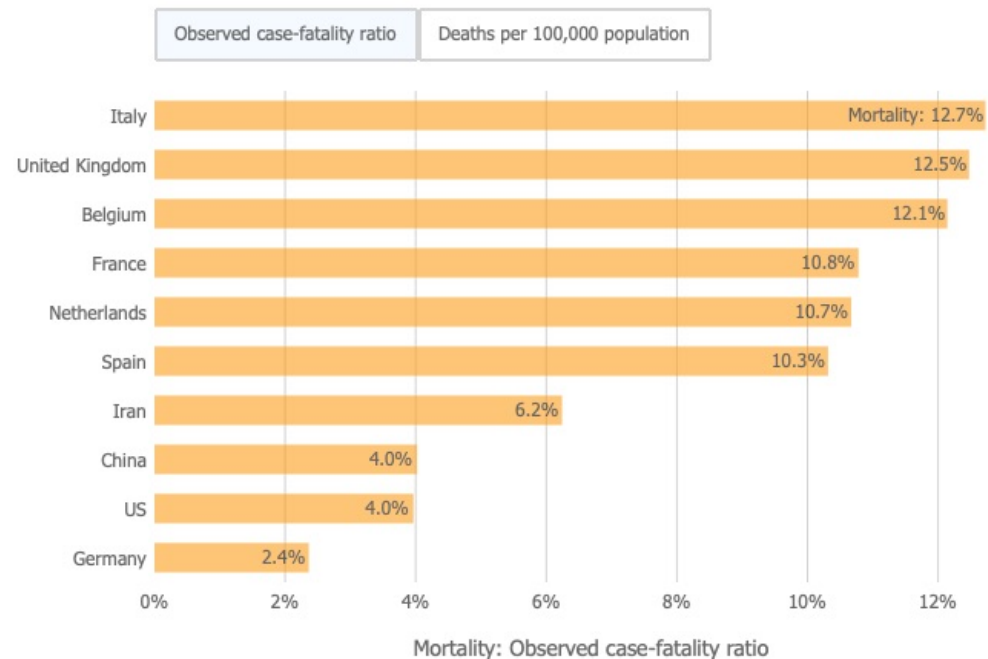
Angiotensin System



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%)

April 12, 2020



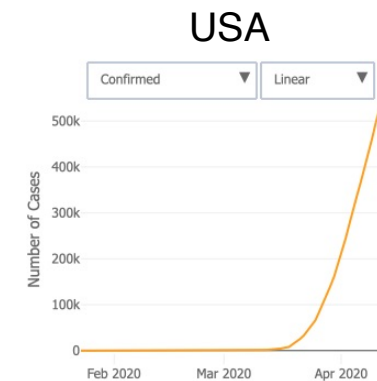
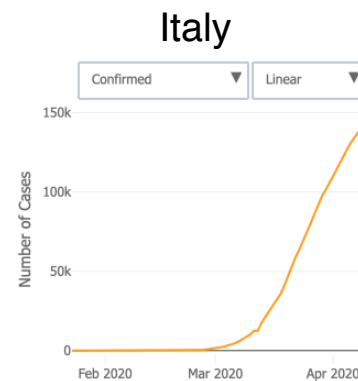
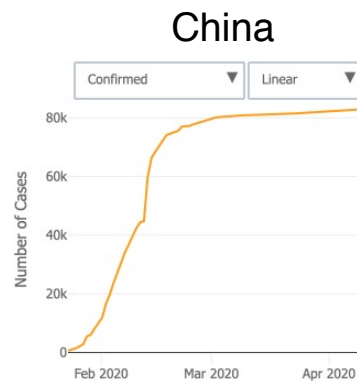
<https://coronavirus.jhu.edu/map.html>

COVID-19 Transmission

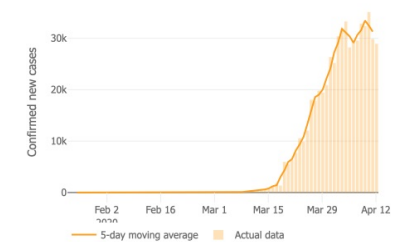
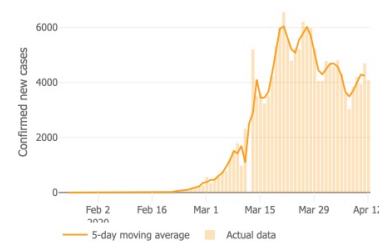
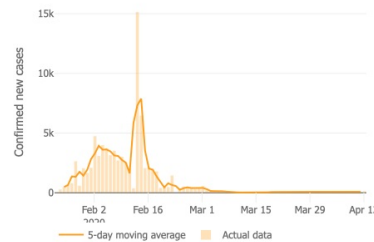
► Transmission

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

Total Cases 4-12-20



New Cases 4-12-20



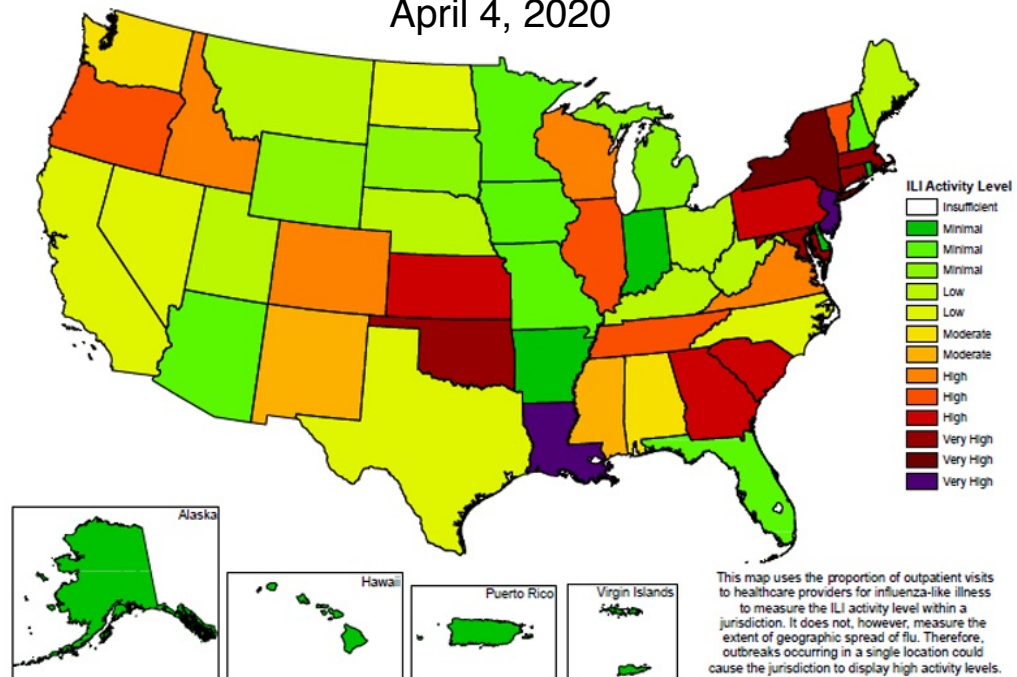
<https://coronavirus.jhu.edu/map.html>

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%)

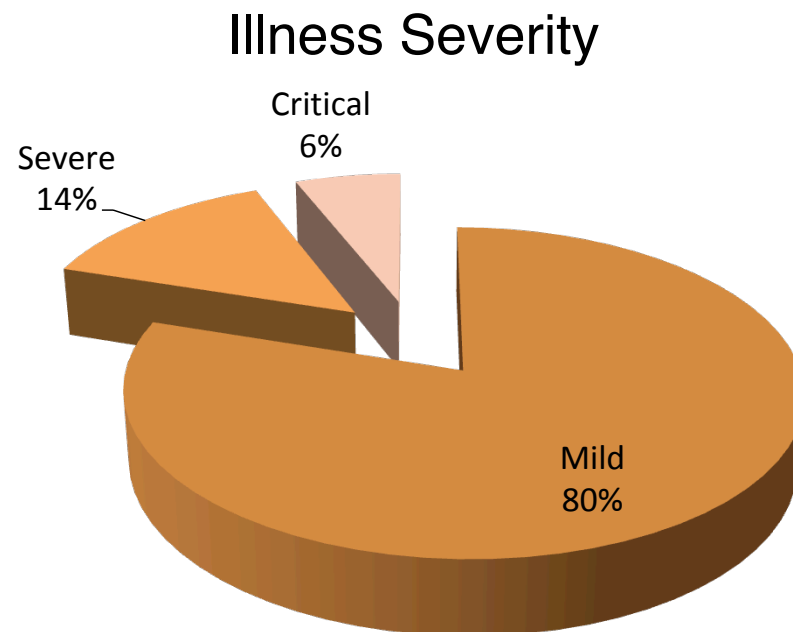
Influenza-like Illness

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



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 Yourself & 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**
 - $\text{RR} > 24$ breath/min
- $\text{HR} > 125$ beats/min
- CXR with PNA

► Triage

- $< 6\text{L O}_2$ Floor
- $\geq 6\text{L O}_2$ **ICU***** THIS IS CRITICALLY IMPORTANT**
- **Strongly consider transfer if needing $\geq 4\text{L O}_2$**

► Risk Factors for Severe Disease

- Age > 55
- Chronic Pulmonary Disease
- Chronic Kidney Disease
- Diabetes
- Hypertension
- Cardiovascular Disease
- Immunosuppression

Respiratory Emergencies Increased on the Floor



► Response

- Increase RN/MA education
- Move patients to the ICU if on $\geq 6L$ O₂ 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

Higher PEEP/lower FiO₂

FiO ₂	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5
PEEP	5	8	10	12	14	14	16	16

FiO ₂	0.5	0.5-0.8	0.8	0.9	1.0	1.0
PEEP	18	20	22	22	22	24

- ▶ 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!!”

Problems

- ▶ Hypercoagulability
 - Microvascular thrombosis
 - Pulmonary embolism & CVA
 - Clotting dialysis circuits
- ▶ Myocarditis
 - Shock/arrhythmias
 - Pulmonary edema
- ▶ 2^o Bacterial Infections
- ▶ Acute Renal Failure

Response

- ▶ **Heparin prophylaxis is critical**
- ▶ CT Angio and/or Head CT
- ▶ Consider full anticoagulation
- ▶ **Limit fluids, avoid Precedex™**
- ▶ Check BNP and Troponin
- ▶ Select/careful use of dobutamine
- ▶ Antibiotics
- ▶ Continuous bedside hemodialysis

There are NO proven therapies!!!

Caveat emptor!

Severity

- ▶ ICU Hospitalization
 - Increasing O₂ needs
 - Mechanical ventilation

- ▶ Cytokine storm with ≥ 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^o Hydroxychloroquine 400mg BID x 1 day, then 200 mg BID for 4 days
- ▶ 2^o Lopinavir/ritonavir 400/100 \pm ribavirin x 5 days

- ▶ 1^o Tocilizumab – IL-6 Blocker
- ▶ 1^o Sarilumab – IL-6 Receptor Blocker



Resources

- ▶ UCHealth Clinical Practice Documents
 - <https://www.uchealth.org/today/clinical-practice-documents/>
- ▶ CDC Hospital Preparedness Checklist
 - <https://www.cdc.gov/coronavirus/2019-ncov/hcp/hcp-hospital-checklist.html>
- ▶ WHO COVID Surge Planning Tools
 - <http://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/news/news/2020/4/new-who-tools-launched-to-help-hospitals-manage-surge-in-covid-19-patients>
- ▶ ICU Management of COVID-19
 - [https://doi.org/10.1016/S2213-2600\(20\)30161-2](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
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- ▶ **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**
 - $\geq 4\text{L O}_2$ or respiratory difficulty

Goal is to prevent chaos!!

