GENERAL PRINCIPLES

INFECTION CONTROL

- Hand hygiene prior to and after all patient encounters and when changing PPE
- Use contact and droplet precautions for patients with confirmed/suspected COVID-19, including:
  - Surgical/medical mask
  - Eye protection
  - Gloves
  - Gowns
- N95 respirators should be used for all aerosol-generating procedures, including:
  - Endotracheal intubation
  - Deep suctioning
  - Nebulizer treatments
  - Bronchoscopy
  - Noninvasive ventilation
  - Chest compressions
  - Chest physiotherapy
- Patients should be placed in negative-pressure rooms, as able, and in geographic cohorts.
- Avoid unnecessary aerosolizing procedures, if possible.

INITIAL WORKUP

Symptoms (% of cases)

- Fever (44-94%)
- Cough (68-83%)
- Sore throat (14-61%)
- Shortness of breath (11-40%)
- Fatigue (23-38%)
- URI symptoms (5-25%)
- Myalgias (11-15%)
- Headache (8-14%)
- Confusion (9%)
- GI symptoms (3-17%)
- Anosmia

Labs suggestive of disease

- Lymphopenia
- Mild transaminitis (AST / ALT ~200s)
  - GGT elevated, AlkPhos elevations are rare
- Anemia
- Elevated D-dimer (in absence of known culprit thrombus/embolus)
- Elevated CK
- Elevated LDH
**GENERAL PRINCIPLES**

(CONTINUED)

- Low/normal procalcitonin, elevated in severe disease and/or superimposed bacterial infection
- Elevated inflammatory markers:
  - LDH, CRP, ESR, ferritin, IL-6

**RISK FACTORS FOR MORE SEVERE DISEASE**

**Demographics**
- Age > 55
  - Older age has higher OR for ARDS and death
- Male sex
- High BMI
- Long-term care facility inhabitant

**Vital signs**
- Initial SpO₂ <92% on RA
- Initial HR > 125 bpm
- Initial RR > 24 bpm

**Comorbid conditions**
- Asthma
- Coronary artery disease
- CKD
- Chronic lung disease
- Diabetes
- HTN
- Heart failure
- Immunocompromised/malignancy

**Lab findings**
- Low absolute lymphocyte count (<0.8)
- Elevated D-dimer (>1000)
- Elevated CRP (>10)
- Rising troponin

**DISEASE COURSE**

**Duration of symptoms**
- Fever - median 4-12 d
- Dyspnea - median 13 d
- Cough - median 19 d
  - Still present in 45% of survivors on discharge and 72% of nonsurvivors on death

**Timing of complications**
- Sepsis - median 9 d
- ARDS - median 12 d
- Acute cardiac injury - 15 d
- Acute kidney injury - 15 d
- Secondary infection - 18 d
Suggested labs
- CBC w/diff
- BMP, Mg, Phos
- LFTs, Troponin & CPK, NT-proBNP
- LDH, CRP, D-dimer, procalcitonin
- PTT/INR, ferritin

ICU transfer potential
- Provider concern
- Shock (SBP<90, MAP<65)
- Respiratory distress (need for >6L O₂, rapid respiratory deterioration, significant WOB)
- Acidosis (pH <7.30, CO₂>50), lactate >2
- Deterioration in mental state

RESPIRATORY ESCALATION

Target SpO₂: 92-96%, RR <25, Normal WOB

1. Nasal cannula: up to 6LPM
2. Venturi Mask: 9-12LPM with FiO₂ 30-60%
3. Trial HFNC if available: 100% to start at 20-30L/min up to 60L/min flow
   - Aerosolization potential, perform in negative pressure room
4. NIPPV: trial CPAP or BiPAP with mask & filter
   - High aerosolization potential, perform in negative pressure room
   - PEEP 5 to start up to 15-20

If mental status deteriorates, hypercarbia or acidosis develops, cardiac instability ensues, or patient has persistent profound hypoxia, tracheal intubation is likely next step.

Intubation
- Full PPE (N95 or PAPR, goggles/face shield, gown, gloves, hair cover)
- Set up vent with initial settings, viral filter in line, EtCO₂ inline, suction, post intubation sedation, vitals cycling q3-5’
- Preoxygenate using 100% oxygen through previously connected oxygen device
- Most experienced person by video laryngoscopy
- After intubation, inflate cuff, directly connect to vent w/ inline filter and EtCO₂ device to confirm placement. Secure ETT. Avoid auscultation, if possible.

DIAGNOSING ARDS

Criteria
New or worsening hypoxemia with bilateral opacities on imaging

Severity
- Mild: PaO₂/FiO₂ 200-300
- Moderate: PaO₂/FiO₂ 100-200
- Severe: PaO₂/FiO₂ <100
RESPIRATORY

(CONTINUED)

**Utilize lung protective/ARDSnet recommendations**
- Choose mode of ventilation (ACVC or ACPC)
- Vt: 4-6 mL/kg ideal body weight
- Choose RR (10-15 BPM) titrated to blood gas
- Titrate PEEP/FiO₂ to target PaO₂ > 55 mm Hg or SaO₂ 88-95%
- Consider higher PEEP based on severity of illness and BMI
  - BMI <35: PEEP 5
  - BMI >35: PEEP 10

**ADJUSTING THE VENT**

**Assess patient response**
- Patient RR; peak pressure; plateau pressure; ABG; SaO₂
- Goals: normal RR, pH 7.25-7.35, minute ventilation 6-7LPM, PaO₂ 55-80, SaO₂ 88-95%
- Plateau pressure goal ≤ 30 cm H₂O
  - If plateau pressure > 30, decrease Vt by 1 mL/kg steps until 4 mL/kg
  - If plateau pressure < 25 and Vt < 6 mL/kg, increased Vt until plateau pressure > 25 or Vt = 6 mL/kg

**To improve oxygenation (SaO₂ and PaO₂):**
Increase FiO₂ and/or PEEP per ARDSnet q15-30min to goal SaO₂

<table>
<thead>
<tr>
<th>FiO₂</th>
<th>30-40%</th>
<th>40-50%</th>
<th>50-70%</th>
<th>70-80%</th>
<th>90-100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP</td>
<td>5-8</td>
<td>8-10</td>
<td>10-12</td>
<td>12-14</td>
<td>14-24</td>
</tr>
</tbody>
</table>

**To improve ventilation (RR, PCO₂ and EtCO₂):**
- If pH 7.15 – 7.30, increase RR until pH > 7.30 or PaCO₂ < 25 (max set RR 35)
- If pH < 7.15, increase RR to 35
- If pH remains < 7.15, increase Vt by 1 mL/kg until pH > 7.15
- May give NaHCO₃
- If pH > 7.45, decrease RR

**REFRACTORY HYPOXIA**
- Assess fluid status and attempt diuresis if able.
- Deep sedation to RASS -5
- Consider neuromuscular blockade.
- Consider recruitment maneuvers if physiology deemed recruitable.
- Consider proning patient early if PaO₂/FiO₂ <150 12 hours into ventilation.

- Consider pulmonary vasodilators (iNO).
- Consider steroids.
- Consider ECMO consult if:
  - Persistent PaO₂ < 75 requiring FiO₂ > 0.75
  - Plateau pressure >30
  - Refractory hypercapnia and pH < 7.2
  - Absence of contraindications
RESPIRATORY

(CONTINUED)

Troubleshooting

D – dislodged/displaced ETT
O – obstructed (secretions, blood)
P – pneumothorax
E – equipment failure (attempt BMV)
D – dyssynchrony

SYSTEMS

CARDIOVASCULAR

Acute Cardiac Injury
- Upwards of 22% of patients 14 d into illness
- Seen as a rise in troponin >99th percentile

Cardiac Arrest
- Asystole 89%, PEA 4.4%, VF/VT 5.8%

Shock
- Acute onset of new/sustained hypotension (MAP <65, SBP <90) with signs of hypoperfusion (poor capillary refill, poor urine output, lactic acidosis, worsening mental status), or vasopressor requirement
- Consider etiology of shock.
  - Cardiogenic vs. septic vs. vasodilatory
- Empirc antibiotics within 1st hour
- Consider conservative fluid management strategy (withholding fluid bolus or giving smaller 250 mL – 500 mL boluses)
- Start norepinephrine as first agent.
  - Titrate every 3-5 minutes.
  - 2-20 mcg/min (max 100 mcg/min)
- Next line agents include vasopressin or epinephrine.
  - Epi 1-10 mcg/min
  - Vaso 0.01-0.04 units/min
- Dobutamine is considered if cardiac dysfunction playing a large role.

NEURO/SEDATION

Neuro
- High incidence of neurologic manifestations
- Dizziness, headache, impaired consciousness, hypogeusia, and hyposmia are most common.
- Stroke can occur.

Sedation
- Combination of analgesia and sedation should be employed.
- Daily sedation holidays if able/safe.
- Sedation should be targeted to facilitate improved oxygenation/ventilation.
- Scoring systems such as the RASS should be employed.
**Analgesic Medications**
- Fentanyl 0-300 mcg/hr, 25-100 mcg q30min PRN
- Hydromorphone 0-4 mg/hr, 0-2 mg q1h PRN
- Morphine 0-10 mg/hr, 2-4 mg q1h PRN

**Sedation Medications**
- Propofol 0-80 mcg/kg/min, 10-50 mg q5min PRN
- Dexmedetomidine 0.2-1.4 mcg/kg/hr
- Midazolam 0-5mg/hr, 0.5-2 mg q2h PRN
- Ketamine 5-30 mcg/kg/min, 0.1-0.2 mg/kg q5min PRN

**HEME/RENAL**

**Heme**
- High incidence of thromboemboli and hypercoagulability
- Suggested prophylaxis of all patients if no contraindications
  - If CrCl > 30: enoxaparin 40 mg SC daily
  - If CrCl < 30 or AKI: heparin 5000 units SC TID
  - Hold if platelets <30,000 or bleeding, start TEDs and SCDs
  - If the patient is on direct oral anticoagulants or warfarin, consider switch to full dose anticoagulation.
  - Consider TPA or therapeutic anticoagulation if signs of emboli.
- DIC – high risk with median onset 4 d after hospitalization
  - If fibrinogen <150 → cryoprecipitate, FFP or fibrinogen concentrate
  - If platelets <30 → hold anticoagulation, consider platelet transfusion.
  - If bleeding → hold anticoagulation, consider FFP or 4F-PCC.

**Renal**
- AKI – high incidence (0.5-27%) due to ATN
  - Avoid nephrotoxic drugs.
  - Assess pre-renal vs intrinsic renal (FENa).
  - Dose medications based on CrCl.
- RRT – high incidence in ICUs (5-23%)
  - High mortality

**THERAPIES**

There is insufficient evidence to issue a recommendation on the use of specific agents. Agents should ideally be studied as part of a trial.

**Medications**
- Hydroxychloroquine 400 mg PO BID x1 d followed by 200 mg PO qd x4 d
  - Poor evidence but may be beneficial early.
  - NIH advises not to use with azithromycin.
- Remdesivir IV 200 mg x1 d then 100 mg IV qd x5 d or 10 d
  - Ongoing trials of efficacy
- Lopinavir/ritonavir 400 mg/100 mg PO q12h x10 d
  - Poor evidence with suggestion not to use
Methylprednisolone IV 60 mg/day or dexamethasone IV 10 mg/day
- No clear evidence
- Consider for ARDS, shock

Tocilizumab IV 4-8 mg/kg x1 d
- Poor evidence with trials ongoing
- Consider use with evidence of cytokine storm syndrome.

Convalescent plasma dosing uncertain
- Minimal evidence