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GUIDANCE FOR TREATMENT OF COVID-19 IN ADULTS AND CHILDREN

Patient population:

Adult and pediatric patients with COVID-19 infection, who are admitted on an inpatient floor or to the intensive care unit.

Key points:

Details regarding isolation/precautions, personal protective equipment, patient movement, family/visitor policy, and cleaning/disinfection can be found here.

Clinical symptoms:

Range from asymptomatic, uncomplicated upper respiratory tract viral infection to pneumonia, acute respiratory distress syndrome (ARDS), sepsis, and septic shock (**Table 1**)

Diagnosis:

See current COVID-19 testing recommendations.

Treatment:

Based on data from several randomized control trials, Remedesivir may provide a modest benefit in a subgroup of patients hospitalized with COVID-19. See further details regarding patient populations (see below) and Table 2.

Table 1. Potential Treatment Recommendations by Severity of Disease

Disease severity	**Potential Treatment Recommendations** (per ID consult discretion based on details in Table 2)
No supplemental oxygen	• Supportive care • Monoclonal Antibodies may be an option in certain high risk patients (see eligibility criteria in ***Table 2***) admitted for reasons other than COVID-19 who have mild to moderate symptoms of COVID-19
Low flow supplemental oxygen	• Supportive care • Dexamethasone (Exception: Minimal supplemental oxygen (1-2 L) in adults with <7 days of symptoms—uncertain benefit) • Remdesivir
High flow supplemental oxygen or non-invasive mechanical ventilation	• Supportive Care • Dexamethasone • Remdesivir (uncertain benefit)
Mechanical ventilation or ECMO	• Supportive care • Dexamethasone

Convalescent plasma and Baricitinib may also be added per FDA issued Emergency Use Access (See Table 2 for additional information).

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Table 2: Therapeutic agents dosing, duration, and details for treatment of COVID-19

Therapeutic Agents	Dosing & Duration	Comments
Remdesivir *Patients not hypoxic and those requiring mechanical ventilation or ECMO will not meet the below criteria because existing data does not demonstrate that remdesivir confers a clinical benefit in these patients (clinical recovery or mortality). Exceptions to the below criteria may be considered on an individualized basis.* <u>Guidelines for Use: Patients should meet criteria a & b.</u> a. Laboratory confirmed SARS-CoV-2 infection by PCR from nasopharyngeal or respiratory sample and ≤14 days of symptoms b. Severe COVID-19 on admission or during hospitalization: Resting SpO_2 <94% on room air or requires supplemental oxygen, high-flow nasal cannula*, or non-invasive mechanical ventilation* **HFNC and NIMV are included as possible indications for remdesivir, but it is uncertain if remdesivir confers a clinical benefit among patients requiring this level of O2 support*	<u>Adult dosing:</u> 200 mg IV load, then 100 mg IV q24h <u>Pediatric dosing*:</u> *<40 kg:* 5 mg/kg IV load, then 2.5 mg/kg q24h *≥40 kg:* 200 mg IV load, then 100 mg IV q24h <u>Duration:</u> 5 days or until hospital discharge whichever comes first. Patients started on remdesivir and progress to requiring higher level of oxygen support (i.e. mechanical ventilation) should still complete a course of remdesivir *pediatric dosing of remdesivir is taken from the WHO recommendations for treatment of Ebola virus, as no specific dosing recommendations exist for COVID-19.	• Please page 30780 for approval prior to first dose of remdesivir between 7 AM and 11 PM (7 days a week). • ID consult is recommended for the following reasons: ○ Question about Remdesivir should be initiated/ continued ○ Patient does not meet criteria for remdesivir but unique clinical circumstances warrant ID evaluation for treatment ○ Patient/family request ○ Pediatric patient • CrCl <30 mL/min is not a contraindication to remdesivir. The risk of cyclodextrin accumulation to a toxic level with 5 days of therapy is small & benefit likely outweighs risk • Increased LFTs: daily monitoring of hepatic function is recommended. The risk of hepatotoxicity with a baseline AST/ALT >5x ULN is not known due to patient exclusion from clinical trials; weigh benefit versus risk • Patients <12 years or ≥3.5 kg to <40 kg can qualify under EUA with additional requirements for use prior to prescribing (see Gilead Webpage for more info): ○ Patient/caregiver should be informed of potential risks/benefits and extent to which such risks/benefits are unknown ○ Patient/caregiver should be informed of alternative treatments ○ Provide the patient/caregiver a copy of the Fact Sheet for Parents and Caregivers ○ Document in the medical chart the information discussed/provided to the patient/caregiver

Therapeutic Agents	Dosing & Duration	Comments
Dexamethasone Adult Patients 1. *Recommended in patients with COVID-19 who require mechanical ventilation or ECMO* 2. *Recommended for patients on supplemental oxygen. The benefit of dexamethasone is uncertain in adults on minimal levels of supplemental oxygen (1-2L) with <7 days of symptoms. Decisions should be individualized in such patients with consideration of disease severity in conjunction with risks and benefits of glucocorticoid therapy.* *This recommendation is based on the RECOVERY RCT, NIH and IDSA treatment guidelines for patients with COVID-19 (see references)* Pediatric Patients *Pediatric patients were not represented in the RECOVERY RCT and the mean participant age was 66 years. It is not known if the benefit of dexamethasone will extend to children with COVID-19 who require oxygen, or if there is even the potential for harm, as seen in adults who did not require oxygen. However, it is reasonable to consider dexamethasone for children who require mechanical ventilation, or high levels of oxygen support, particularly if they are rapidly progressing toward mechanical ventilation. Recommend consultation with Infectious Diseases.*	Adult dosing: 6 mg PO or IV q24h Pediatric dosing*: 0.15 mg/kg/dose IV q24h (max: 6 mg/dose) Duration: Maximum 10 days, or until discharge *Shorter duration is reasonable to consider in patients who have improved rapidly or are experiencing adverse events from steroids. The median duration of therapy in the RECOVERY trial was 6 days.* **Pediatric dosing is based on extrapolation from the adult dose and the RECOVERY protocol but has not been established for COVID-19*	Weigh risks/benefits of use on a case-by-case basis in patients with: • Active bacterial or fungal infection • Diabetic ketoacidosis • Baseline immunosuppression Not recommended in the following patients: • Not requiring supplemental oxygen. (In RECOVERY, those had a trend towards worse outcomes). • No longer COVID-19 PCR positive, but remain intubated. (In RECOVERY, patients were randomized after admission; the risk/benefit of alternative approaches later in the disease course is unknown). Pregnancy, breastfeeding: • Consult OB for gestational age of viability. Alternatives may be prednisone 40 mg PO daily or hydrocortisone 80 mg IV BID. Dexamethasone is a CYP3A4 substrate, as such drug interactions should be assessed prior to use. Alternatives less prone to interactions are prednisone 40 mg PO daily, methylprednisolone 32 mg IV daily, or hydrocortisone 80 mg IV BID. Potential adverse events: • Increased risk for infection • Hyperglycemia • Peripheral edema • Increased appetite • Insomnia, irritability, delirium In the setting of a dexamethasone shortage, an equivalent total daily dose of an alternative glucocorticoid to dexamethasone 6 mg daily can be used (e.g., methylprednisolone 32 mg (<40 kg: 0.8 mg/kg) daily or prednisone 40 mg (<40 kg: 1 mg/kg) daily)

Therapeutic Agents	Dosing & Duration	Comments
COVID-19 Convalescent Plasma Insufficient data are available to provide guidance regarding efficacy or optimal target population for use. Though administration earlier in the disease course may be better. Recent RCTs have not demonstrated a clinical benefit with convalescent plasma but other RCTs are ongoing. Available via FDA issued Emergency Use Authorization for hospitalized patients with COVID-19 but not considered standard of care. Decisions regarding use outside of clinical trials should be individualized	One unit of COVID-19 Convalescent Plasma of High Titer (preferred over Low Titer when available)	Order Set now in place – do not need to page blood blank Health Care Providers must review FDA Fact Sheet for Health Care Providers Health Care Providers must provide recipients with the Fact Sheet for Patients/Caregivers and communicate the following information to the recipients: 1. FDA has authorized emergency use of COVID-19 convalescent plasma, which is not an FDA-approved biological product 2. The patient or caregiver has the option to accept or refuse administration of COVID-19 convalescent plasma 3. The significant known and potential risks and benefits of COVID-19 convalescent plasma and the extent to which such risks and benefits are unknown 4. Information on available alternative treatments and the risks and benefits of those alternatives.

Therapeutic Agents	Dosing & Duration	Comments
SARS-COV-2 Neutralizing Antibodies Available via FDA issued Emergency Use Authorization **Bamlanivimab** or **Casirivimab** plus **Imdevimab** Eligibility Criteria Patients with mild or moderate COVID-19 who meet criteria #1-4 AND either criteria #5 or criteria #6 1. Admitted for a reason not related to COVID 2. No requirement for supplemental oxygen (or no increase from baseline supplemental oxygen) 3. Symptoms ≤10 days 4. Not received convalescent plasma 5. Adult ≥18 years old and ≥40 kg AND one of the following: a) BMI ≥35 b) Age ≥65 c) Age ≥55 and have DM, CKD (stage III, IV, or end stage CKD-GFR <15 or dialysis), or chronic respiratory disease (e.g., COPD, Asthma, Bronchiectasis, CF, ILD) d) Immunosuppressed: congenital or acquired immunodeficiency, SOT, active malignancy receiving chemotherapy, BMT, or autoimmune diseases requiring immunosuppressive therapy 6. Pediatric patient 12-17 years old weighing ≥40 kg AND one of the following: a) BMI ≥97% for age on CDC growth chart b) Immunosuppressed: congenital or acquired immunodeficiency, SOT, active hematologic malignancy receiving chemotherapy, or BMT	Adult and Pediatric Dosing **Bamlanivimab** 700 mg IV once **Casirivimab** 1200 mg IV once plus **Imdevimab** 1200 mg IV once	**Requires ID consultation and can only be ordered by ID consultants** Health Care Providers must review "FDA Fact Sheet for Health Care Providers" for the SARS-Cov-2 neutralizing Antibody Given (chosen agent depends on supply): **Bamlanivimab** Fact Sheet for Health Care Providers **Casirivimab** plus **Imdevimab** Fact Sheet for Healthcare providers Health Care Providers must provide recipients with the Fact Sheet for Patients/Caregivers and communicate the following information to the recipients: **Bamlanivimab** Fact Sheet for Patients/Caregivers **Casirivimab** plus **Imdevimab** Fact Sheet for Patients/Caregivers 1. FDA has authorized emergency use of (**Bamlanivimab** or **Casirivimab** plus **Imdevibam**), which is not an FDA-approved therapy 2. The patient or caregiver has the option to accept or refuse administration 3. The significant known and potential risks and benefits of the therapy and the extent to which such risks and benefits are unknown 4. Information on available alternative treatments and the risks and benefits of those alternatives.

Therapeutic Agents	Dosing & Duration	Comments
Baricitinib Available via FDA issued Emergency Use Authorization *In patients with COVID-19 on supplemental oxygen, we recommend dexamethasone with Remdesivir as first-line therapy. We **do not** endorse the use of Baricitinib as first-line as it showed no mortality benefit based on preliminary results from the ACTT-2 trial.* Eligibility Criteria *Adult patients* • *Patients with COVID-19 on supplemental oxygen, HFNC, or NIMV* who are unable to tolerate dexamethasone. In this scenario Baricitinib in conjunction with Remdesivir can be considered.* ***Recommend consultation with Infectious Diseases.*** **Not recommended in Patients requiring mechanical ventilation or ECMO because the ACTT-2 study found no clinical benefit in this subgroup of patients.* *Pediatric patients* *Pediatric patients were not represented in the ACTT-2 RCT and the mean participant age was 55 years. It is not known if the benefit will extend to children with COVID-19 who require oxygen and who cannot tolerate dexamethasone. Recommend consultation with Infectious Diseases.*	Adult, pediatric patients ≥9 years old: 4 mg PO q24h Pediatric patients between 2 and <9 years of age*: 2 mg PO q24h Duration: Maximum 14 days, or until discharge *Shorter duration is reasonable to consider in patients who have improved rapidly or are experiencing adverse events.* **Dosing is based on extrapolation from the adult dose and the ACTT-2 protocol but has not been established for COVID-19*	**Requires ID consultation** Not recommended in the following patients: • Not requiring supplemental oxygen • Requiring mechanical ventilation or ECMO • Patients worsening on dexamethasone (not been studied in this scenario and concern for additive immunosuppression) • Patients with known active Tuberculosis • Patients with AKI and eGFR <15, or those with ESRD or receiving dialysis Potential adverse events: • Thromboembolic events: VTE, PE • Increased risk for infection Health Care Providers must review FDA Fact Sheet for Health Care Providers Health Care Providers must provide recipients with the Fact Sheet for Patients/Caregivers and communicate the following information to the recipients: 1. FDA has authorized emergency use of Baricitinib, which is not an FDA-approved therapy 2. The patient or caregiver has the option to accept or refuse administration of Baricitinib 3. The significant known and potential risks and benefits of Baricitinib and the extent to which such risks and benefits are unknown 4. Information on available alternative treatments and the risks and benefits of those alternatives.

Do not use (therapies without any supportive evidence and/or associated with potential harm)**:** hydroxychloroquine, hydroxychloroquine + azithromycin, lopinavir/ritonavir, nitazoxanide, oseltamivir, baloxavir, interferon, ribavirin, IVIG

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Antibiotic Management for Pneumonia in PUI and Confirmed COVID-19 Patients

Recommendations:

1. In patients admitted with suspected COVID-19 pneumonia (testing pending), decisions whether to initiate antibiotic therapy should be based on guidance provided in the institutional pneumonia treatment and procalcitonin usage guidelines.
2. Continuation/initiation of antibiotic therapy *solely* due to confirmation of COVID-19 pneumonia is not indicated as described below.
3. In patients with confirmed COVID-19 pneumonia, community-onset bacterial co-infection is uncommon, even in critically ill patients, and elevated procalcitonin levels are not reliably associated with bacterial infection, especially in the setting of concomitant renal dysfunction. Empiric antibiotic therapy should generally be discontinued once a patient is confirmed COVID-19 positive, but may be indicated in patients with leukocytosis and/or hemodynamic instability. De-escalation/discontinuation of antibiotics should be considered based on clinical and microbiological data. Note that an extended duration of fevers is typical in COVID-19 patients.
4. In patients who test negative for COVID-19 pneumonia, antibiotic therapy should be based on guidance provided in the institutional pneumonia treatment and procalcitonin usage guidelines.

Reports thus far have not identified unusual associations between COVID-19 infection and bacterial co-infection. Additionally, no unique association with resistant pathogens, including MRSA or *Pseudomonas,* has been made.

In an observational analysis by Somers et al of 154 patients with severe COVID-19 infection requiring mechanical ventilation at Michigan Medicine:

- 40% developed a bacterial superinfection, with 32% developing bacterial pneumonia. The median time to development of infection was 8-10 days after initiation of mechanical ventilation.

In a review of studies reporting bacterial co-infections in patients with COVID-19, Lansbury et al reported that the proportion of co-infection in ICU patients was 14%, compared to a proportion of 4% in studies which grouped ICU and floor-status together. Timing of onset of infection was not reported. Similarly, Vaughn et al reported that 3.5% of all patients hospitalized with COVID-19 had a community-onset bacterial co-infection and that 11% of patients admitted directly to the ICU had a community-onset bacterial co-infection[11].

In the study of adult patients by Zhou et al.:

- 15% of hospitalized COVID-19 patients developed a secondary bacterial infection (definition: clinical symptoms or signs of pneumonia or bacteremia with a positive culture).
- The median time to secondary bacterial infection was 17 days (13 to 19 days).
- Of all COVID-19 patients in their cohort, 79% had a WBC <10.
- Only 1% of survivors developed a secondary bacterial infection, yet the median duration of fever in survivors was 12 days and cough persisted for 19 days. Thus, 'just in case' treatment of bacterial infection can result in prolonged durations of therapy.

Data in pediatric patients are limited, but one small study (Xia et al.) suggests that procalcitonin may be higher in children with COVID-19, regardless of suspected bacterial superinfection. Decisions about antibiotic management for children should continue to be guided by clinical judgment.

Adult pneumonia treatment guidelines are summarized here, and adult and pediatric pneumonia treatment guidelines are available in their entirety at:

- Pneumonia Treatment (Adult)
- Community-Acquired Pneumonia Treatment (Pediatrics)
- Procalcitonin Use Guidelines

Procalcitonin

- Although PCT levels should not be used in isolation to decide whether to initiate antibiotics in patients with suspected bacterial pneumonia, **bacterial co-infection is unlikely in a confirmed COVID-19 patient with a low procalcitonin (<0.25), and antibiotics can be safely withheld[11]. In addition, PCT levels >0.25 are not uncommon in patients with COVID-19 pneumonia, and do not appear to be a reliable marker of bacterial superinfection. Importantly, patients with CKD and AKI have falsely elevated PCT levels, and as such PCT is not reliable in such settings**. Procalcitonin should also NOT be routinely used to *extend* treatment duration.

Adult Pneumonia Treatment Summary Recommendations

Indication	1st Line Empiric Therapy (see guidelines for alternatives)	Duration of Therapy
Pathway A – Inpatient community-acquired with no risk factors	**Ampicillin-sulbactam** 3 g IV q6h + Azithromycin 500 mg IV/PO x1 day, then 250 mg q24h x4 days	Uncomplicated pneumonia: 5 days for patients who defervesce within 72 hours and have **no more than 1** sign of CAP instability at the time of antibiotic discontinuation
Pathway B **-Community onset pneumonia with risk factors for drug resistant pathogens (see risk factors below)**	**Piperacillin-tazobactam** 4.5 g IV q6h (+ **Tobramycin** IV if admitted to ICU) + **Vancomycin*** IV (see Standard Dosing Guideline) *Discontinue vancomycin if no evidence of MRSA colonization/infection (negative MRSA nasal swab or respiratory culture).	Uncomplicated pneumonia: 7 days
Pathway C **Hospital-acquired Pneumonia** **Ventilator-associated pneumonia**	**Piperacillin-tazobactam** 4.5 g IV q6h (+ **Tobramycin** IV if admitted to ICU) + **Vancomycin*** IV (see Standard Dosing Guideline) *Discontinue vancomycin if no evidence of MRSA colonization/infection (negative MRSA nasal swab or respiratory culture).	Uncomplicated pneumonia: 7 days

PATHWAY B RISK FACTORS

- History of infection or colonization with Pseudomonas spp., MRSA, or pathogens resistant to standard CAP therapy (ampicillin-sulbactam or ceftriaxone) within previous 12 months
- Severe community-acquired pneumonia (septic shock OR requiring mechanical ventilation OR high clinical concern for needing ICU care[3]), AND meeting 1 of the following criteria:
    - Hospitalization for at least 48 hours AND use of any intravenous antibiotic, fluoroquinolone, or linezolid within previous 90 days OR
    - Immunocompromised, defined as:
        - AIDS (CD4 <200)
        - Neutropenia (ANC <1000)
        - Kidney or liver or heart transplant recipient within previous 1 year
        - Solid organ transplant recipient treated for rejection within previous 6 months
        - Lung transplant recipient
        - Allogeneic stem cell transplant within previous 1 year or those with chronic GVHD
        - Autoimmune disorders on biologic agents (TNFα inhibitors, rituximab, etc.)

Concomitant use of NSAIDs and/or ACE-I/ARBs:

There are conflicting theories regarding the risk and benefit of non-steroidal anti-inflammatory drugs (NSAIDs) or angiotensin converting enzyme inhibitors/ angiotensin II receptor blockers (ACE-I/ARBs) in patients with COVID-19 infection. Currently, there are no robust data demonstrating beneficial or adverse outcomes with use of these drugs in COVID-19 infections or specifically in COVID-19 infected patients taking these medications for cardiovascular disease. The American Heart Association, American College of Cardiology, and Heart Failure Society of America do not recommend stopping ACE-I or ARBs in COVID-19 infected patients. In addition, a clinical trial (NCT04312009) is investigating whether adjunctive ARB therapy can improve outcomes in COVID-19 patients. Pending this data, we do not endorse stopping or starting such therapies solely because of COVID-19 infection.

References:

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Antimicrobial Subcommittee Approval: N/A	Originated: 03/2020
P&T Approval: N/A	Last Revised: 12/2020

Revision History:

3/16: Removed testing recommendations - added link to testing document
3/17: Added tocilizumab, adjusted pediatric hydroxychloroquine dosing
3/19: Revised tocilizumab criteria, added pneumonia guidance
3/20: Revised tocilizumab dosing to weight based due to changes in Epic dose rounding capabilities, added limited data for corticostaroids in ARDS
3/24: Added guidance on azitrhomycin, revised tocilizumab dosing, added clincial study enrollment appendix
3/25: Revised criteria for HCQ use.
3/26: Revised tocilizumab criteria & included sarilumab study caveat
3/27: Removed study flow diagram
3/31: Removed recommendation for routine HCQ, removed nitazoxanide and lopinavir/ritonavir options, revised ACE/ARB/NSAID recommendations, recommendations re: combination HCQ/Azithromycin, revised pregnancy/breastfeeding recommendations and Remdesivir compassionate use criteria, deleted Tocilizimab re-dosing
4/2: Added suggested labs, revised remdesivir clinical trial information
4/3: Added hyperlink to Appendix A - review of HCQ data
4/6: Revised testing guidance hyperlink
4/7: Revised tocilizumab criteria
4/10: Revised tocilizumab criteria
4/15: Revised tocilizumab criteria
5/15: Revised tocilizumab criteria, revised remdesivir comments
6/3: Revised secondary infection information, revised remdesivir obtainment information
7/10: Added dexamethasone section
8/3: Added remdesivir criteria
9/15: Added convalescent plasma section
10/5: Removed tocilizumab, updated remdesivir comments, updated convalescent plasma comments
10/14: Revised remdesivir criteria
10/28: Revised Table 1, revised remdesivir section
11/19: Revised remdesivir comments
12/3: Revised remdesivir criteria
12/8: Added neutralizing antibiodies section, revised remdesivir criteria.
12/17: Revised neutralizing antibiodies criteria
12/23: Revised neutralizing antibiodies criteria