Inclusion Criteria

- Suspected COVID-19 acute infection
- Fever AND critically ill
- Persistent fever ≥3d AND ill-appearing AND concern for MIS-C
- Persistent unexplained fever ≥5 days

COVID-19 (Acute COVID and MIS-C) Care

The features of acute COVID infection complicated by hyperinflammation and MIS-C may overlap; consider time course and clinical scenario and refer to both MIS-C and acute COVID algorithm as needed (Adapted from Siddiqi, HK, and Mehra, MR. 2020).

Acute COVID Care and Treatment
MIS-C Care and Treatment
Monoclonal Antibody Products for Mild-Moderate COVID-19
Anticoagulation in COVID-19 and MIS-C
Differential Diagnoses & Labs to Consider with Consultants
Definitions of Organ System Involvement
SIU Guidance

Appendix

Version Changes Approval & Citation Evidence Ratings Bibliography
COVID-19 Pathway v4.0: Acute COVID

Inclusion Criteria

- Suspected COVID-19 acute infection

Illness Severity Definitions

**Mild**
- Symptoms of viral illness or upper respiratory tract infection (such as fever, cough, diarrhea, myalgias, rhinorrhea, sore throat, etc.)

**Moderate**
- Signs or symptoms of pneumonia (such as tachypnea, retractions, abnormal chest xray, etc.) AND
- No sustained hypoxia

**Severe**
- Signs or symptoms of pneumonia AND
- New or increased oxygen requirement

**Critical**
- Pneumonia AND one of the following:
  - Requiring positive pressure ventilation OR
  - Signs of sepsis or multi-organ failure

PCR+ or high clinical suspicion for COVID

Review illness severity and consider MIS-C

**Tier 1 Labs**
- COVID PCR if no recent positive, CBC/d, CRP, ESR, BMP, ALT, albumin
- Consider UA and RVP
- Testing guidance documents
- Antibody Testing Indications (for SCH Only)
- Guidance on Who to Test (for SCH Only)

**Tier 2 Labs**
- BNP, troponin, D-dimer, ferritin, fibrinogen, INR/PT/PTT, specimen storage

Consider Sepsis Pathway labs

**Asymptomatic, Mild, or Moderate Illness**

- No hypoxia
- No labs indicated
- Review admission criteria
- Inpatient or outpatient supportive care and monitoring for increasing severity
- Home Quarantine Handout (for SCH Only)
- Monoclonal antibodies

**Severe Illness**

- New or increased oxygen requirement
- Tier 1 labs
- EKG, CXR
- Consult Infectious Disease
- Trend labs and add Tier 2 if symptoms worsen to monitor for complications such as hyperinflammation or MIS-C

Clinically worse OR lab evidence of hyperinflammation?

**Phase Change**

- Go to Acute COVID Treatment

**Lab Evidence of Hyperinflammation**

- No lab criteria is diagnostic; consider if multiple markers of inflammation

**Common values:**
- CRP >3 mg/dL
- ESR >40 mm/h
- ferritin >500 ng/mL
- ANC >7700
- ALC <1500
- platelet <150k
- D-dimer >2 mg/mL
- fibrinogen >400 mg/dL
- albumin <3 g/dL
- anemia for age
- ALT >40 U/L
- INR >1.1

**Inpatient Admit Criteria**

- Admit to Special Isolation Unit (SIU)
  - Hypoxia
  - Inability to tolerate PO
  - Increased work of breathing (grunting, retracting, tachypnea)

**PICU Admit Criteria**

- Concern for respiratory failure, sepsis
- Need for positive pressure ventilation
- Hypotension requiring inotropic support

Stop and Review

**Critical Illness**

- Requires positive pressure ventilation, sepsis, or multi-organ failure
- Tier 1 and 2 labs
- Consider Sepsis Pathway
- ED Guidance: Resuscitation for High-Risk COVID Patient (for SCH Only)
- EKG, CXR, consider ECHO
- Consult PICU and Infectious Disease
- Consult Rheumatology for hyperinflammation
- Imaging for thrombi as indicated by clinical evaluation as D-dimer expected to be elevated in inflammation

**Consider MIS-C if cardiac involvement or labs indicative of severe inflammation and/or multi-organ involvement**
COVID-19 Pathway v4.0: Acute COVID Treatment

Acute COVID Treatment for Patients with Severe or Critical Illness
- Review MIS-C algorithm if indicated
- Plan for daily multi-disciplinary consultants and primary team discussion, and more often if escalation of care
- Consider if clinical trials are applicable
- For patient ≥18, please refer to NIH COVID-19 Treatment Guidelines

Pathogen-directed: Use only in consultation with Infectious Disease
- Remdesivir: Suggested for patients with severe illness and consider for patients with critical illness. To be obtained by ID team.
- Convalescent plasma: (In rare circumstances) Contact transfusion services to obtain

Immunomodulatory:
- Dexamethasone: Consider for patients, especially adolescents, with critical illness or rapidly progressive severe illness
  - 0.15 mg/kg/dose (6 mg max) once daily for up to 10 days or until discharge
- Other corticosteroids: Consider for ARDS or in consultation with Rheumatology for hyperinflammation
- Biologic immunomodulatory medications
  - Anakinra: In consultation with Rheumatology for hyperinflammation

Adjunctive:
- Mechanical thromboprophylaxis with SCDs if possible
- Prophylactic anticoagulation with heparin or enoxaparin if severely or critically ill with risk factors (see anticoagulation page)
- Stress dose hydrocortisone: For patients on chronic glucocorticoids if febrile, requiring O2, hypotensive, or unexplained vomiting

Discharge Isolation Instructions
- Determine length of isolation and need for repeat testing based on severity of illness, first positive PCR or onset of illness, and immunosuppression (patients receiving steroids are considered immunosuppressed by IP) using Infection Prevention Guidance document (for SCH Only)
- Advise family, PCP, and followup providers of end date of isolation and, if immunosuppressed, that repeat PCR x2 after 20 days of isolation is needed to end healthcare facility-based isolation (it should not be needed to end home isolation)
- Please obtain repeat PCR if result may clear patient from healthcare facility-based isolation (ex: if immunosuppressed and 20 days have passed since first positive PCR)
COVID-19 Pathway v4.0: MIS-C

Inclusion Criteria
- Fever AND critically ill OR Persistent fever ≥3d AND ill-appearing AND concern for MIS-C OR Persistent unexplained fever ≥5 days

MIS-C Case Definitions
- CDC
- WHO

Clinical Features/Evidence of MIS-C
- Most patients have ≥4 organ system involvement; ≥2 required for diagnosis
- Involvement of following systems (percent of patients in case series):
  - Gastrointestinal (92%)
  - Cardiovascular (80%)
  - Hematologic (76%)
  - Mucocutaneous (74%, 59% had rash)
  - Respiratory (70%)
  - Musculoskeletal (23%)
  - Renal (8%)
  - Neurologic (6%)
- See definitions of organ system involvement
- Recent COVID illness OR exposure (note: not necessary to suspect MIS-C)

Lab Evidence of MIS-C
No lab criteria is diagnostic; most patients have 4 or more markers of inflammation
- Evidence of inflammation, common values: CRP >3 mg/dL, ESR >40 mm/h, ferritin >500 ng/mL, ANC >7700, ALC <1500, platelet <150k, D-dimer >2 ug/mL, fibrinogen >400 mg/dL, albumin <3 g/dL, anemia, ALT >40 U/L, INR >1.1
- Other: AKI, hyponatremia, high LDH, high troponin, BNP >400 pg/mL, prolonged PT or PTT; If ESR low but high ferritin and CRP, consider MAS

Percentage values adapted from Feldstein et al, NEJM June 2020

Lab Evidence of MIS-C
- Obtain Initial Labs
  - If high clinical suspicion, add Additional Labs
  - CXR (if resp sx)
- If no lab criteria, consider alternate diagnoses
- Admit to Special Isolation Unit (SIU)
- Suspected MIS-C (review case definition “clinically severe illness”)

Inpatient Admit Criteria
- Altered mental status
- Concern for respiratory failure, sepsis
- Need for positive pressure ventilation
- Hypotension or shock

PICU Admit Criteria
- Stop and Review
- Consider differential diagnosis including acute COVID

Consider alternate diagnoses
- Consider discharge with close follow-up
- Obtain Initial Labs
- Add Additional Labs
- CXR (if resp sx)
- Obtain Initial and Additional Labs, EKG, CXR
- ECHO (early if signs of cardiac dysfunction)
- Consider Sepsis Pathway
  - Caution with boluses
  - Monitor for cardiac dysfunction

Complete or Incomplete Kawasaki?
- Yes
  - Follow Kawasaki Disease Pathway
  - If COVID testing negative or while pending
  - Monitor closely for signs of shock
- No

Evidence of MIS-C without alternate diagnosis?
- Yes
  - Go to MIS-C Treatment
- No

PCR or IgG+ OR cardiac dysfunction
- Patients with MIS-C have significant risk for developing shock

For questions concerning this pathway, contact: COVID19Pathway@seattlechildrens.org

Medical Disclaimer: This information is not intended to replace the medical advice of your healthcare provider.
COVID-19 Pathway v4.0: MIS-C Treatment

**Review case definition**: age <21, >24h fever, lab evidence of inflammation (most patients have 4 or more markers), multi-system involvement, and clinically seriously ill, without alternative diagnosis (review differential diagnosis) plus confirmed SARS-CoV-2 or known exposure. (For age >21 see NIH Guidelines for adults)

- ECHO if not already done; repeat as indicated
- Antibiotics per Sepsis Pathway only if and while bacterial infection suspected
- Consider supportive care only for patients who have mild* illness; monitor for increasing severity until clearly improving
- Consultations by Infectious Disease, Rheumatology and Cardiology are usually indicated for diagnostic and/or treatment recommendations; huddle as needed to assist decisions by primary ICU or medical team; consultants see patients in SIU per policy

**First-line treatment for all seriously* ill patients with MIS-C:**

- IVIG 2 g/kg (use ideal body weight) over 12 hours
- Anti-platelet: ASA 3-5 mg/kg (max of 81 mg) due to risk of developing coronary aneurysms
- Mechanical thromboprophylaxis with SCDs if possible
- Anticoagulation: see anticoagulation page
- Early initiation of steroids and/or higher dose of steroids may be indicated for critically ill patients, such as those with persistent shock/inotropic requirement, respiratory or heart failure, or concern for MAS

**Second-line**: Steroids if not improving ~12 h post-IVIG

- Methylprednisolone 2 mg/kg/day divided BID, change to PO when tolerating diet
- Consider higher dose steroids (methylprednisolone 10mg/kg/day) for patients with moderately or severely depressed cardiac function, in consultation with heart failure team
- Start H2 blocker for GI ulcer prophylaxis while on both steroids and ASA
- Wean over 2-3 weeks if possible, due to risk of rebound with short course

**Third-line**: Anakinra if not improving post steroid initiation or if labs suggestive of MAS

- 4 mg/kg/dose q6 hours (or frequency per Rheumatology), max dose 100 mg/dose

Trend CBCd, CRP, LDH, ALT, Albumin, Ferritin, Creatinine, Lytes, D-Dimer, Fibrinogen and BNP (frequency dependent on clinical status and medication weaning; post-discharge labs per consultants)

**Classification of illness severity is not well defined. Consider:**

*Mild*: Normal vital signs apart from fever, does not meet inpatient criteria other than poor PO, mild dehydration, or monitoring for worsening.

*Serious*: Definitively meets case definition and any of: ill-appearing, evidence of organ dysfunction/injury, require for respiratory or cardiovascular support.

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**Discharge Isolation Instructions**

- Determine length of isolation and need for repeat testing based on severity of illness, first positive PCR or onset of illness, and immunosuppression (patients receiving steroids are considered immunosuppressed by IP) using Infection Prevention Guidance document (for SCH ONLY)
- Advise family, PCP, and followup providers of end date of isolation and, if immunosuppressed, that repeat PCR x2 after 20 days of isolation is needed to end healthcare facility-based isolation (it should not be needed to end home isolation)
- Please obtain repeat PCR if result may clear patient from healthcare facility-based isolation (ex: if immunosuppressed and 20 days have passed since first positive PCR)
Monoclonal Antibody Products for Mild-Moderate COVID-19

**Background:** Recent FDA Emergency Use Authorizations (EUAs) allow for the use of monoclonal antibody products (bamlanivimab and combination casirivimab and imdevimab) for early treatment in high-risk patients ≥12 years and ≥40kg for mild-moderate COVID-19.

**Guidance statement:** Based on current available evidence available we suggest against routine administration of monoclonal antibody therapy (bamlanivimab, or casirivimab and imdevimab), for treatment of COVID-19 in any group of children or adolescents. Rather, the Seattle Children’s Hospital COVID-19 Monoclonal Antibody Approval group will consider the use of monoclonal antibodies on a case by case basis for patients at very high risk of progression to severe disease.

**Rationale:** There are no safety or efficacy data for these products in pediatric patients. Based on our experience both internally and around the globe, pediatric patients in general have lower risk of progression to severe disease and poor outcomes. In addition, clear risk factor stratification data is extremely limited and the adult efficacy data upon which these EUA’s are based demonstrated very small numbers of outcomes in both treatment and placebo groups. Finally, supplies of these products are very limited at this time and based on allotments from the public health department.

**Exclusion criteria:**
Hospitalization for COVID-19, O₂ requirements for COVID-19, SARS-CoV-2 antibody positive, Age < 12 or weight <40kg (per EUA), infection >10 days

Provider should email intake form (for SCH Only) to COVIDmab@seattlechildrens.org

**References:**
Lily bamlanivimab EUA: [https://pi.lilly.com/eua/bamlanivimab-eua-factsheet-hcp.pdf](https://pi.lilly.com/eua/bamlanivimab-eua-factsheet-hcp.pdf) (December 2020)
NIH guidance statements:
Anticoagulation in COVID-19 and MIS-C

Patients with severe or critical acute COVID infection or MIS-C are likely at higher risk for thrombosis and therefore should be considered for anticoagulation; review criteria to determine if they require low dose or therapeutic dosing. Also use mechanical thromboprophylaxis with SCDs if possible.

- Relative contraindications to anticoagulation include active major bleeding, platelet level <50,000, and fibrinogen <100mg/dL.
- Discontinue prophylactic anticoagulation at discharge or earlier if patients are improved and risk factors resolved; consider continuation post-discharge for ongoing severe inflammation with other risk factors.
- Consult Hematology for documented thrombosis or as indicated for recommendations in unusual circumstances.
- Asymptomatic, mild, or moderate COVID is not an indication for anticoagulation, use standard indications.

**Indications for low dose anticoagulation (LMWH goal=0.2-0.4units/mL or UFH goal=0.1-0.3units/mL):**

Hospitalized with MIS-C or severe/critical COVID-19 
AND one or more of the following risk factors:

- D-dimer >2.5 mcg/mL
- Age >12 years or post-pubertal
- Obesity (>95th %ile)
- Concomitant estrogen-containing oral contraceptive use
- First degree family history of unprovoked VTE
- History of thrombosis or acquired or inherited thrombophilia
- Central venous catheter
- Any rhythm abnormalities: heart block, etc.
- Inotropic infusion requirement
- Sedated and muscle-relaxed or complete immobility
- Active malignancy, nephrotic syndrome, flare of underlying inflammatory disease state, sickle cell VOC
- Congenital or acquired heart disease with venous stasis or impaired venous return

**Indications for therapeutic anticoagulation (LMWH goal=0.5-1units/mL or UFH goal=0.3-0.6units/mL):**

Hospitalized with MIS-C or severe/critical COVID-19 
AND One or more of the following:

- Documented thrombosis (also consult Hematology)
- Moderate to severe ventricular dysfunction per Cardiology
- Coronary aneurysm Z score >10
- **Consider therapeutic anticoagulation for active malignancy, nephrotic syndrome, flare of underlying inflammatory disease state, heart disease with venous stasis or impaired venous return, personal history of thrombosis, or multiple risk factors – discuss indications with specialist managing underlying condition and/or hematology**

Continue therapeutic dosing while indicated and formulate outpatient plan with consultants

Adapted from Goldenberg et al, 2020
Differential Diagnoses

Kawasaki Disease
- More common in younger children, if COVID testing negative, and without shock/cardiac dysfunction

Bacterial Infections/Sepsis
- Obtain cultures and evaluate for source
- Consider meningitis

Staph/Strep Toxin-Mediated or Post-Infectious
- Consider Toxic Shock or Acute Rheumatic Fever
- Obtain cultures and evaluate for source including gynecologic or scarlet fever

Staph Scalded Skin Syndrome (SSSS)
- Increasing erythema and bullae
- Younger children
- Obtain cultures

Tick-Borne Illnesses
- With epidemiologic risk factors
- Rocky Mountain Spotted Fever or Leptospirosis

Viral Infections
- Measles, adenovirus, enterovirus, active COVID infection

Myocarditis
- May overlap with MIS-C or have alternate cause

Drug Hypersensitivity Reactions
- Consider SJS, DRESS, or serum sickness like reaction
- History of recent or semi-recent exposure to drug; consider with arthralgias and diffuse mucositis

Labs to Consider with Consultants
- Quantitative immunoglobulins (IgG, IgA, IgM, red tube)
- Specimen storage, red and lavender (freeze)
- Lymphocyte subset – Full Panel with TCR
- Antiphospholipid Ab (anticardiolipin, β2 glycoprotein, lupus anticoagulant)
- Cytokine panel
- IL-1β (ARUP test code 0051536, collect 2-3mL in gold/red top, spin and freeze within 2h)
- sIL-2R (AKA sCD25)
- ASO
Definitions of Organ System Involvement

Gastrointestinal 92%
- Nausea/vomiting
- Diarrhea
- Abdominal pain
- Appendicitis
- Pancreatitis
- Hepatitis
- Gallbladder hydrops or edema

Cardiovascular 80%
- Hypotension or shock
- Cardiac dysrhythmia or arrhythmia
- Ejection fraction <55%
- Pulmonary edema due to left heart failure
- Coronary artery z score ≥2.5
- Pericarditis or pericardial effusion or valvulitis
- B-type natriuretic peptide (BNP) >400 pg/mL
- Elevated troponin
- Receipt of vasopressor or vasoactive support
- Receipt of cardiopulmonary resuscitation (CPR)

Hematologic 76%
- Total white blood cell <4k
- Anemia for age
- Platelet count <150,000 /µL
- Deep vein thrombosis
- Pulmonary embolism
- Hemolysis
- Bleeding or prolonged PT/PTT
- Ischemia of an extremity

Mucocutaneous 74%
- Bilateral conjunctival injection
- Oral mucosal changes
- Rash or skin ulcers
- ‘COVID’ toes
- Swollen red cracked lips
- Erythema of palms or soles
- Edema of hands or feet
- Periungual (nails) desquamation

Respiratory 70% (more frequent in teens)
- Receipt of mechanical ventilation or any type of supplemental oxygen (or increased support for patients receiving respiratory support at baseline)
- Severe bronchospasm requiring continuous bronchodilators or
- Pulmonary infiltrates on chest radiograph
- Lower respiratory infection
- Pleural effusion
- Pneumothorax or other signs of barotrauma
- Pulmonary hemorrhage
- Chest-tube or drainage required

Musculoskeletal 23% (more frequent in teens)
- Arthritis or arthralgia
- Myositis or myalgia

Renal 8%
- Acute kidney injury with or without dialysis

Neurologic 6%
- Stroke or acute intracranial hemorrhage
- Seizures
- Encephalitis, aseptic meningitis, or demyelinating disorder
- Altered mental status
- Suspected meningitis with negative culture

Adapted from Feldstein et al, NEJM June 2020
SIU Policies and Guidance

COVID information page on CHILD (for SCH Only)

SIU Admission Job Aid (for SCH Only)

COVID-19 Patient Admit Flow and Testing (includes information on providers and consultants in SIU) (for SCH Only)

Isolation Discontinuation for patients with COVID-19 including MIS-C (for SCH Only)
Summary of Version Changes

- **Version 1.0 (7/9/2020):** Go live.
- **Version 2.0 (8/13/2020):** Removed CK and triglycerides from Labs. Added consult with Cardiology with Echo and added Indications for therapeutic dosing of anticoagulation to Treatment page.
- **Version 3.0 (9/17/2020):** Added Acute COVID algorithm and treatment pages.
- **Version 4.0 (12/21/2020):** Changes include
  - Updated document to the new CSW algorithm template (incl. a Table of Contents)
  - Added illustration of time course highlighting overlap between viral phase and inflammatory phase
  - Acute COVID Tier 1 labs edited to remove D-dimer, LDH, and ferritin; those were moved to Tier 2 due to concern for overuse, guidance added on getting Tier 2 labs for “worsening” cases
  - Added advice on interpreting D-dimer
  - Monoclonal antibody guidance added
  - Updated anticoagulation information: indications for prophylactic and therapeutic dosing as well as contraindications were edited based on Goldenberg et al, 2020.
  - Inpatient and PICU admit criteria added to MIS-C algorithm
  - Steroid wean over “2-3” weeks changed from “minimum 3 weeks” based on ACR guidelines
  - Discharge isolation guidance box added
  - SIU Policies and Guidance page added
  - Bibliography edited to reflect current references
Approved by the CSW COVID-19 Pathway team for December 21, 2020, go-live

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Retrieval Website: https://www.seattlechildrens.org/pdf/covid-19-pathway.pdf

Please cite as:
Evidence Ratings

This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children’s. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94, Hultcrantz M et al. J Clin Epidemiol. 2017;87:4-13.):

Quality ratings are *downgraded* if studies:
- Have serious limitations
- Have inconsistent results
- If evidence does not directly address clinical questions
- If estimates are imprecise OR
- If it is felt that there is substantial publication bias

Quality ratings are *upgraded* if it is felt that:
- The effect size is large
- If studies are designed in a way that confounding would likely underreport the magnitude of the effect OR
- If a dose-response gradient is evident

**Certainty of Evidence**

🌟🌟🌟🌟 High: The authors have a lot of confidence that the true effect is similar to the estimated effect
🌟🌟🌟 Moderate: The authors believe that the true effect is probably close to the estimated effect
🌟🌟 Low: The true effect might be markedly different from the estimated effect
🌟 Very low: The true effect is probably markedly different from the estimated effect

Guideline: Recommendation is from a published guideline that used methodology deemed acceptable by the team
Expert Opinion: Based on available evidence that does not meet GRADE criteria (for example, case-control studies)
Literature Search Methods
Both CDC and WHO case definitions were utilized in the development of this pathway. The articles cited are a representation of local and international experts’ and national societies' resources that were being shared widely, some pre-publication and many that were published by the centers that were diagnosing and treating this new syndrome as the pandemic swept across the globe.

A systematic literature review is in process and may inform future versions of this document. Due to the rapidly evolving literature and the need for urgent guidance, a non-systematic review was used to guide the development of the initial version of this algorithm.

Literature Search Results
The search retrieved 1961 records. Once duplicates had been removed, we had a total of 1550 records. We excluded 1173 records based on titles and abstracts. We obtained the full text of the remaining 94 records and excluded 80. We included 14 studies. The flow diagram summarizes the study selection process.

Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535
Bibliography

December 2020 Included Studies

July 2020 Included Studies
July 2020 Included Studies continued


Medical Disclaimer

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

However, in view of the possibility of human error or changes in medical sciences, neither the authors nor Seattle Children’s Healthcare System nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from the use of such information.

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