

# MYOPERICARDITIS EVALUATION

## After COVID19 Vaccination



Children's National®

### SYMPTOMS

(Children, age 12 and older\*)

• Chest Pain • Shortness of breath • Palpitations

### EVALUATION

RECENT MRNA COVID19 VACCINE?<sup>1</sup>

NO

YES

Routine Chest Pain Evaluation

Check cardiac enzymes<sup>2</sup>

History & Physical Exam

WNL

Elevated

Referral to Pediatric Cardiology, if indicated<sup>3</sup>

Close Clinical Follow-Up

Consult Pediatric Cardiology

### DIAGNOSIS

### MANAGEMENT

Consider Admission (at discretion of physician)

EKG<sup>5</sup>, Echo, SARS-CoV-2 Evaluation<sup>6</sup>, Trend Enzymes

Normal

Abnormal

Supportive care (NSAID, rest)

Care concurrent with diagnostic and clinical findings

Pediatric Infectious Diseases consult and additional work-up<sup>7</sup>



If no improvement in 24 hours

All probable or confirmed cases of myopericarditis following COVID-19 vaccination should be reported to VAERS online by primary team/PCP<sup>4</sup> [www.vaers.hhs.gov](http://www.vaers.hhs.gov)

## FOOTNOTES

\* Children <12 years of age may instead present with 2 or more of the following: irritability, vomiting, poor feeding, tachypnea or lethargy

<sup>1</sup> Recent vaccination = within past 7 days; ask if 1st or 2nd dose

<sup>2</sup> Cardiac Enzymes = Troponin I, CK-MB. May also add inflammatory markers such as ESR and CRP.

<sup>3</sup> Refer to "red flag cardiac symptoms": chest pain or fainting with exercise, pain that radiates to back, jaw, left arm or shoulder, pain worse when lying down or pain with fever. Harahsheh et al. Promoting Judicious Primary Care Referral of Patients with Chest Pain to Cardiology: A Quality Improvement Initiative. Medical Decision Making. January 2021. <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/safety/myocarditis.html>

<sup>4</sup> VAERS (Vaccine Adverse Event Reporting System) – all post-vaccination cases of myopericarditis should be reported to VAERS, regardless of clinician causality assessment; primary team/physician should report online at [www.vaers.hhs.gov](http://www.vaers.hhs.gov)

<sup>5</sup> EKG abnormalities (per CDC working case definition) include ST elevation and T wave inversion or PR-depression (pericarditis)

<sup>6</sup> SARS-CoV-2 PCR from NP swab (if not previously performed) and SARS-CoV-2 nucleocapsid IgG antibody for previous infection (send out to Quest, "SARS-CoV-2 Antibody (IgG), Nucleocapsid, Qualitative", Test code 39749)

<sup>7</sup> Additional Infectious Diseases Evaluation (per CNH Myocarditis Protocol); obtain prior to any IVIg administration if possible

- Lyme Disease Screen with reflex confirmatory Western Blot
- EBV antibody panel (including VCA IgG, VCA IgM, EBNA IgG)
- EBV quantitative blood PCR
- CMV IgM and IgG
- CMV quantitative blood PCR
- Adenovirus blood PCR
- Enterovirus blood PCR
- Parechovirus blood PCR
- Parvovirus blood PCR
- HIV 1/2 Ag/Ab screen (4th gen)
- Multiplex Respiratory Pathogen PCR Panel
- Mycoplasma blood PCR

## CDC CASE DEFINITION FOR ACUTE MYOCARDITIS

### PROBABLE

**Presence of  $\geq 1$  new or worsening clinical symptoms:**

- Chest pain/pressure/discomfort
- Dyspnea/shortness of breath/pain with breathing
- Palpitations
- Syncope

**OR**

**infant and children < 12 may instead present with  $\geq 2$  of the following symptoms:**

- Irritability
- Vomiting
- Poor feeding
- Tachypnea
- Lethargy

**AND**

**$\geq 1$  new finding of:**

- Troponin > ULN
- Abnormal EKG findings, specifically:
  - ST-segment or T-wave abnormalities
  - Paroxysmal or sustained arrhythmias
  - AV nodal conduction delays or IV conduction defects
- Abnormal cardiac function on echocardiogram
- cMRI findings consistent with myocarditis (Lake Louise criteria)

**AND**

no other identifiable cause of the symptoms/finding

### CONFIRMED

**Presence of  $\geq 1$  new or worsening clinical symptoms:**

- Chest pain/pressure/discomfort
- Dyspnea/shortness of breath/pain with breathing
- Palpitations
- Syncope

**OR**

**infant and children < 12 may instead present with  $\geq 2$  of the following symptoms:**

- Irritability
- Vomiting
- Poor feeding
- Tachypnea
- Lethargy

**AND**

Histopathologic confirmation of myocarditis

**OR**

Troponin > ULN PLUS cMRI findings consistent with myocarditis (Dallas criteria)

**AND**

no other identifiable cause of symptoms/findings

## CDC CASE DEFINITION FOR ACUTE PERICARDITIS

**Presence of  $\geq 2$  new or worsening of the following clinical features:**

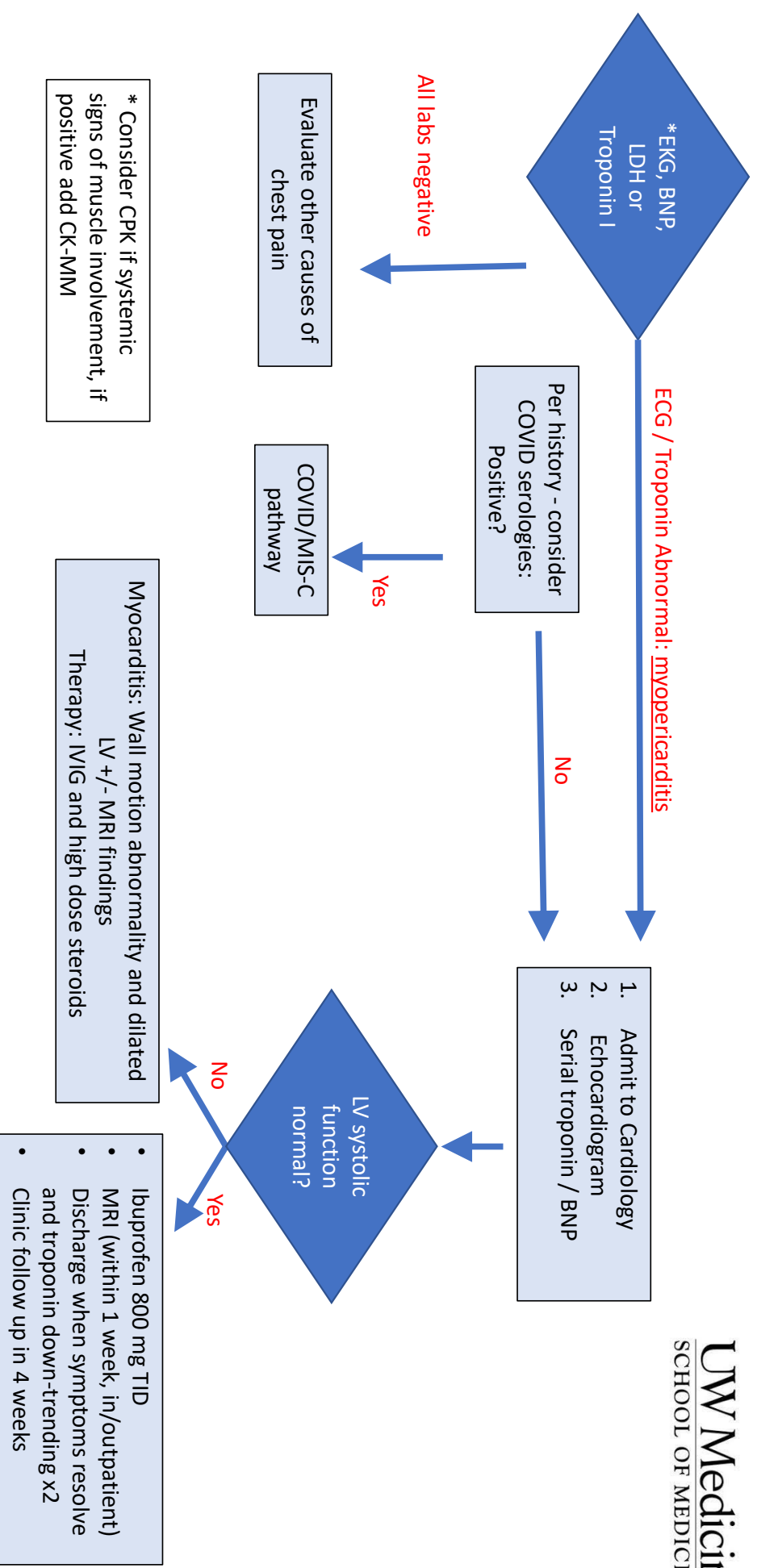
- Acute chest pain
- Typically worse when lying down, with deep inspiration or with cough and relieved by sitting up/leaning forward
- Pericardial rub on exam
- New ST-elevation or PR-depression on EKG
- New or worsening pericardial effusion on echocardiogram or MRI

## Concern for Post COVID vaccine myopericarditis (chest pain within 2 weeks after vaccine)



Seattle Children's  
HOSPITAL • RESEARCH • FOUNDATION

UW Medicine  
SCHOOL OF MEDICINE



\* Consider CPK if systemic signs of muscle involvement, if positive add CK-MM

Myocarditis: Wall motion abnormality and dilated LV +/- MRI findings  
Therapy: IVIG and high dose steroids

- Ibuprofen 800 mg TID
- MRI (within 1 week, in/outpatient)
- Discharge when symptoms resolve and troponin down-trending x2
- Clinic follow up in 4 weeks

## COVID-19 Vaccine Associated Myocarditis Management Protocol

Authors: Elizabeth Profita, Shiraz Maskatia, Grace Lee, Hayden Schwenk, Alan Schroeder

### CDC Working Definition of Acute Myocarditis

#### Clinical Case:

1. Presence of 1 or more symptoms of chest pain/pressure/discomfort, dyspnea/SOB, palpitations
  - a. In Children < 12 years of age, consider 2 or more symptoms of irritability, vomiting, poor feeding, tachypnea, lethargy
2. Abnormal testing (At least 1 new finding):
  - a. Elevated troponin (above upper limit of normal for lab)
  - b. Abnormal ECG
  - c. Abnormal echo (decreased systolic function, pericardial effusion)
  - d. CMRI findings consistent with myocarditis or decreased systolic function
3. No other identifiable cause of symptoms and findings

#### Confirmed Case:

1. Presence of 1 or more symptoms of chest pain/pressure/discomfort, dyspnea/SOB, palpitations
  - a. In Children < 12 years of age, consider 2 or more symptoms of irritability, vomiting, poor feeding, tachypnea, lethargy
2. Abnormal testing
  - a. Elevated troponin (above upper limit of normal for lab) and CMRI findings consistent with myocarditis
  - b. Histopathologic (biopsy) confirmation of myocarditis
3. No other identifiable cause of symptoms and findings

### CDC Working Definition of Acute Pericarditis

#### Clinical Case:

1. Presence of 2 or more:
  - a. Pericardial Chest Pain\*
  - b. Pericardial rub on exam
  - c. New ST segment elevations or PR depressions on ECG
  - d. New or worsening pericardial effusion on echo or CMRI

\*Typically described as pain made worse by lying down, deep inspiration, or cough and relieved by sitting up or leaning forward, although other types of chest pain may occur

## COVID-19 Vaccine Associated Myocarditis Management Protocol

### Criteria for Evaluation of Suspected COVID-19 Vaccine Associated Myocarditis

1. Presence of chest pain, chest pressure or discomfort; dyspnea or shortness of breath; or palpitations in an individual who is within 10 days of receiving COVID-19 mRNA vaccine (Pfizer-BioNTech or Moderna) dose (either 1<sup>st</sup> or 2<sup>nd</sup> dose) should prompt consideration of evaluation
2. Initial Diagnostic testing
  - a. Vital signs
  - b. Troponin
  - c. NT-proBNP, or BNP according to lab availability
  - d. CRP
  - e. ECG
3. If evaluation above is reassuring, symptomatic treatment with ibuprofen may be considered with outpatient follow-up at 48-72 hours to confirm resolution
4. If there are significant abnormalities in the evaluation, or if symptoms are severe, further evaluation should be performed within 48 hours (or more urgently at discretion of treating physician)
  - a. Pediatric cardiology evaluation
    - i. Repeat troponin, NT-proBNP/BNP, CRP
    - ii. SARS-CoV2 nucleocapsid antibody, Rapid Respiratory Pathogen/COVID-19 Panel\*
    - iii. Repeat ECG
    - iv. Cardiac Echo
    - v. Consider admission for telemetry and observation
    - vi. Recommend cMRI if abnormal troponin
  - b. Evaluation in ED should be considered if initial evaluation suggests unstable vital signs or rapidly evolving clinical findings; or if expedited cardiology evaluate is not possible
    - i. ED evaluation to include lab testing above (troponin, NT-proBNP/BNP, CRP, SARS-CoV2 nucleocapsid antibody, Rapid Respiratory Pathogen/COVID-19 Panel)
    - ii. Consult pediatric cardiology
    - iii. Repeat ECG
    - iv. Obtain echo if not yet obtained
    - v. Recommend CMRI if abnormal troponin
    - vi. Consideration for evaluation of other causes of symptoms
    - vii. If all studies in ED are normal, discharge from ED may be considered with follow-up in 24-72 hours with ibuprofen for symptom management
5. Report clinical or confirmed cases of myocarditis/pericarditis to VAERS (<https://vaers.hhs.gov/>)

\* Rapid Respiratory Pathogen/COVID-19 Panel includes SARS-CoV-2, influenza A, influenza subtype, influenza B, RSV, parainfluenza 1-4, metapneumovirus, rhinovirus/enterovirus, adenovirus, Chlamydia pneumoniae, and Mycoplasma pneumoniae.

## COVID-19 Vaccine Associated Myocarditis Management Protocol

### Inpatient Care Recommendations

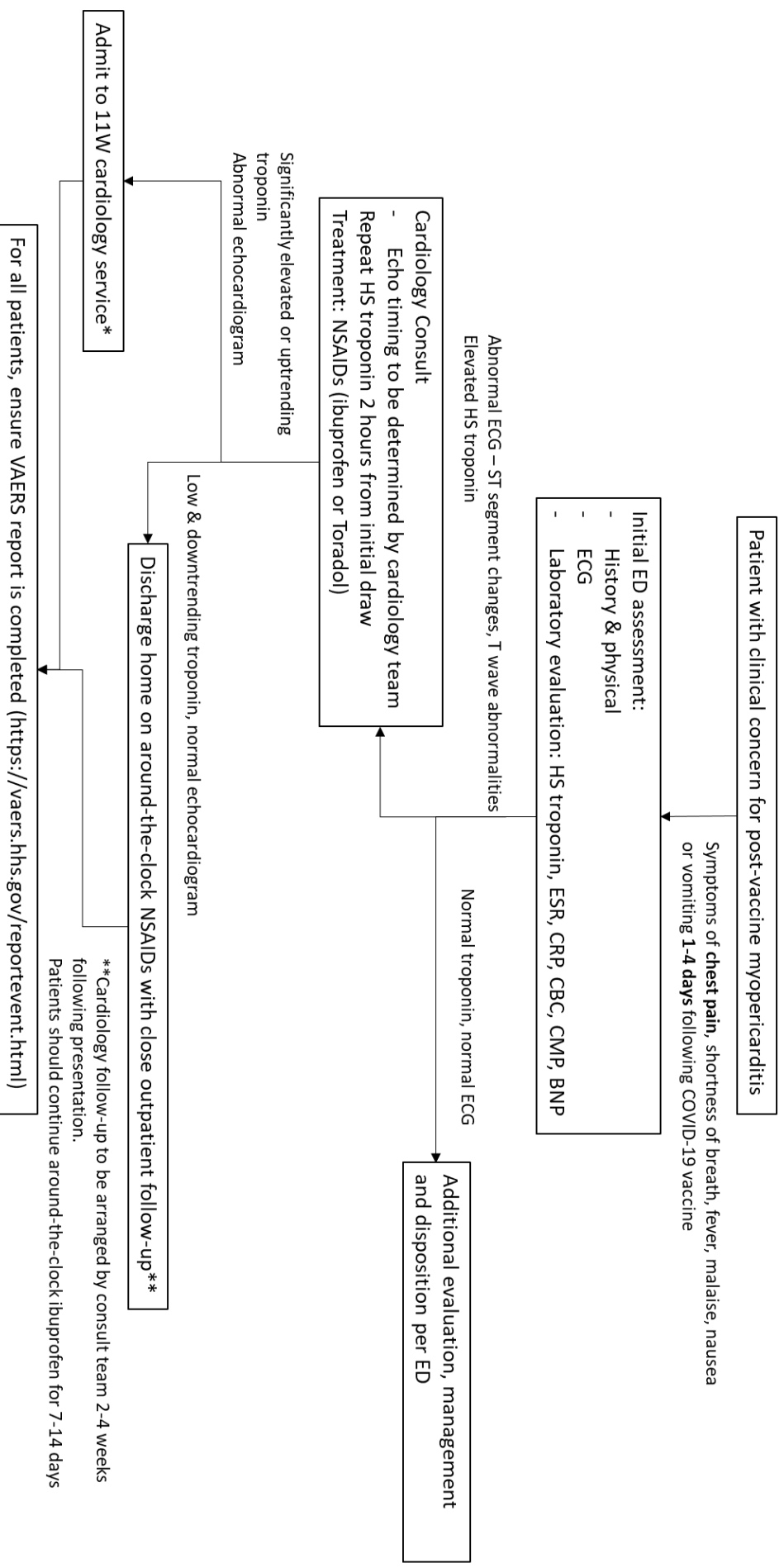
1. Admission to acute care cardiology is warranted in the presence of elevated troponin, abnormal ECG or mildly decreased systolic function
2. Admission to CVICU is warranted in the presence of significant dysrhythmia, respiratory distress, or moderately/severely decreased systolic function
3. During initial phase of inpatient care, the following should be considered
  - a. Serial troponin monitoring
  - b. Telemetry
  - c. cMRI [Order: Morphology and function with contrast, and indication to evaluate for myocarditis post COVID-19 vaccine]
  - d. If any concerning family history (sudden death, unexplained death < age 40, or cardiomyopathy), consult cardiac genetics for consideration of genetic testing (Invitae Cardiomyopathy and Arrhythmia Panel)
  - e. Contact Kari Nadeau regarding immune response study (knadeau@stanford.edu)
4. Symptom management – use prn to treat pain, no need to schedule medication to treat inflammation
  - a. First line: ibuprofen 10 mg/kg q6 hr, Second line: toradol, Third line: colchicine
    - i. If significant LV dysfunction or concern for lymphocytic myocarditis, consider addition of steroids (prednisone 2mg/kg BID) or IVIG (2g/kg)
  - b. Discharge criteria
    - i. Resolution or significant improvement in symptoms
    - ii. No significant arrhythmia x 24 hrs
    - iii. Down-trending troponin
    - iv. Ziopatch placed on discharge if dysrhythmia or abnormal echo or CMRI
    - v. Troponin and EKG do not need to normalize prior to discharge
    - vi. Provide exercise restriction guidance (see below)

## COVID-19 Vaccine Associated Myocarditis Management Protocol

### Follow-up recommendations

1. Negative Work-Up (negative troponin, normal echo, negative CMRI):
  - i. Follow-up with PCP within 3 days
  - ii. Consider repeat evaluation if persistent symptoms
  - iii. No scheduled cardiology follow-up
  - iv. No exercise restriction
2. Clinical Case (elevated troponin, negative CMRI):
  - i. Follow-up with PCP within 3 days
  - ii. Follow troponin weekly until normalizes
  - iii. Cardiology follow-up in 2-4 weeks with echo, ECG
  - iv. No scheduled repeat CMRI unless new symptoms
  - v. Exercise restriction until troponin and echo normalizes and cleared by cardiology
3. Confirmed Case (elevated troponin, and abnormal echo or CMRI):
  - i. Ziopatch on discharge
  - ii. Follow-up with PCP within 3 days
  - iii. Follow troponin weekly until normalizes
  - iv. Cardiology follow-up in 2-4 weeks with echo, ECG
  - v. Repeat CMRI at 3 months
  - vi. Exercise Test at 3 months
  - vii. Exercise restriction until cardiac follow-up at 3 months, pending normalization of labs and CMRI
  - viii. If persistent abnormalities at 3 month evaluation, may need 6 month exercise restriction and/or repeat imaging

### Recommendations for patients presenting to the ED with concern for post-COVID-19 vaccination myopericarditis (University of Michigan)



\*For patients with normal echocardiogram and only mildly elevated troponins, there may be an option for extended ED observation with serial HS troponin and ECG, with involvement of the cardiology consult team

\*\*Cardiology follow-up to be arranged by consult team 2-4 weeks following presentation. Patients should continue around-the-clock ibuprofen for 7-14 days



### *Background & additional details*

There is increasing awareness regarding the incidence of myopericarditis following the 2<sup>nd</sup> dose of mRNA COVID-19 vaccine (Pfizer or Moderna) in adolescents and young adults. This was first reported in Israel and has now been seen in the US. There have been approximately 300 cases reported throughout the country. We have seen several cases at Mott and in surrounding area hospitals. Patients typically present with significant, acute onset, chest pain with or without shortness of breath 1-4 days following the second dose. Additional symptoms have included: malaise, fever, nausea and vomiting. Outcomes are generally good, though only short-term data is known at this point.

In our experience, very few patients have had change in their ventricular function. All patients have had excellent symptomatic response to NSAID therapy and have not required escalation of therapy.

ECGs can be normal or abnormal at initial presentation. Abnormalities seen on ECG include T-wave abnormalities (flattening or inversion) and ST segment elevation.

High-sensitivity troponin is commonly quite elevated in these patients (hundreds to thousands). It is not yet known if this correlates with severity of illness. Troponin can take days to weeks to normalize following presentation.

## **Post Covid vaccine myocarditis**

### Presentation: (in < 21 years age)

- Mostly boys
- So far only after the Pfizer mRNA vaccine– in that age group because that's the only one approved less than 18 years age. But has been reported with the Moderna in young adults.
- Typically, on day 3 after second dose of vaccine, (2 to 10 days, upto 30 days), can happen after 1<sup>st</sup>, but rare
- Presenting symptoms **chest pain**, shortness of breath, palpitations

### Work-up:

- ECG
- Echo
- Initial labs: CBC, CMP, **troponin**, BNP, CRP, ESR, urine toxicology if applicable, Covid PCR
- Subsequent labs: Trend troponins, myocarditis panel
- Cardiac MRI if felt necessary, though we feel that symptoms along with elevated troponin and timing after second dose is enough to make the diagnosis and an MRI is not really necessary in the acute phase

### Admission:

If diagnosed with post Covid myocarditis: Admit to **telemetry unit** for monitoring. Some of these patients have been noted to have isolated PVCs or nonsustained ventricular tachycardia. In case of bed shortage on cardiac unit, can admit to PICU for at least 24 hours monitoring

### Treatment:

**-Typical presentation:** Chest pain, shortness of breath with elevated troponins but with normal cardiac function: Can treat with high-dose Motrin along with a GI protective agent.

**-Severe cases:** In case of **heart failure, persistent elevation of troponin:** Consider giving steroids, IVIG

-we have used Methylprednisone 10mg/kg/d X 3 days, if still having ectopy, we start a steroid taper with prednisone 2 mg/kg/d in 2 doses, decrease every 5 days by 0.5 mg/kg/d

-IVIG 1 g/kg in 1 or 2 divided doses

**-Very mild cases:** In case of resolution of symptoms at the time of admission and troponin less than 1 ng/mL: May consider observation for 24 hours without any treatment

-consider Beta blockers for persistent non sustained VT

Please **report at:** <https://vaers.hhs.gov/esub/index.jsp>

### Discharge Criteria:

- resolution of chest pain
- downtrending troponin for atleast 3 tests
- no significant ectopy (isolated PVCs are ok)

### Follow-up:

- restrict from intense activity and sports for 3-6 months (regardless of severity)
- May consider discharging with a 30-Day Loop monitor in case of noted arrhythmia
- Follow-up in cardiology with ECG and echocardiogram in 2 weeks
- If happened after 1<sup>st</sup> dose, withhold 2<sup>nd</sup> dose

Please feel free to call/ email with any questions.

**dthacker@nemours.org**

**POST-COVID-VACCINE MYOCARDITIS PROTOCOL SUMMARY v.1 (CHLA)**

<b>EMERGENCY ROOM – HPI: chest pain, dyspnea, palpitations within 14 days of vaccine</b>
<b>Evaluation</b>
Labs: Troponin-I (TN-I) in addition to other clinically relevant work-up
Obtain Echo, EKG in addition to other clinically relevant work-up
<b>Management</b>
For symptoms of chest pain, ibuprofen 600mg (or 10 mg/kg) TID x3-7 days, then taper according to severity of symptoms
<b>Disposition</b>
IF TN-I normal, echo normal, but EKG abnormal: Outpatient general cardiology referral
IF TN-I elevated, echo abnormal, or concerning vital signs: Admit to CHLA
<b>CV ACUTE – Normal echo (FS ≥ 28%), no arrhythmias seen in ED telemetry, AND stable vital signs</b>
<b>Evaluation</b>
Labs (can be timed 6-8h after initial TN-I): CBC, Chem 14, ESR, CRP, BNP, TN-I, SARS-CoV-2 PCR, SARS-CoV-2 IgG, RV panel, extra tube of blood to hold
Echo (if not done in ER)
Obtain baseline cardiac MRI (inpatient)
Consider ID consult
Daily TN-I until down-trending
<b>Management</b>
For symptoms of chest pain, ibuprofen 600mg (or 10 mg/kg) TID x3-7 days, then taper according to severity of symptoms
If ESR/CRP elevated, Medrol Dosepack (or oral methylprednisolone starting at 0.5mg/kg/day with daily taper by 0.1mg/kg/day)
<b>Discharge</b>
D/c home when TN-I begins to trend downward
F/u in myocarditis clinic in 2 weeks
<b>CTICU – Abnormal echo (FS &lt; 28%), arrhythmias, OR concerning hemodynamic status</b>
<b>Evaluation</b>
Labs (can be timed 6-8h after initial TN-I): CBC, Chem 14, ESR, CRP, BNP, TN-I, extra tube of blood to hold
Viral myocarditis work-up: SARS-CoV-2 PCR, SARS-CoV-2 IgG, RV panel, HIV screen, blood PCR assays (enterovirus, adenovirus, EBV, parvovirus), stool PCR assays (EBV, enterovirus, adenovirus)
Echo (if not done in ER)
Obtain baseline cardiac MRI (inpatient)
ID consult, heart failure team consult
Daily TN-I until down-trending
If fulminant myocarditis, or prolonged ICU stay (>2 weeks), consider endomyocardial biopsy for further evaluation
<b>Management</b>
<i>For symptoms of chest pain:</i>
Mild-moderate: Ibuprofen 600mg (or 10 mg/kg) TID x3-7 days, then taper according to symptoms
Severe: Ketorlac IV ATC (monitor renal function closely)
<i>For inflammation:</i>
If ESR/CRP elevated, Medrol Dosepack (or oral methylprednisolone starting at 0.5mg/kg/day with daily taper by 0.1mg/kg/day)
<i>First-line immunomodulatory treatment:</i>
Intravenous immunoglobulin (IVIg) 2g/kg ideal body weight administered in 2 divided doses, one dose daily
<i>Other immunomodulatory treatment:</i>
If prolonged ICU requirement and viral etiology unlikely (s/p biopsy), consider steroid pulse and taper per general myocarditis protocol: methylprednisolone IV 5mg/kg x1, 1mg/kg/dose q12h x5 days, 0.5mg/kg/dose q12h x2 weeks, further taper over 1-6 mo.
<b>Discharge</b>
D/c home when clinically stable, TN-I down-trending
F/u in heart failure clinic in 2 weeks

**OUTPATIENT FOLLOW-UP**

Clinic visits at 2 weeks, 3 months, 6 months, 12 months for patients with normal ventricular function

Echo and EKG

Labs: CBC, Chem 14, CRP, ESR, BNP, TN-I (if abnormal at time of discharge/last appointment)

If patient received IV steroids or IVIg, obtain SARS-CoV-2 IgG for anti-spike antibody measurement

IF history of arrhythmia: ZioPatch monitor at 3 months (discuss results at 6-month visit)

IF abnormal MRI at presentation (or no MRI done), order MRI at 3 months (discuss results at 6-month visit)

If applicable, recommend 2<sup>nd</sup> vaccination when echocardiogram, EKG, ESR, CRP, TN-I have normalized

Exercise restriction for 3-6 months

- May consider progressive return to sports after 3 months in patients with normal function and cardiac MRI without LGE
- Recommend 6 months of exercise restriction for patients with ventricular dysfunction, LGE on cardiac MRI, or significant arrhythmia
- Consider exercise stress test at 3-6 months prior to return to sport

## **COVID-19 Vaccination and Myocarditis, Pericarditis, and Myopericarditis**

Recent reports have indicated rare cases of cardiac related complications following m-RNA based COVID vaccine administration. These complications most commonly have been pericarditis, myocarditis, or myopericarditis. These complications have been rare (estimated incidence 1 in 10,000 patients vaccinated) and have been well tolerated with median hospitalization of 3-4 days. There is a predominance of these rare cases to occur following the second dose of the vaccine and with rates higher in males. These symptoms often occurred within a week of vaccination. The Center for Disease Control (CDC) continues to monitor this situation very closely, however given the rare number of cases (much lower than previous reports of acute COVID infection causing myocarditis, or of Multisystem Inflammatory Syndrome in children), and the significant benefit to individuals and the population at large, the benefits appear to far outweigh the potential risks.

### **I. CASE DEFINITIONS**

#### **Pericarditis**

Presence of  $\geq 2$  new or worsening of the following clinical features:

- New onset, acute chest pain (typically worse with lying down, deep inspiration, or cough, and relieved by sitting up)
- Pericardial rub on exam
- New ST-elevation or PR-depression on EKG or
- New or worsening pericardial effusion

#### **Myocarditis**

Presence  $\geq 1$  new or worsening of the following symptoms\*:

- New onset chest pain/pressure/discomfort
- Shortness of breath
- Palpitations
- Syncope

\* Infants may present with irritability, vomiting, poor feeding, tachypnea and lethargy

AND

Presence  $\geq 1$  finding:

- Troponin elevation
- Abnormal electrocardiogram (ST or T wave changes, dysrhythmias, or AV conduction/ interventricular conduction delays)
- Abnormal cardiac function or wall motion abnormalities
- Cardiac MRI findings of myocarditis

AND

- No other identifiable source

#### **Myopericarditis**

Clinical Scenario where both case definitions are met

## II. CLINICAL CCHMC PEDIATRIC CARDIOLOGY RECOMMENDATIONS

### Symptoms of Potential Cardiac Complications Prompting Evaluation

- Chest pain
- Shortness of breath
- Palpitations
- Lethargy
- Syncope particularly with exertion

### Encouraged Clinical Workup

- Electrocardiogram (looking for diffuse ST segment elevation, PR depression, or new conduction delay)
- Chest X ray
- High-sensitivity troponin and NT-proBNP
- Consider a cardiology consultation if any testing is abnormal or a pericardial friction rub is appreciated on exam. **If testing normal, cardiology consultation is not required, however we are happy to help in individual clinical scenarios**

### Anticipated course of action

- If testing is normal, recommend a short course of non-steroid inflammatory management and follow up with their primary care doctor
- If troponin elevated would consider an echocardiogram to evaluate for dysfunction and pericardial effusion
- If echocardiogram is abnormal would consider hospital admission with supportive treatment (for pain relieve and possible anti-inflammatory medications)
- Discharge to home when clinically stable and adequate pain control. Exercise restriction until seen by Cardiology to monitor for resolution of heart inflammation.

## III. ADVICE REGARDING SUBSEQUENT VACCINATION FOR THOSE WITH DOCUMENTED CARDIAC COMPLICATIONS

Given the uncertainty regarding the association of mRNA COVID-19 vaccine with myocarditis, deferral of the 2<sup>nd</sup> dose is recommended. However, proceeding with the 2<sup>nd</sup> dose can be considered in certain

circumstances. If choosing to proceed with vaccination, waiting at least until the heart has made a full recovery is recommended. Recovery includes resolution of symptoms attributed to myocarditis as well as no evidence of ongoing heart inflammation or sequelae as determined by the individual's clinical team, which may include a cardiologist. In such cases, a conversation between the patient, their guardian(s), and their clinical team may assist with decisions about proceeding with vaccination, though a conversation with a healthcare provider is not required before vaccination. Considerations for vaccination may include:

- Personal risk of severe acute COVID-19 (e.g., age, underlying conditions)
- Level of COVID-19 community transmission and personal risk of reinfection
- Limited safety data of COVID-19 vaccines following these illnesses
- Timing of any immunomodulatory therapies (ACIP's [general best practice guidelines for immunization](#) can be consulted for more information)

CDC is continuing to investigate cases of myocarditis and pericarditis after vaccination, and this guidance will be updated as new information is obtained. All cases of myocarditis, pericarditis, or myopericarditis following COVID-19 vaccination should be reported to Vaccine Adverse Event Reporting System (<http://vaers.hhs.gov>) [VAERS](#).

\*\*\*Last edited 7/1/21

## **Guidance for Management of Myopericarditis post COVID-19 vaccination**

**Division of Infectious Diseases**

**Dr. Jocelyn Ang, Dr. Basim Asmar, Dr. Nahed Abdel-Haq, Dr. Harbir Arora, Dr. Jeff Sanchez**

**Division of Cardiology**

**Dr. Gautam Singh, Dr. Sanjeev Aggarwal; Dr. Yamuna Sanil, Dr. Raya Safa**

**Children's Hospital of Michigan**

**Detroit, Michigan**

***Disclaimer:** This document is intended to provide guidance on the medical management of patients with Myopericarditis post COVID-19 vaccination at Children's Hospital of Michigan. Our understanding of this illness is constantly evolving. This document is subject to revisions in the future.*

Since April 2021, increased cases of myocarditis and pericarditis have been reported in the United States after mRNA COVID-19 vaccination (Pfizer-BioNTech and Moderna), particularly in adolescents and young adults.

In most cases, patients who presented for medical care have responded well to medications and rest and had prompt improvement of symptoms. Reported cases have occurred predominantly in male adolescents and young adults 16 years of age and older. Onset was typically within several days after mRNA COVID-19 vaccination, and cases have occurred more often after the second dose than the first dose. CDC and its partners are investigating these reports of myocarditis and pericarditis following mRNA COVID-19 vaccination. <https://www.cdc.gov/vaccines/covid-19/clinical-considerations/myocarditis.html>.

**Who should be considered and need high index of suspicion for post COVID 19 vaccine myocarditis? Consider myocarditis and pericarditis in adolescents or young adults with fatigue, acute chest pain, shortness of breath, or palpitations within 7 days after COVID-19 vaccination.**

**For initial evaluation** of patients with suspected myopericarditis, obtain ECG, troponin level, and inflammatory markers (C-reactive protein and erythrocyte sedimentation rate). In the setting of normal ECG, troponin, and inflammatory markers, myocarditis or pericarditis are less likely.

Evaluation and management vary depending on the patient age, clinical presentation.

Report all cases of myocarditis and pericarditis post COVID-19 vaccination to VAERS **by primary team**. <https://vaers.hhs.gov/reportevent.html>

**Additional work-up for suspected myocarditis and pericarditis in patients with abnormal troponin or ECG:**

- 1. Consult Infectious Diseases and Cardiology services for assistance with evaluation and management.**
2. Evaluate for prior SARS-CoV-2 infection :
  - a. Order in house COVID-19 antibody testing
  - b. Obtain 3 cc of blood in a gold top tube to be sent to Michigan Department of health — for detection of both SARS-CoV-2 nucleocapsid AND spike protein antibodies)
    - i. fill form to be provided by ID consultation team
    - ii. tube sample and form to DMC send out lab
    - iii. if IVIG is to be given ,obtain sample prior to start of IVIG infusion
3. Rule out acute COVID-19 and other viral etiology:
  - a. Send NP sample for RVP PCR testing which includes COVID-19 virus and other respiratory viral pathogens.
  - b. Send blood for: Parvovirus B-19, Adenovirus and Enterovirus PCRs



- c. Send blood sample for Myocarditis/Pericarditis Panel (Antibodies for Coxsackie B1-6; Echovirus 4,7,9,11,30; Influenza A/B ; *Chlamydomphila pneumoniae*)
  - i. Obtain 2 cc of blood in a red top tube
  - ii. Fill out a DMC send out lab slip
  - iii. Send sample to **DMC send –out- lab**
  - iv. Blood sample to be obtained prior to starting IVIG (if IVIG is to be given).
4. Obtain CBC, CMP, BNP
5. Repeat CRP, ESR and Troponin
6. Chest X-ray
7. Echocardiogram
8. Cardiac MRI to be done ASAP, preferably within 48 hours of the admission. (please contact Dr. Sanjeev Aggarwal , beeper 3834 to facilitate the test)

Management:

1. Admit patients to 4 cardiac PICU **for initial monitoring with telemetry** – transfer to ID floor when stable
2. Trend troponin level:
  - Every 6-8 hours for unstable patients with decreased heart function
  - Every 12-24 hours if function is normal until troponin level is decreasing
3. Obtain ECG and repeat echocardiogram if condition is worsening (increasing troponin level, new arrhythmia or hypotension)
4. Pain control with NSAIDS (Ketorolac: 0.5 mg/kg/dose IV q6-8 hours; max 30 mg/dose)

**5. For stable patients with normal 2 D echo but elevated high sensitivity troponin 1 ( $\geq 100$  ng/L) and increasing by  $\geq 25\%$ :**

- Start NSAIDS treatment (ketorolac, ibuprofen, naproxen, **or** aspirin) at the discretion of ID consultant and monitor closely
- Short course PO steroid can be considered
- Low dose ASA to be determined on a case to case basis
- Monitor markers of inflammation, cardiac function and ECG until normalization

**6. For hemodynamically unstable patients (increasing troponin  $\geq 25\%$  from baseline), decreased cardiac function, and hypotension, abnormal EKG) start immunomodulatory treatment:**

**1. IVIG**

- Dosing
  - 2 gm/kg IV infuse over 15 to 18 hours
  - For obese patients, use ideal body weight based on the 50<sup>th</sup> weight percentile corresponding to patient's actual height
  - Monitor vital signs per protocol during infusion

**2. Steroids**

- Dosing based on clinical status and severity.
  - Methylprednisolone IV: 2 mg/kg/day, divided q12h x 3- 5 days
- Start weaning at discharge over 3-4 weeks as follows (PO prednisone):  
 2 mg/kg/day divided Q 12hours (max 60 mg/day) for 5 days  
 Then taper by Q 3 days as follows:

1 mg/kg/day divided Q 12hours (max 30 mg/day) for 3 days  
20 mg/day for 3 days  
10 mg/day for 3 days  
5 mg/day for 3 days then stop

### **3. Low dose Aspirin**

- At discharge start low-dose aspirin therapy (3-5 mg/kg/day once daily) max 81 mg/day for 2-4 weeks until outpatient follow up
- Avoid concomitant ibuprofen administration

**It is prudent to monitor markers of inflammation, cardiac function and ECG prior to termination of anti-inflammatory therapy.**

- If there is concomitant pericarditis (ECG changes consistent with pericarditis, or clinical rub on exam and/or evidence of pericardial effusion on echo), use short course NSAIDs (dose above) until pericarditis resolves
- GI prophylaxis with famotidine for patients on NSAIDs or steroids
  - Famotidine dose: 0.25 mg/kg/dose IV q12; 0.5 mg/kg/dose PO q12; max 40 mg/day

Follow-up:

- Appointment to be made prior to discharge with both Peds ID and cardiology in 2 weeks  
Echocardiogram, EKG and labs (CBC, CRP, ESR, BNP, Troponin)
- If initial Cardiac MRI is abnormal, repeat at 6 months
- Avoid strenuous activities and excessive for 3-6 months until cleared by cardiology
- Need exercise stress test at 3-6 months prior to return to sport

Risk of further COVID-19 vaccination—to be discussed prior to hospital discharge.

For further questions, please contact:

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**GUIDELINE FOR MANAGEMENT OF POST COVID VACCINE ADJACENT MYOCARDIAL INFLAMMATION / MYOCARDITIS TEMPORALLY ASSOCIATED WITH COVID VACCINATION**

Preeti Ramachandran – Peds cardiology; David Nelson/ Matthew Bacon/ Johnna Forman – CHP program;  
Landon Jones – Emergency Medicine

**CRITERIA FOR ADMISSION to CHP service (Must meet criteria 1 PLUS one or more of criteria 2-5)**

1. Received second dose of COVID vaccine within last 1 week
2. Persistent chest pain +/- shortness of breath, nausea and tachycardia
3. Elevated troponin or inflammatory markers
4. Abnormal ECG findings
5. Ventricular arrhythmias

**ER evaluation**

1. CXR 2 view
2. EKG 12 lead
2. High sensitivity troponin
3. CRP, ESR, procalcitonin
4. COVID PCR + resp viral PCR
5. COVID IgG ab
6. Echo in ER if hemodynamically unstable on evaluation/ Echo can be deferred to inpatient if patient is hemodynamically stable
7. Start Ibuprofen 10-15mg/kg q6hrs or 600mg or 800mg q6hrs based on weight if persistent chest pain or sings of pericarditis on ECG
8. Start GI prophylaxis while on ibuprofen

**Inpatient admission**

1. Trend troponin q8hrs for first 24hrs followed by q24hrs thereafter
2. Repeat EKG not unrequired unless symptoms evolving, concern for arrhythmia
2. Echo to assess LV systolic and diastolic function and r/o pericardial effusion
3. Continue Ibuprofen q6 or q8hrs and titrate for chest pain. Morphine prn if severe chest pain
4. Consider IVIG if LV dysfunction present or sustained VT occurs
5. Consider colchicine if there is pericardial effusion on echo.
6. Arrange for inpatient CMR (MR Cardiac morphology order and MR Cardiac flow order) once chest pain resolves and patient able to lay flat. If no clinical or lab evidence of myocarditis, no advanced cardiac imaging required.
7. Consider ID consult If concern for other infectious sources
8. Report case to VAERS, CDC prior to d/c (Go to <https://vaers.hhs.gov/reportevent.html>) – please list cardiac ICU attending/ primary cardiologist as contact on PDF

**Discharge planning**

1. Plan for 12 lead EKG
2. Activity restriction until seen by cardiology as outpatient
3. Continue ibuprofen 1 week following d/c with GI prophylaxis. Following this Ibuprofen can be taken prn.
4. Patient to call clinic If has recurrent chest pain after 1 week
5. Place VAER

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**Outpatient management**

1. Follow up in cardiology clinic in 2 weeks with EKG, ECHO.
2. Follow up CMR at 6months from initial episode.

**CDC VAERS REPORTING CHECKLIST**

Checklist of information to complete the VAERS form

(VAERS will still accept a report even if you cannot provide all this information)

Information about the PATIENT who received the vaccine

o Name, address, phone number and email address

o Date of birth

o Sex (male or female)

o Date and time of vaccination

o Date and time the adverse event (health problem) started

o Age at vaccination

o Whether the patient was pregnant at the time of vaccination and the due date (for females only, if applicable)

o Prescriptions, over-the-counter medications, dietary supplements and herbal remedies being taken

o Allergies to medications, food, or other products

o Other illnesses at the time of vaccination (and up to one month prior)

o Chronic or long-standing health conditions

Information about the person completing or submitting the VAERS form

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- o Name, address, phone number and email address

- o Relation to the patient (for example: healthcare professional, parent, caregiver, etc.)

Information about the healthcare professional

- o Name and phone number for the best doctor or healthcare professional to contact to get more information about the patient and the adverse event

Information about the facility (or place) where the vaccine was given

- o Facility/clinic name, fax number, address and phone number

- o Facility type (for example: doctor's office or hospital, pharmacy or drug store, workplace clinic, etc.)

Information about which vaccines were given and what happened to the patient

- o Vaccine type and brand name, manufacturer, and lot number

- o How the vaccine was given (route of administration, body site where given, and dose number if the vaccine was part of a series)

- o Description of the adverse event, including medical treatment and diagnosis

- o Results of medical tests and laboratory tests

- o Outcome of the adverse event (for example: doctor office visit, emergency room visit, hospitalization, etc.)

- o Whether the patient has recovered from the adverse event

Additional information

- o Any other vaccines received by the patient within a month prior to the current vaccine(s) (include vaccine type and brand name, manufacturer, lot number, and how the vaccine was given)

- o Adverse event(s) after previous vaccinations

- o Patient's race and ethnicity

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