Kawasaki Disease Clinical Guideline

November 2, 2016
Definition

Kawasaki disease (KD), also known as Kawasaki syndrome, is an acute febrile illness of unknown cause that primarily affects children younger than 5 years of age. The disease was first described in Japan by Tomisaku Kawasaki in 1967, and the first cases outside of Japan were reported in Hawaii in 1976. Clinical signs include fever, rash, swelling of the hands and feet, irritation and redness of the whites of the eyes, swollen lymph glands in the neck, and irritation and inflammation of the mouth, lips, and throat.

Epidemiology

Studies of hospital discharge records by the United States Centers for Disease Control (CDC) estimated an overall annual incidence of 20 per 100,000 children younger than five years in the United States [11]. Annual incidence was highest among Asians and Pacific Islanders (30 per 100,000), intermediate among non-Hispanic African Americans (17 per 100,000) and Hispanics (16 per 100,000), and lowest among Caucasians (12 per 100,000) [11]. A winter-spring predominance of cases is characteristic, and the peak incidence of illness is at less than one year of age [11]. In contrast to Japan, surveillance in the United States is passive, and many cases may be missed.

The overall incidence was 22 per 100,000 children less than five years of age in San Diego County during a six-year period from 1998 to 2003 [3]. The rates based upon ethnicity were 15, 25, 20, and 46 per 100,000 children less than five years of age for non-Hispanic whites, non-Hispanic African Americans, Hispanics, and Asian/Pacific Islanders, respectively.

Etiology

The etiology of Kawasaki disease is unknown. Several aspects of the presentation mimic infection; however, no one infection has been found to be causative. Seasonality associated with increased incidence in geographic areas has been described in Japan and the United States; this suggests a transmissible factor. Studies are ongoing regarding this finding. Immune mediated presentation, such as bacterial or other toxins acting as superantigens, leading to nonselective T cell activation has been postulated; studies have varied regarding the isolation of superantigen producing organisms, superantigen proteins, or the presence of immunologic signature of superantigen activity. The innate immune system plays a vital role in the pathogenesis of Kawasaki’s disease. Neutrophils are important factors in the initial inflammatory response on coronary artery walls. Recent studies also demonstrate increased expression of innate immunity associated genes during the acute phase of Kawasaki’s disease. Impaired immune regulation has been found to also play a role in pathogenesis of KD as studies of acute and subacute sera from KD patients have shown a decrease in the population of T regulatory cells in the acute phase with normalization following treatment with IVIG. The role of B cells has not been clearly defined; IgA plasma cells have been found in coronary artery lesions from fatal cases of KD. Their specific role is unknown.

Genetic predisposition to respond to multiple triggers in a common pathway has also been postulated, given that multiple infectious agents have been found in patients with KD. Infections may trigger vasculitis. Recent studies have described functional single nucleotide polymorphisms in the inositol, 1, 4, 5, triphosphate 3-kinase C (ITPKC) gene with increased risk of susceptibility to KD, more severe coronary artery disease, and IVIG resistance. This gene acts as a negative regulator of T cell activation; signaling alterations may lead to immunoregulatory dysfunction.
Guideline Eligibility Criteria

- Patients with symptoms concerning for possible Kawasaki Disease
  - Prolonged febrile illness (>5 days) in a patient with any of the principle clinical features of Kawasaki Disease
  - Patient exam with 4 or 5 principal clinical features and fever < 5 days
  - Prolonged fever in an infant < 6 months without any principle clinical features

Guideline Exclusion Criteria

- Atypical/Incomplete Kawasaki Disease
- Kawasaki Disease with complicating morbidities
- Recurrent/Refractory Kawasaki Disease
- Pre-existing medications that modulate immune response
- Complicating existing diagnoses:
  - Hematologic
  - Immunologic
  - Rheumatic diseases
  - Major Chronic inflammatory/immunologic diseases
  - Significant congenital heart disease
  - Infectious disease(s)
  - Active uveitis
- Suspected systemic JIA with active systemic features

Not exclusive to these diagnosis review Differential Diagnosis.

Differential Diagnosis

Infections predominate in the list of differential diagnoses for Kawasaki Disease. (See Table) However, the finding of a concomitant infection does not rule out the possibility of KD as one study reports up to 30% of children with classic presentation had laboratory evidence of at least one infection. Detailed history regarding exposures, presenting signs and symptoms, and associated physical findings may help support one process over another. Infections may also stimulate an inflammatory process with vasculitis.

Adenovirus, EBV and measles infection are often considered. Distinguishing features of the viral infections may involve exudative conjunctivitis or pharyngitis; in the case of measles, immunization history and possible exposure is critical in a child with significant cough and coryza. Flaviviruses may also present with mucocutaneous inflammation; exposure history, and laboratory findings may help with differentiation.

Bacterial illnesses such as those related to acute Group A streptococcus and S. aureus may present with acute lymphadenitis, and mucocutaneous inflammation. Toxin mediated illness secondary to bacterial illness (Staphylococcal or Streptococcal disease) need to be considered, as well as rickettsial illness. Hypotension may be important in the presentation of these disorders.

Hypersensitivity syndromes such as Stevens - Johnson syndrome, and drug hypersensitivity, mercury poisoning, and autoimmune disorders such as systemic Juvenile idiopathic Arthritis should also be considered.
CLINICAL PRESENTATION

1. Fever (>38.0°C or 100.4°F rectally or orally) for at least 5 days in the presence of 4 of the 5 following criteria:
   a. Bilateral congestion of the ocular conjunctivae (94%)*
   b. Changes of the lips and oral cavity (at least one of the following):
      a. Dryness, erythema, fissuring of lips (70%)
      b. Strawberry tongue (71%)
      c. Diffuse erythema of oral and pharyngeal mucosa without discrete lesions (70%)
   c. Changes of the extremities (at least one of the following):
      a. Erythema of palms and soles (80%)
      b. Indurative edema (67%)
      c. Periungual desquamation of fingers and toes (29%)
   d. Polymorphous exanthem (92%)
   e. Non-suppurative cervical adenopathy (>1.5 cm) (42%)

* (%) indicates percentage of U.S. patients manifesting this clinical sign within the first ten days after onset of fever (Burns, et al., Clinical and epidemiological characteristics of patients referred for evaluation of possible KD. J Pediatr. 118:680-686, 1991.)

LABORATORY TESTS

Laboratory tests, even though are nonspecific, can provide diagnostic support in patients with clinical features that are suggestive but not diagnostic of Kawasaki disease.

1. Complete blood count
   a. Leukocytosis is typical during the acute stage of Kawasaki disease with a predominance of immature and mature granulocytes. About 50% have white blood cell counts >15 000/mm³.
   b. Anemia may develop with more prolonged active inflammation.
   c. Thrombocytosis is rare in the 1st week of illness but may appear in the 2nd week (peaking in the 3-4th week) with a mean peak platelet count of ≈ 700 000/mm³.

2. Complete metabolic panel
   a. Hyponatremia can be noted.
   b. Mild to moderate elevations in serum transaminases occur in ≤40% of patients.
   c. Mild hyperbilirubinemia can occur in ≈ 10% of patients.
   d. Hypoalbuminemia is common and is associated with more severe and prolonged acute disease.

3. Erythrocyte sedimentation rate
   a. Elevation of acute phase reactants is nearly universal in Kawasaki disease. Elevation of ESR (but no of CRP) can be caused by IVIG therapy; therefore, ESR should not be used as the sole determinant of the degree of inflammatory activity in IVIG-treated patients.

4. C-reactive protein
   a. Elevation of CRP is seen but should return to normal by 6-10 weeks after onset of illness.

5. Urine analysis
   a. Urinalysis reveals intermittent mild to moderate sterile pyuria in ≈ 33% of patients. Cells originate in the urethra and a catheterized specimen may not contain these cells.

6. Gold Top for further workup

IMAGING TESTS

1. Echocardiography* - The major sequelae of Kawasaki disease are related to the cardiovascular and, more specifically, the coronary arterial system, so cardiac imaging is a critical part of the evaluation of all patients with suspected Kawasaki disease. Long-term follow-up for patients with abnormal coronary arteries must be individualized and should be performed by an experienced pediatric cardiologist.

2. Abdominal ultrasound – Acute acalculous distention of the gallbladder (hydrops) occurs in ≈ 15% of patients during the first 2 weeks of the illness and can be identified by imaging.

* indicates a required imaging test.
Methods

Existing External Guidelines/Clinical Pathways

<table>
<thead>
<tr>
<th>Existing External Guideline/Clinical Pathway</th>
<th>Organization and Author</th>
<th>Last Update</th>
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<tbody>
<tr>
<td>Diagnosis, Treatment, and Long-Term Management of Kawasaki Disease</td>
<td>American Heart Association</td>
<td>2004</td>
</tr>
<tr>
<td></td>
<td>Jane W. Newburger, MD, et. al.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tsutomu Saji, et. al.</td>
<td></td>
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<tr>
<td>Management of Kawasaki Disease</td>
<td>UCI Institute of Child Health</td>
<td>2013</td>
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<td></td>
<td>D Eleftheriou, et. al.</td>
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Any published clinical guidelines have been evaluated for this review using the AGREE II criteria. The comparisons of these guidelines are found at the end of this document. AGREE II criteria include evaluation of: Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity of Presentation, Applicability, and Editorial Independence.

Review of Relevant Evidence: Search Strategies and Databases Reviewed

<table>
<thead>
<tr>
<th>Search Strategies</th>
<th>Document Strategies Used</th>
</tr>
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<tbody>
<tr>
<td>Search Terms Used:</td>
<td>Kawasaki disease, complete kawasaki, incomplete/atypical, IVIG, aspirin, IVIG unresponsive, Refractory, IVMP, steroids, inflammatory response, predictors, febrile, coronary abnormalities, methylprednisolone, risk factors</td>
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<td>English</td>
</tr>
<tr>
<td>Age of Subjects</td>
<td>&lt; 18 years</td>
</tr>
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</table>
| Search Engines | http://www.cochrane.org/  
https://scholar.google.com/ |
| EBP Web Sites | http://www.seattlechildrens.org/healthcare-professionals/gateway/pathways/  
http://childrenshospital.libguides.com/content.phe?pid=114078&sid=1001858  
http://www.chop.edu/pathways#.V4Oyfo7E_OE  
https://www.cincinnatichildrens.org/service/j/anderson-center/evidence-based-care/recommendations/  
http://www.texaschildrenshealthplan.org/for-providers/provider-resources/practice-guidelines |
| Professional Organizations | http://www.kdfoundation.org  
http://www.kawasaki-kids-found.org  
http://patient.info/health/kawaski-disease-leaflet  
http://www.vasculitisfoundation.org/education/forms/kawasaki-disease/?gclid=CO2ipaTl8cwCFQEJaOodk4AMnQ  
http://kidshealth.org/en/parents/kawasaki.html# |
Evidence Found with Searches

<table>
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<tr>
<th>Check Type of Evidence Found</th>
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<td>☐</td>
<td>Government/State agency regulations</td>
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<td>☒</td>
<td>Professional organization guidelines, white papers, etc.</td>
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<tr>
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Evaluating the Quality of the Evidence

The GRADE criteria were used to evaluate the quality of evidence presented in research articles reviewed during the development of this guideline. The table below defines how the quality of evidence is rated and how a strong versus a weak recommendation is established.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Type of Evidence</th>
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<tbody>
<tr>
<td>Strong</td>
<td>Desirable effects clearly outweigh undesirable effects or vice versa</td>
</tr>
<tr>
<td>Weak</td>
<td>Desirable effects closely balanced with undesirable effects</td>
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<table>
<thead>
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<th>Type of Evidence</th>
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<tbody>
<tr>
<td>High</td>
</tr>
<tr>
<td>Moderate</td>
</tr>
<tr>
<td>Low</td>
</tr>
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<td>Very Low</td>
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## Recommendations

<table>
<thead>
<tr>
<th>Evidence Supports</th>
<th>Evidence Lacking/Inconclusive</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVIG and HD ASA should be used in combination as first line therapy</td>
<td>ESR and CRP values could be used as markers for inflammatory response to treatment.</td>
</tr>
</tbody>
</table>
| IVIG therapy should be used as the first line therapy for patients diagnosed with either classic or incomplete/atypical Kawasaki Disease | Use of the current established Japanese scoring systems to identify high risk patients in the US population:  
  - Kobayashi score  
  - Egami score  
  - Sano score |
| IVIG resistance/unresponsive should be considered if the patient is febrile or refractory 36 hours after starting IVIG |  |
| Intravenous pulse methylprednisolone (IVMP) should be considered for second line therapy in patients that are unresponsive to an initial treatment of IVIG |  |
| Recrudescence of fever should be used to determine inflammatory response to treatment |  |
**Kawasaki Disease Diagnosis Pathway**
 Evidence Based Outcome Center

**EXCLUSION CRITERIA**

Complicating existing diagnoses:
- Hematologic
- Immunologic
- Rheumatic diseases
- Major Chronic inflammatory/immunologic diseases
- Significant congenital heart disease
- Infectious disease(s)
- Active uveitis
- Suspected systemic JIA with active systemic features

*Not exclusive to these diagnosis review Differential Diagnosis.*

**GUIDE INCLUSION CRITERIA**

Patients with symptoms concerning for possible Kawasaki Disease
- Prolonged febrile illness (≥ 5 days) in a patient with any of the principle clinical features of Kawasaki Disease
- Patient exam with 4 or 5 principal clinical features and fever < 5 days
- Prolonged fever in an infant < 6 months without any principle clinical features

**Order Diagnostic Labs:**
- Complete blood count
- Complete metabolic panel
- Erythrocyte sedimentation rate
- C-reactive protein
- Urine analysis
- Gold/Yellow Top for additional workup

Discuss with infectious diseases specialist

**Concern for Recurrent Kawasaki Disease**

YES → ADMIT patient to hospital

MANAGE OFF-PATHWAY

NO →

**Previously treated for Kawasaki Disease**

YES → ADMIT patient to hospital

**Classic Kawasaki Disease Management Pathway**

NO →

**Meets classic diagnostic criteria for Kawasaki Disease**

YES →

Discuss with infectious diseases specialist

**Assess Patient for Other Possible Clinical and Laboratory Findings**

-AND-

Discuss with infectious diseases specialist

**Consistent with Kawasaki Disease**

YES → ADMIT patient to hospital

MANAGE OFF-PATHWAY

NO →

**Review differential diagnosis Manage OFF PATHWAY**

Kawasaki Disease Diagnostic Criteria:
- Prolonged febrile illness ≥ 5 days

-AND-

Presentation of four or more of the following symptoms meets classic criteria, if the patient presents with two or three symptom consider incomplete Kawasaki Disease:
1. bilateral conjunctival congestion
2. changes in lips and oral cavity: reddening of lips, strawberry tongue, diffuse injection of oral pharyngeal mucosa
3. polymorphous exanthema
4. changes in peripheral extremities: reddening of palms and soles, indurative edema (initial stage), membranous desquamation from fingertips (convalescent stage)
5. acute non-purulent cervical lymphadenopathy

For questions concerning this pathway, **Click Here**

Last Updated November 2, 2016
For questions concerning this pathway, Click Here
Last Updated November 2, 2016
### Other clinical and laboratory findings:

<table>
<thead>
<tr>
<th>Cardiovascular</th>
<th>Gastrointestinal</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Congestive heart failure, myocarditis, pericarditis, valvular regurgitation</td>
<td>• Diarrhea, vomiting, abdominal pain</td>
</tr>
<tr>
<td>• Coronary artery abnormalities</td>
<td>• Hepatic dysfunction</td>
</tr>
<tr>
<td>• Aneurysms of medium-size noncoronary arteries</td>
<td>• Hydrops of gallbladder</td>
</tr>
<tr>
<td>• Raynaud's phenomenon</td>
<td></td>
</tr>
<tr>
<td>• Peripheral gangrene</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Musculoskeletal system</th>
<th>Genitourinary system</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Arthritis, arthralgia</td>
<td>• Urethritis/meatitis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Central Nervous System</th>
<th>Other findings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Irritability</td>
<td>• Anterior uveitis (mild)</td>
</tr>
<tr>
<td>• Aseptic meningitis</td>
<td>• Desquamating rash in groin</td>
</tr>
<tr>
<td>• Sensorineural hearing loss</td>
<td></td>
</tr>
</tbody>
</table>

### Laboratory findings in Kawasaki Disease

- Normal or elevated WBC with predominance of neutrophils
- Elevated ESR (≥ 40 mm/h) and/or CRP (≥ 3 mg/dL)
- Anemia for age
- Albumin < 3 mg/dL
- Hyponatremia
- Thrombocytosis (platelets ≥ 450,000 /mm³)
- Sterile pyuria (≥ 10 WBC/hpf)
- Elevated serum transaminases with or without elevated serum GGT or bilirubin
- CSF pleocytosis
- Leukocytosis in synovial fluid (WBC > 15,000 /mm³)

### Differential Diagnosis for Kawasaki Disease

- Viral infections (adenovirus, EBV, enterovirus)
- Scarlet fever
- Staphylococcal scalded skin syndrome
- Toxic Shock syndrome
- Bacterial cervical lymphadenitis
- Drug hypersensitivity reactions
- Stevens-Johnson Syndrome
- Juvenile idiopathic arthritis
- Rocky Mountain spotted fever
- Leptospirosis
- Mercury hypersensitivity reaction
Kawasaki Disease Management – Echocardiogram Pathway
Evidence Based Outcome Center

**Non-sedated Criteria**
Patients who are developmentally and emotionally mature enough to cooperate with echocardiogram. Have demonstrated cooperation during previous interactions with medical personnel. Should be capable of lying still and cooperating for 30 minutes.

Perform non-sedated echocardiogram
- AND -
Document findings (LINK)

Adequate ECHO

YES

Perform minimal-sedated echocardiogram
- AND -
Document findings (LINK)

Adequate ECHO

YES

Cardiologist evaluate ECHO & Document findings (Link)

NO

Administer intra-nasal midazolam
DOSE:
0.2 – 0.5 mg/kg | Max dose = 7.5 mg

Perform minimal-sedated echocardiogram
- AND -
Document findings (LINK)

Adequate ECHO

YES

Cardiologist evaluate ECHO & Document findings (Link)

NO

Manage patient on Pediatric Minimal Sedation Guidelines

Sedated Criteria
Patients who have demonstrated a clear inability to cooperate with medical procedures.

Perform sedated echocardiogram
- AND -
Document findings (LINK)

YES

Manage patient with Pediatric Guidelines for Analgesia, Anxiolysis, Amnesia & Sedation and Seton Sedation Policy

NO

Non-sedated Criteria
Patients who are developmentally and emotionally mature enough to cooperate with echocardiogram. Have demonstrated cooperation during previous interactions with medical personnel. Should be capable of lying still and cooperating for 30 minutes.

Perform non-sedated echocardiogram
- AND -
Document findings (LINK)

Adequate ECHO

YES

NO

Minimal-sedated Criteria
Patients who demonstrate a mild degree of apprehension or mildly limited capacity to cooperate with 30 minute procedure.

Administer intra-nasal midazolam
DOSE:
0.2 – 0.5 mg/kg | Max dose = 7.5 mg

Perform minimal-sedated echocardiogram
- AND -
Document findings (LINK)

Adequate ECHO

YES

Cardiologist evaluate ECHO & Document findings (Link)

NO

Manage patient on Pediatric Minimal Sedation Guidelines

NO

YES

Manage patient with Pediatric Guidelines for Analgesia, Anxiolysis, Amnesia & Sedation and Seton Sedation Policy

Perform sedated echocardiogram
- AND -
Document findings (LINK)

YES

Cardiologist evaluate ECHO & Document findings (Link)
Kawasaki Disease Action Plan
Evidence Based Outcome Center

This action plan is your “checklist” to make sure you and your child are prepared after your recent hospitalization for Kawasaki Disease. You should complete this form along with your care team before you leave the hospital.

- I received patient information packet on Kawasaki disease
  - ☐ No anomaly/aneurysm
  - ☐ Possible coronary anomaly/aneurysm

- Our first **Cardiology Clinic** visit will be in 2-3 weeks:
  
  Date of visit: ________________________________
  
  Provider: ________________________________
  
  Phone number for office contact: ________________________________

- Our first **Infectious Disease Clinic** visit is in 2-3 weeks:
  
  Date of visit: ________________________________
  
  Provider: ________________________________
  
  Phone number for office contact: ________________________________

- At my child’s first visits, the Cardiology and Infectious Disease Teams will arrange for future follow-up visits.

- I understand my child is to continue aspirin until instructed to stop by the cardiologist seen outside the hospital (Aspirin usually continues for 6-8 weeks).

I understand the following symptoms should make me worry. If any of the following are present, I will contact the Infectious Disease Doctors at 512-628-1820:

  - Fever over 100.4°F
  - Conjunctivitis (redness of the eyes)
  - Red lips and mouth
  - Rash
  - Unusual irritability
  - Swelling of hands or feet
  - Vomiting

- I understand live virus vaccines like the measles vaccine or the chicken pox vaccine should not be given to my child for 11 months after treatment with IVIG for Kawasaki Disease

- I understand that children on aspirin and their families should receive the influenza vaccination.
### Initial (Acute) Phase Dosing Recommendation: 80-100 mg/kg/day divided Q6H

<table>
<thead>
<tr>
<th>Weight Range</th>
<th>Low kg (mg/kg)</th>
<th>High kg (mg/kg)</th>
<th>Dose</th>
<th>Total Daily Dose (mg)</th>
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<tbody>
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<td>2.9</td>
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<tr>
<td>3 (108 mg/kg)</td>
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<td>101.25 mg (1.25 tabs) Q6H</td>
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<td>6 (108 mg/kg)</td>
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<td>202.5 mg (2.5 tabs) Q6H</td>
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<td>8 (101 mg/kg)</td>
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<td>10 (97 mg/kg)</td>
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<td>12 (95 mg/kg)</td>
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<td>16 (101 mg/kg)</td>
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<td>20 (97 mg/kg)</td>
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<td>24 (95 mg/kg)</td>
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**Maintenance (Step-Down Dosing Recommendation): 3-5 mg/kg/day**

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<tr>
<th>Weight Range</th>
<th>Low kg (mg/kg)</th>
<th>High kg (mg/kg)</th>
<th>Dose</th>
<th>Total Daily Dose (mg)</th>
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<tbody>
<tr>
<td>+++++</td>
<td>3.9</td>
<td>4.9 (3 mg/kg)</td>
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</tbody>
</table>

- Aspirin 81 mg tablets may be crushed/chewed and mixed with flavoring for immediate single dose administration. Aspirin 81 mg tablets CANNOT be compounded into a suspension for multi-dose administration.
- Aspirin 325 mg tablets are enteric coated (EC) and CANNOT be crushed or chewed.
- Substitution with 325 mg tablets may be considered for patients on high doses and patients able to tolerate swallowing tablets whole.
- Maximum daily dose = 4000 mg/day or 120 mg/kg/day, whichever is less.
- Long term, high dose aspirin therapy puts children at increased risk for Reye’s syndrome.
- **Primary aim**
  - Identify coronary artery involvement, pericarditis, and/or myocarditis

- **Timing of echocardiography**
  - Uncomplicated Kawasaki
    - At time of diagnosis
    - Two-three weeks
    - Six to eight weeks
  - Complicated Kawasaki
    - At minimum, should adhere to echocardiography timing for uncomplicated Kawasaki
    - Increased frequency of imaging may be necessary and should be determined by clinical provider

- **Optimization of overall image assessment (improving quality and resolution)**
  - Plan for possible sedation in children between 12mo-3yrs
  - Use highest possible frequency transducer
  - Use cine loops/still frame images in conjunction with color Doppler imaging
  - Reduce two-dimensional gain and compression
  - Use low Nyquist limit to optimize visualization of normal diastolic coronary flow

- **Echocardiographic report content**
  - Coronary arteries
    - Visualization and location of coronary arteries
    - Presence and description of coronary abnormalities
    - Summary comment in conclusions about presence/absence of coronary involvement
  - Valvular function
  - Biventricular systolic function
  - Presence of pericardial effusion
  - Presence of pleural effusions

- **Coronary artery assessment**
  - Should be performed in multiple imaging planes
  - Optimal views to attain imaging of each coronary should be attempted *(see page 2)*
  - Method of measurement *(see page 3)*
    - Inner edge to inner edge of the vessel wall and not measured at the level of normal branching
  - Descriptions of coronaries should use specific descriptive terms *(see page 3)*

- **Additional resources** *(page 4-5)*
  - Normal coronary artery diameters with mean and standard deviation
  - Additional information about Kawasaki
  - Atypical Kawasaki-Echocardiographic Assessment

- **References** *(page 8)*
Optimal Views to Image Coronary Arteries

- Left main coronary artery (LMCA):
  - parasternal short axis at level of aortic valve
  - parasternal long axis toward PA
  - subcostal left ventricular long axis

- Left anterior descending (LAD):
  - parasternal short axis at level of aortic valve
  - parasternal long axis toward PA
  - parasternal short axis of left ventricle

- Left circumflex (LCx):
  - parasternal short axis at level of aortic valve
  - apical 4-chamber in MV AV groove

- Right coronary artery (RCA):
  - proximal segment:
    - parasternal short axis at level of aortic valve
    - parasternal long axis toward the TV
    - subcostal coronal projection of RVOT
    - subcostal short axis at level of AV groove
  - middle segment:
    - parasternal long axis of left ventricle toward TV
    - apical 4-chamber
    - subcostal left ventricular long axis
    - subcostal short axis at level of AV groove
  - distal segment
    - apical 4-chamber (inferior)
    - subcostal atrial long axis (inferior)

- Posterior descending artery (PDA):
  - apical 4-chamber (inferior)
  - subcostal atrial long axis (inferior)
  - parasternal long axis (inferior tangential) imaging
  - posterior interventricular groove
Method of Measurement (inner-to-inner)

- Left main coronary artery (LMCA)
  - Measure in the mid-position, distal to the flaring often seen near the aortic orifice and before the first bifurcation
- Left anterior descending (LAD)
  - Measure distal to the bifurcation and before the first marginal branch
- Right coronary artery (RCA)
  - Measure in the relatively straight section of artery just after the initial rightward turn from the anterior facing sinus of Valsalva

Coronary Descriptors

-Specific terminology should be used to describe coronary abnormalities seen in patients with Kawasaki disease in order to improve interoperator reliability between reports
- Main features of coronary artery involvement:
  - Dilatation (intra-luminal diameter Z-score of ≥ 2.5mm)
    - Ectatic:
      - Uniform: dilated long segment
      - Segmented: multiple dilatations joined by normal or stenotic areas
  - Lack of tapering of the distal coronary vessel
  - Perivascular brightness
  - Aneurysm formation
    - Fusiform: spindle-shaped, gradual tapering from normal to dilated segment
    - Saccular: spherical, acute transition from normal to dilated segment
Normal Coronary Diameters

Mean and prediction limits for 2 and 3 SDs for size of LAD (A), proximal RCA (B), and LMCA (C) according to body surface area for children <18 years old. Adapted from de Zorzi, Newburger, J. W. et al. Pediatrics 2004;114:1708-33.
Additional Information about Kawasaki

- Common sites of coronary involvement (from highest to lowest frequency):
  - Proximal LAD
  - Proximal RCA
  - LMCA
  - LCx
  - Distal RCA
  - Junction of RCA and PDA

- Risk stratification of aneurysms
  - Smaller aneurysms/fusiform aneurysms have greater chance of resolution
  - Distal coronary artery aneurysms tend to regress more rapidly than proximal aneurysms

- Cardiovascular disease
  - History of Kawasaki disease may increase risk for adult cardiovascular disease
  - Studies show abnormal vascular endothelial function, intimal thickness and abnormal lipid profiles
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Approved by the Kawasaki Disease Evidence-Based Outcomes Center Team

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### References

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