Kawasaki Disease Diagnosis Pathway

Evidence Based Outcome Center

High Risk Clinical or Initial Echo features: 1

The following patients require rapid recognition, treatment, and planning for next step therapy if not responding to initial therapy. Initial therapy includes steroids.

- Children ≤ to 6 months
- KD with shock and KD with MAS. Mild tachycardia and irritability is expected with KD but blood pressure and perfusion changes should trigger PICU evaluation.
- Abnormal ECHO(s): (hyperlink to cards write-up about echos) LAD or RCA z score >/equal 2.5
- Rheumatology consultation is needed for high risk populations not responding to initial therapy.

Discharge Criteria: 2

- Vital signs normal:
  - Afebrile > 36 hours after treatment complete
  - Tachycardia resolved
- CRP down-trending
- Clinical symptoms resolving(ed)
- Tolerating oral medication

KD Discharge Tasks: 3

- Prescription for ASA: low-dose 3-5 mg/kg day. Provide 30-day supply. Educate family to not stop ASA until instructed by Cardiology
- Complete KD Action Plan
- **Schedule** follow-up appointments with ID and Cardiology in 2-3 weeks

Abnormal Echo Criteria: 4

ECHO is abnormal if any of these 3 conditions are met:

- Z score of Left Anterior Descending (LAD) or Right Coronary Artery (RCA) 2.5
- Coronary artery aneurysm is observed
- 3 other suggestive features are present: (i.e. decreased LV function, MR, pericardial, effusions, other significant cardiac abnormalities (in discussion with Cardiology)

Team Meeting: 5

- Cardiology, ID, Rheumatology, PCRS to review clinical case, plan treatment and follow-up

Kawasaki Disease (KD) Suspected

- Less/equal to 18 years of age
- **Complete KD:** Prolonged febrile illness ≥ 4 days with 4/5 principal clinical findings
- **Incomplete KD:** Prolonged febrile illness ≥ 5 days with 2-3/5 principal clinical findings
  OR Infant < 6 mo with prolonged febrile illness ≥ 7d without explanation

KD w/MAS, KD w/ Shock or Hemodynamic Instability?

No → **Evaluation**
Labs: CBC, CMP, ESR, CRP, UA (bag, clean catch ok)
EKG
ECHO: within 24 hours (non urgent) for Complete KD or timing as needed to confirm incomplete KD
Assess for High Risk KD 1

Yes → **ADMIT to PICU** 1 Consult/treatment for High Risk KD

KD Unlikely

Consider ddx/ **Mange Off Pathway**

Incomplete KD

CRP < 3 AND/OR ESR <40

- Evaluate DDx
- Perform serial clinical and laboratory reevaluation if fever persists
- ECHO if no clear source and /or skin peeling occurs
- Infectious Disease consult

Meets diagnostic criteria for Incomplete KD?

No → KD Unlikely
Non KD source identified
MANAGE OFF-PATHWAY

Yes → (Initial Treatment)

CRP ≥ 3 AND/OR ESR ≥ 40

- Assess for ≥ 3 supplemental lab findings
- Leukocytosis (WBC > 15 K)
- Anemia for age
- Thrombocytosis (PI> 450K after 1st wk of illness)
- Albumin <3 g/dl
- Elevated ALT
- Sterile pyuria (WBC > 10 WBC/pf
  OR
- ECHO: Abnormal EchoFindings 4

<3 supplemental laboratory criteria and normal ECHO → (Initial Treatment)

≥ 3 supplemental laboratory criteria OR abnormal ECHO 4 → (Initial Treatment)

Complete KD

Initial Treatment

- **IVIG:** Intravenous immunoglobulin 2g/kg single infusion per protocol
- **ASA:** (moderate dosing)
  (Do not delay treatment for Echo)
- If abnormal echo 4 and/or <6months old, add **Steroids** to treatment

Discharge Criteria Met? 2

Yes → **DISCHARGE** 3

No → Persistent or recrudescent fever >24 hrs. after IVIG treatment?

Abnormal ECHO and/or < 6 months of age 4

Subsequent Treatment
In consultation with KD team, administer additional treatment of one or more:

- Repeat IVIG
- Steroids
- Infliximab*
- Cyclosporin*
- Cyclophosphamide*
- Other

*Consult Rheumatology

Normal Echo

Subsequent Treatment

- Repeat CRP, ESR
- Repeat Echo per ID and Cardiology
- Second round of IVIG and steroids

Discharge Criteria Met? 2

Yes → **DISCHARGE** 2 3

No → Persistent or Recurrent fever >24 hours after subsequent treatment, **TEAM HUDDLE** 5 and Manage Off Pathway

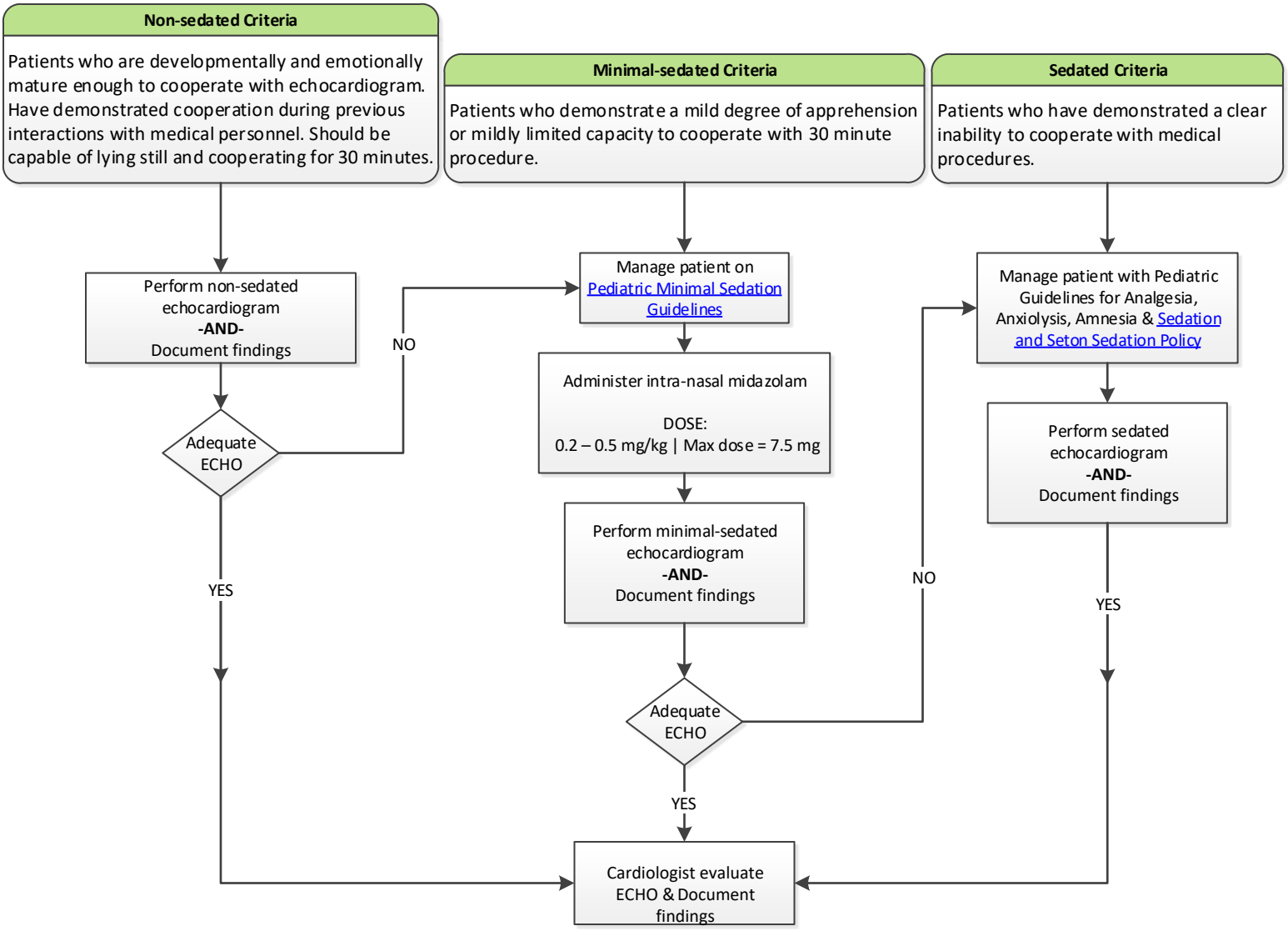
KD Diagnosis / Treatment Tips:

- KD has a broad ddx and many mimics. Specific history questions to assess for presence of KD symptoms at any time during course of illness is needed.
- Children with significant congenital heart disease, current rheumatic, immunologic, hematologic disease should NOT be managed on this pathway. Although KD may be on the differential, individualized diagnostic and treatment plans need to be utilized. Broad subspecialty involvement with these populations is recommended.
- ECHO is not required for the diagnosis of Complete KD. ECHO is non-urgent and treatment should not be delayed awaiting ECHO results if diagnostic criteria are met.
- Children meeting diagnostic criteria for KD (complete or incomplete) without hemodynamic changes should be admitted to PCRS. A team approach to KD management is essential and consults will be notified by PCRS. Consultation does not need to occur in the ED.
- MIS-C should be considered if initial laboratory values show lymphopenia < 1k, Na+ < 135, platelets < 150.
- Children with abnormal ECHOs may need anticoagulation. Consult Hematology to assess when needed.

Last Updated: January 2024

Kawasaki Disease Management – Echocardiogram Pathway

Evidence Based Outcome Center



Last Updated: January 2024

Addendum 1:

Principal Clinical Findings for Kawasaki Disease
- Bilateral conjunctival congestion
- Changes in lips and oral cavity: reddening of lips, strawberry tongue, diffuse injection of oral pharyngeal mucosa
- Polymorphous exanthema
- Changes in peripheral extremities: reddening of palms and soles, indurative edema (initial stage), membranous desquamation from fingertips (convalescent stage)
- Acute non-purulent cervical lymphadenopathy

Other clinical and laboratory findings:	
Cardiovascular:	**Gastrointestinal:**
Congestive heart failure, myocarditis, pericarditis, valvular regurgitation	Diarrhea, vomiting, abdominal pain
Coronary artery abnormalities	Hepatic dysfunction
Aneurysms of medium-size noncoronary arteries	Hydrops of gallbladder
Raynaud's phenomenon	
Peripheral gangrene	
Musculoskeletal system:	**Genitourinary system:**
Arthritis, arthralgia	Uretrhitis/meatitis
Central Nervous System:	**Other findings:**
Irritability	Anterior uveitis (mild)
Aseptic Meningitis	Desquamating rash in groin
Sensorineural hearing loss	

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 tramsaminases 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, measles infection)
Flavivirus infections (Dengue, West Nile Virus, and Yellow Fever)
Scarlet fever
Staphylococcal scalded skin syndrome
Toxic shock syndrome
Acute rheumatic fever
Bacterial cervical lymphadenitis
Drug hypersensitivity reactions
Stevens-Johnson Syndrome
Juvenile idiopathic arthritis
Rocky Mountain Spotted Fever
Murine Typhus
Acute Gastroenteritis (AGE) due to Yersinia
Leptospirosis
Mercury hypersensitivity reaction

Medication

Medication	Dosing
Aspirin	See full table (KD Aspirin Dosing Table)
IVIG	2 g/kg/dose
Methylprednisolone	1 mg/kg/dose Q12hr (max 60 mg/day) For pulse dosing: 30 mg/kg/dose Q24 hr (max 1 g) for 3 days
Prednisolone	1 mg/kg/dose BID (max 60 mg/day)
Infliximab*	10 mg/kg/dose (*Consult Rheumatology)
Famotidine	0.5 mg/kg/dose BID (or per pharmacy protocol)

DELL CHILDREN'S MEDICAL CENTER
EVIDENCE-BASED OUTCOMES CENTER

KD Aspirin Dosing Table

Initial (Acute) Phase Dosing Recommendation: **Moderate Dose** 30-50 mg/kg/day divided Q6H			
Weight Range		**Dose**	**Total Daily Dose (mg)**
Low kg	**High kg**		
++++'	2.9	Individualized Weight Based Dosing	
3 (54 mg/kg)	5.9 (27.4 mg/kg)	40.5 mg (0.5 tab) Q6H	162
6 (54 mg/kg)	9.9 (32.7 mg/kg)	81 mg (1 tab) Q6H	324
10 (48.6 mg/kg)	12.9 (37.7 mg/kg)	121.5 mg (1.5 tabs) Q6H	486
13 (49.8 mg/kg)	19.9 (32.5 mg/kg)	162 mg (2 tabs) Q6H	648
20 (48.6 mg/kg)	29.9 (32.5 mg/kg)	243 mg (3 tabs) Q6H	972
30 (43.2 mg/kg)	39.9 (32.5 mg/kg)	324 mg (4 tabs) Q6H	1296
40 (40.5 mg/kg)	49.9 (32.5 mg/kg)	405 mg (5 tabs) Q6H	1620
50	++++'	Individualized Weight Based Dosing	
Maintenance (Step-Down) Dosing Recommendations **Low Dose** 3-5 mg/kg/day			
Weight Range		**Dose**	**Total Daily Dose (mg)**
Low kg	**High kg**		
++++'	2.9	Individualized Weight Based Dosing	
4 (10 mg/kg)	13.9 (3 mg/kg)	40.5 mg (0.5 tab) Qday	40.5
14 (5.8 mg/kg)	++++'	81 mg (1 tab) Qday	81

- 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.

Back

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.

-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
- -Method of measurement
  - - 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

-Additional resources
- -Normal coronary artery diameters with mean and standard deviation
- -Additional information about Kawasaki
- -Atypical Kawasaki-Echocardiographic Assessment
- -KD Coronary Echo Nomenclature

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

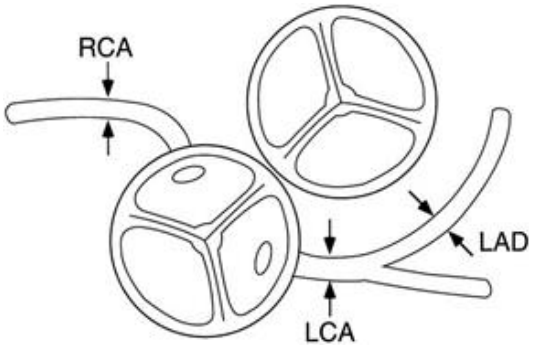
-Left anterior descending (LAD):
- -parasternal short axis at level of aortic valve
- -parasternal long axis toward PA
- -parasternal short axis of left ventricle

-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

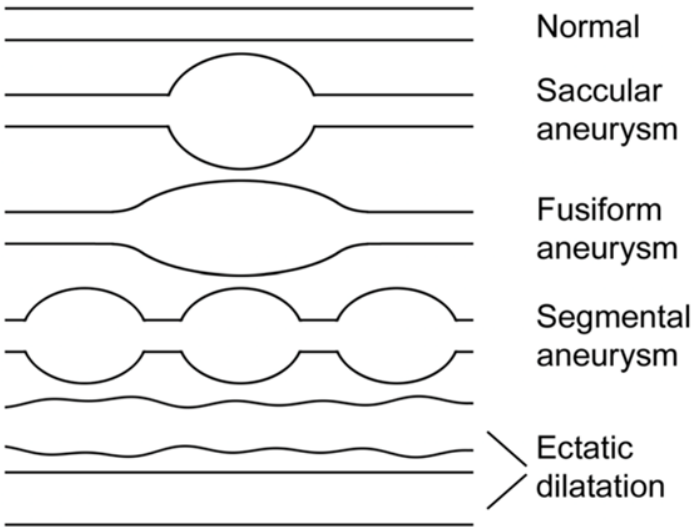
-Right coronary artery (RCA)
- Measure in the relatively straight section of artery just after the initial rightward turn from the anterior facing sinus of Valsalva

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



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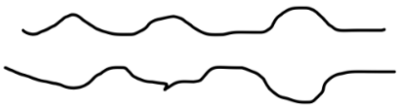
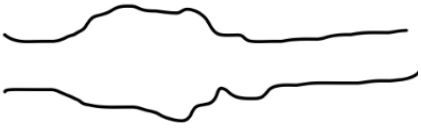
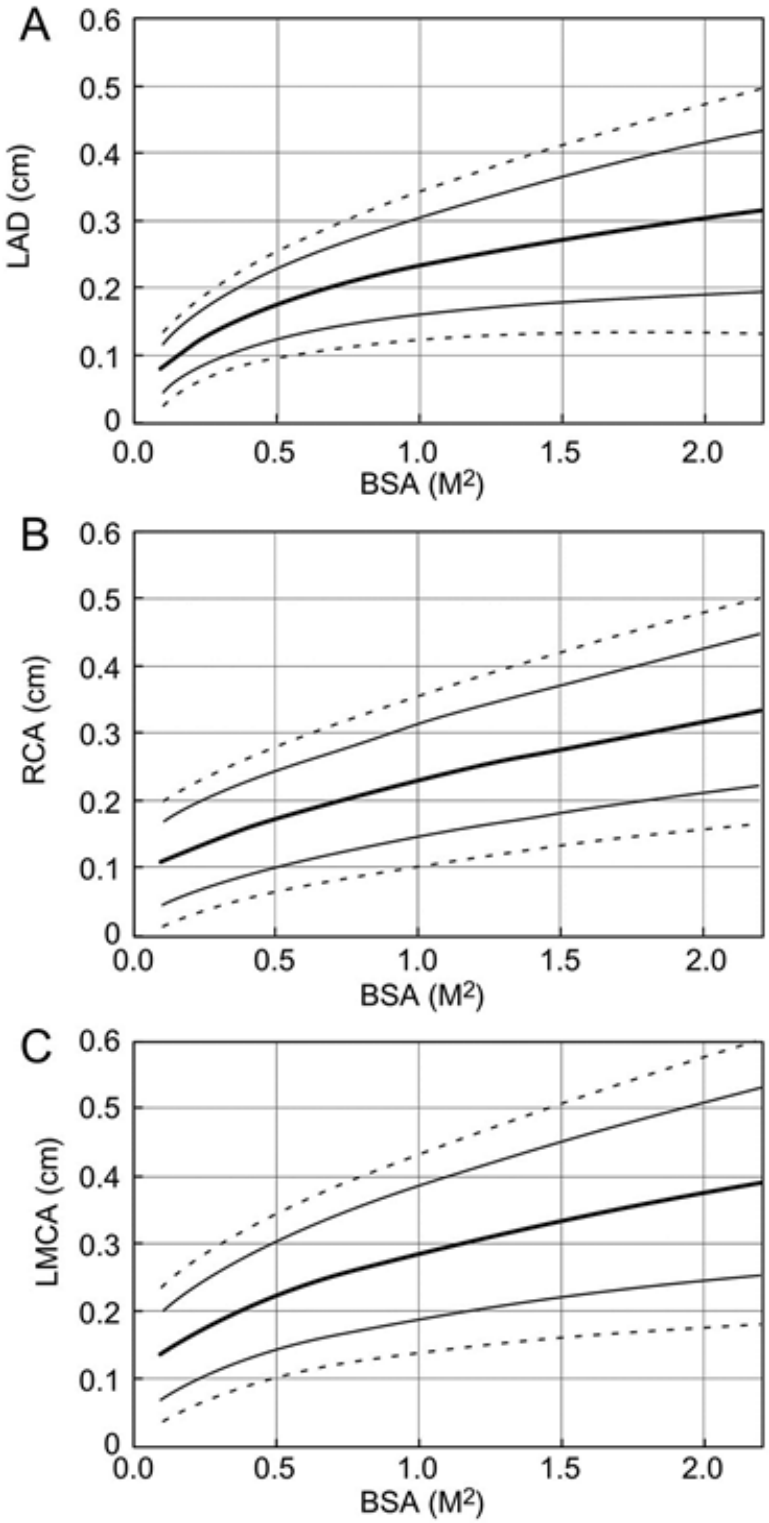
KD Coronary Echo Nomenclature

	Associated Nomenclature	Description	Clinical Relevance
	Normal, No aneurysm or ectasia, Unremarkable	Z score less than +2.5, qualitatively regular lumen and wall appearance	
	Echo-bright, Prominent	Z score normal, no significant wall contour irregularity, qualitative appearance is bright or mildly dilated	**No clinical significance** but meant to call attention to target area on subsequent interrogation
	Somewhat irregular, mildly dilated, mild ectasia	Z score normal or borderline, irregular contour of walls, +/- echobright,	Limited clinical significance, may indicate potential for future aneurysm. Does not dictate need for therapeutic intervention
	Saccular aneurysm	Z score of dilated area > +2.5. Surrounding area may be normal size	Abnormal
	Ectasia, multiple small aneurysms, dilated	Z scores > +2.5. Diffusely irregular contour to vessel walls	Abnormal
	Fusiform aneurysm	Z scores > +2.5, frequently larger. Aneurysm extends over millimeters and is of varied diameters	

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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Revision History

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Last Review Date: January 2024 - Literature review post 2016. Updates to Diagnostic Algorithm, definition of Z-scores, expansion of thrombolytic management, high-risk management with steroids.

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