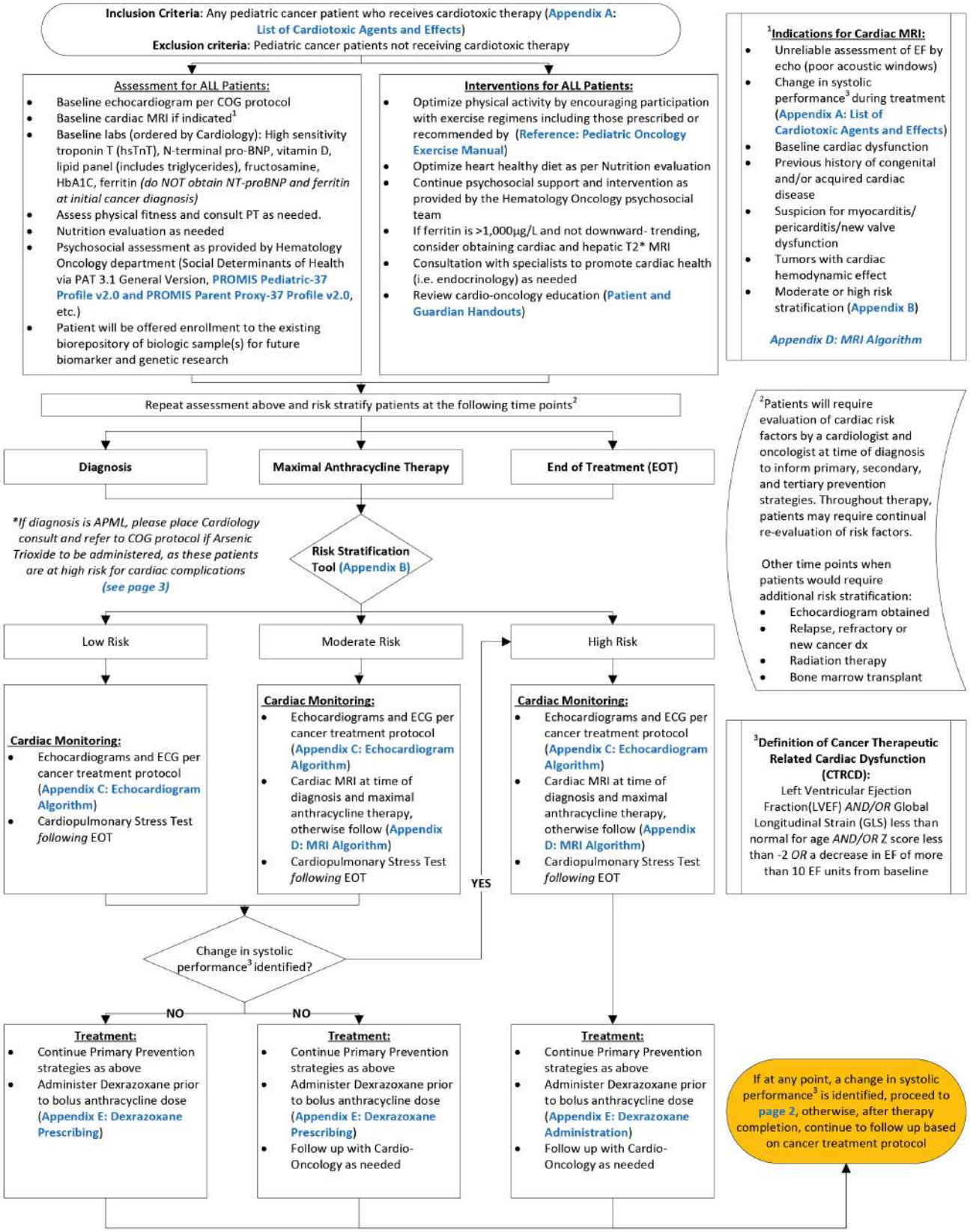
CLINICAL PATHWAY: Pediatric Cardio-Oncology Acute Cardiotoxicity Primary and Secondary Prevention Strategies
Primary Prevention Strategies

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.



NEXT PAGE

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

CLINICAL PATHWAY: Pediatric Cardio-Oncology Acute Cardiotoxicity Primary and Secondary Prevention Strategies Secondary Prevention Strategies

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

Inclusion Criteria: Any pediatric cancer patient who develops change in systolic performance[1] during or after termination of cardiotoxic therapy

Exclusion criteria: No change in systolic performance during or after termination of cardiotoxic therapy

Assessment:

- Obtain labs (Cardiology to obtain): High sensitivity troponin T (hsTnT), N-terminal pro-BNP (NT-proBNP), lipid panel, fructosamine, HbA1C, ferritin, vitamin D 25-hydroxy, chem 7, CBC
- Obtain follow up cardiac MRI if patient stable for procedure (Appendix D: Cardiac MRI Algorithm)

Treatment

If ACE inhibitors are contraindicated, consider carvedilol as first line agent

- **Enalapril or Lisinopril (ACE inhibitors)**
  - *0-5 years of age:* Enalapril 0.1 mg/kg/day PO divided twice daily; titrate upward gradually over a week to a max of 0.3mg/kg/day
  - *>5 years:* Enalapril 2.5 mg PO twice daily; titrate gradually over a week to a max dose of 5 mg PO twice daily
  - *≥ 12 years:* Lisinopril 2.5mg PO once daily; titrate gradually over 1-2 week to a max dose of 10 mg PO once daily as tolerated
- Once ACE inhibitor dose is maximized, add Carvedilol (Appendix F: Carvedilol Administration)
- Consider and angiotensin receptor blocker (losartan) as an alternative to an ACE inhibitor when appropriate
- Continue with primary prevention strategies (page 1)

[1]**Definition of Change in Systolic Performance:**

Left Ventricular Ejection Fraction (LVEF) *AND/OR* Global Longitudinal Strain (GLS) less than normal for age *AND/OR* Z score less than -2 *OR* a decrease in EF of more than 10 percentage points from baseline

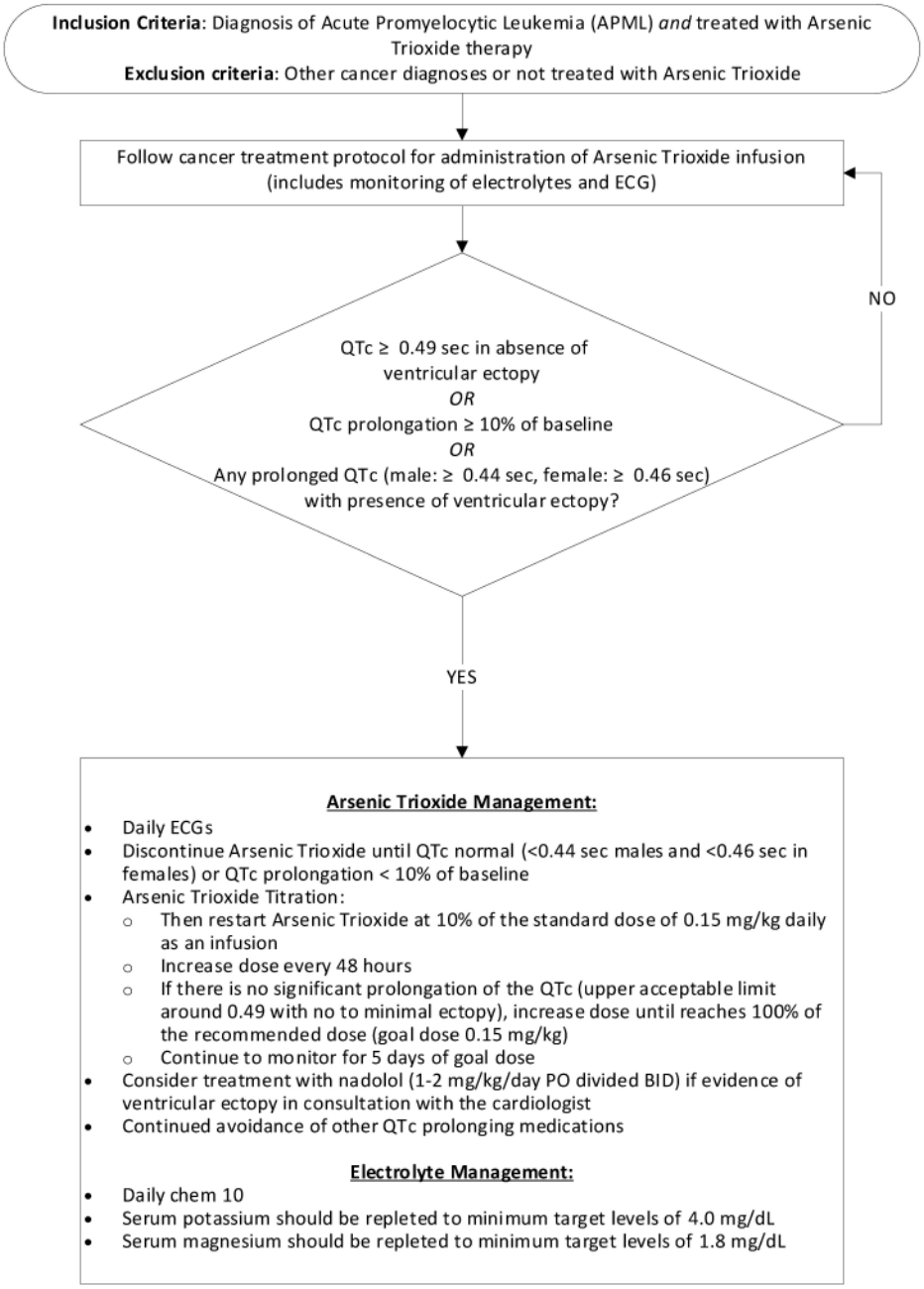
RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

CLINICAL PATHWAY: Pediatric Cardio-Oncology Acute Cardiotoxicity Primary and Secondary Prevention Strategies Arsenic Trioxide Protocol

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.



Patients treated with Arsenic Trioxide are at high risk for cardiac complications, including prolonged QTc, heart failure, pericardial effusion, dysrhythmias, and rarely, torsades de pointe

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

CLINICAL PATHWAY: Pediatric Cardio-Oncology Acute Cardiotoxicity Primary and Secondary Prevention Strategies Appendix A: List of Cardiotoxic Agents and Effects

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

Cardiac effect	LVD/HF	Myocarditis	Arterial Thrombosis	Athero-sclerosis, Coronary Spasm	Pericardial disease	Valve Disease	HTN	Pulmonary HTN or fibrosis
Conventional Therapies								
Anthracyclines	■				■			
Platinum-based Cisplatin			■	■			■	■
Alkylating Agents Cyclophosphamide, Ifosfamide	■		■		■			■
Vinca Alkaloids^ Vinblastine, Vincristine	■			■				
Antimetabolites 5-fluorouricil (5-FU), Capecitabine, Cytarabine			■	■	■			
Microtubule Inhibitors (primarily used in adults) Paclitaxel, Docetaxel	■		■	■				
Targeted Molecular Therapies*								
VEGF Inhibitors Sunitinib, Pazopanib, Bevacizumab	■		■				■	
BRAF inhibitors Dabrafenib	■			■	■		■	
MEK inhibitors Trametinib, Mirdametinib	■				■		■	■
mTOR inhibitors Everolimus	■			■			■	
BCR-ABL TK Inhibtors Imatinib	■							
BCR-ABL1 Inhibtors Dasatinib								■
Proteasome Inhibitors Bortezomib, Carfilzomib							■	■
Immunotherapies								
Immune checkpoint inhibitors	■	■		■	■			■
CAR T-cell therapy	■	■		■	■			■
Radiation	■			■	■	■	■	■
Steroids				■			■	
Imaging								
Echo (preferred screening modality)	■	■			■	■	■	
CMR	■	■	■		■	■	■	
CT			■	■	■			■

^ Vinca Alkaloids only cardiotoxic when used in combination with anthracyclines

** There is continuous introduction of additional target molecular therapies such as BRAF/MEK inhibitors that induce cardiotoxicity. Refer to literature and cancer protocol for additional details.*

Herrmann, J. (2020). Adverse cardiac effects of cancer therapies: cardiotoxicity and arrhythmia. *Nat Rev Cardiol*, *17*(8), 474-502. https://*doi.org/10.1038/s41569-020-0348-1*

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

CLINICAL PATHWAY: Pediatric Cardio-Oncology Acute Cardiotoxicity Primary and Secondary Prevention Strategies Appendix B: Risk Stratification Tool

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

Risk Stratification Tool for Patients Receiving Cancer Treatment

Step 1: Score your patient's cardiovascular and cancer related risk categories
Step 2: Total the cardiovascular and cancer related risk categories
Step 3: Determine if patient is at low, moderate, or high risk for developing cardiac toxicity

Cardiovascular Related Risk Categories	
Body Mass Index (BMI) kg/m²: BMI information within the last year *Use percentiles for patients 0-20 years of age*	
☐ <85th percentile or BMI <25	0
☐ 85th-<95th percentile or BMI 25 – 29.9	0.5
☐ ≥95th percentile or BMI 30 – 34.9	1
☐ ≥120% of 95th % percentile OR BMI ≥35, whichever is lower based on age and sex	1.5
Lipid Panel: Performed within 3 years	
☐ Normal (LDL-c <110 mg/dL AND triglycerides <150 mg/dL)	0
☐ Low-Moderate Risk (LDL-c 110-129 mg/dL OR triglycerides 150-199 mg/dL)	0.5
☐ High Risk (LDL-c ≥130 mg/dL OR triglycerides ≥200 mg/dL)	1
Pre-Diabetes/Diabetes: Performed within 1 year	
☐ Normal glucose/A1c (HbA1c: <5.7%, 2-hr OGTT: <140 mg/dL, or Fasting: <100 mg/dL)	0
☐ Prediabetes (HbA1c: 5.7-6.4%, 2hr OGTT: 140-199 mg/dL, or Fasting: 100-125 mg/dL)	0.5
☐ Diabetes (HbA1c: ≥6.5%, 2-hr OGTT: ≥200 mg/dL, or Fasting: ≥126 mg/dL)	1
Ferritin: Lab result at any point in time	
☐ ≤1,000 µg/L	0
☐ >1,000 µg/L	1
Cardiorespiratory Fitness (CRF): Performed within the last 2 years	
☐ Good-Superior CRF based on relative VO_2 max for age & sex (≥ 80% of predicted value or ≥ 8 METs)	0
☐ Fair-Very Poor CRF based on relative VO_2 max for age & sex (60 - < 80% of predicted or 5–7 METs)	1
☐ Less than Very Poor CRF is categorized as functional disability based on relative VO_2 max for age & sex (<60% of predicted or <5 METs)	2
Previous Heart Disease at Diagnosis	
☐ No	0
☐ Yes	2
Hypertension (HTN): per AHA (≥ 13 years old) & AAP guidelines (<13 years old)	
☐ Normal	0
☐ Elevated/Pre-HTN	0.5
☐ Stage 1	1
☐ Stage 2	3
Change in Systolic Performance*: During or after cancer therapy completion	
☐ No	0
☐ Yes	1.5

Cancer Related Risk Categories	
Age at Cancer Diagnosis	
☐ ≥5 years	0
☐ 1-4 years	1
☐ <1 year	2
Sex: Assigned at birth	
☐ Male	0
☐ Female	1
Radiation: to heart region only	
☐ None	0
☐ <5 Gy	0.5
☐ 5-15 Gy	1
☐ >15-30 Gy	3
☐ >30 Gy	5
Vinca alkaloids^	
☐ No	0
☐ Yes	0.5
Alkylating Agents (i.e. CPM, IFOS)	
☐ No	0
☐ Yes	1.5
Anthracycline (AC) Cumulative Dose	
☐ <101 mg/m²	0
☐ 101-200 mg/m²	0.5
☐ >200-250 mg/m²	1
☐ >250-300 mg/m²	2
☐ >300 mg/m²	3
Dexrazoxane Given: applicable only if patient received ≥ 200mg/m² of AC	
☐ No	2
☐ Yes	0
Transplant: Please total scores for ALL transplants patient has undergone (if patient has a tandem transplants patient score would be 2)	
☐ No	0
☐ Autologous	1
☐ Allogenic	2

^ Only when given in combination with AC

*Change in Systolic Performance definition:

1. Left Ventricular Ejection Fraction (LVEF) less than normal for age AND/OR
2. Global Longitudinal Strain (GLS) less than normal for age AND/OR
3. Z score less than -2 OR
4. A decrease in EF of more than 10 percentage points from baseline

Risk probability for developing cardiac toxicity		
Low Risk	**Moderate Risk**	**High Risk**
0 - <6	6 - <11	≥11
Patient is automatically High Risk if they have a change in systolic performance*		

Created by: Olga H.Toro-Salazar MD, Tiffany Berthod MSN, RN, CPN, CCRC, Andrea Orsey MD, MSCE, Eileen Gillan MD, Shailendra Upadhyay MD, Karen Rubin MD

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

CLINICAL PATHWAY: Pediatric Cardio-Oncology Acute Cardiotoxicity Primary and Secondary Prevention Strategies Appendix C: Echocardiogram Algorithm

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

Inclusion Criteria: Any pediatric cancer patient who receives cardiotoxic therapy (Appendix A: List of Cardiotoxic Agents and Effects) and/or change in systolic performance[1] related to a cancer diagnosis
Exclusion criteria: Pediatric cancer patients not receiving cardiotoxic therapy or no myocardial dysfunction related to a cancer diagnosis

Echocardiogram is the preferred screening imaging modality for patients receiving cardiotoxic therapies

Initial Evaluation:

- Baseline echocardiogram at time of cancer diagnosis per cancer treatment protocol (all patients at this stage of treatment are considered to have stage A Heart Failure– Appendix G: Stages of Heart Failure)
- Consider integrated approach combining echocardiography and biomarkers: High sensitivity troponin T (hsTnT), N-terminal pro-BNP (NT-proBNP)
- Perform risk stratification [2]

[2] Patients will require evaluation of cardiac risk factors by a cardiologist and oncologist at time of diagnosis to inform primary, secondary, and tertiary prevention strategies. Throughout therapy, patients may require continual re-evaluation of risk factors. (Appendix B: Risk Stratification Tool)

Follow-up Evaluations During Cancer Therapy:

- Follow-up echocardiograms are typically based upon cancer treatment protocol *OR* if indicated by clinical status (e.g. abnormal finding on echo, deterioration in clinical status such as sepsis or heart failure)
- Consider integrated approach combining echocardiography and biomarkers: hsTnT, NT-proBNP
- Perform risk stratification [2]

All patients should have echocardiograms at maximal anthracycline therapy

Follow-up Evaluations After Cancer Therapy Completion:

- All patients will have an echocardiogram at completion of cancer therapy
- Subsequent echocardiograms will be performed based upon cancer treatment protocol, previously noted myocardial dysfunction, or changing clinical status to inform heart failure therapy
- Consider integrated approach combining echocardiography and biomarkers: hsTnT, NT-proBNP
- Perform risk stratification [2]

- Patients with significant change in systolic performance[1] during or after cancer therapy will require life-long follow up for continual reassessment of cardiovascular disease
- Ensure safe transition to adult care

[1]Definition of Change in Systolic Performance:

Left Ventricular Ejection Fraction (LVEF) *AND/OR* Global Longitudinal Strain (GLS) less than normal for age *AND/OR* Z score less than -2 *OR* a decrease in EF of more than 10 percentage points from baseline*

**A decrease in LVEF >10 percentage points from baseline echocardiograms in serial follow-up OR an LVEF <55%, is considered clinically significant. A new LVEF <55% should be confirmed by a second echocardiography within 1-2 weeks, or initiate further investigations as clinically indicated.*

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

CLINICAL PATHWAY: Pediatric Cardio-Oncology Acute Cardiotoxicity Primary and Secondary Prevention Strategies Appendix D: Cardiac MRI Algorithm

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

**Cardiac MRI provides superior accuracy and reproducibility for LVEF and left ventricular volumes; in particular it is an excellent modality to quantify ventricular volumes, ventricular mass, and tissue characterization, which are predictors of clinical status and adverse cardiac outcomes*

When to consider cardiac MRI (CMR):

- Unreliable assessment of left ventricular ejection fraction (EF) by echo (poor acoustic windows)
- Change in systolic performance[1] during treatment (Appendix A: List of Cardiotoxic Agents and Effects)
- Baseline cardiac dysfunction
- Previous history of congenital and/or acquired cardiac disease
- Suspicion for myocarditis/pericarditis/new valve dysfunction
- Tumors with cardiac hemodynamic effect
- Moderate or high risk stratification (Appendix B: Risk Stratification Tool)

Perform CMR[2]

Abnormal EF or suspicion of myocarditis or pericardial disease?

NO

Continue clinical follow up with echocardiogram as clinically indicated (no need for further CMR at this time)

Consider CMR if poor acoustic windows by echocardiogram

YES

Myocarditis

Repeat CMR in 3-6 months or sooner if clinically indicated (i.e. dysfunction/deterioration)

Abnormal EF

If persistent abnormal EF, consider repeating CMR as clinically indicated

Consider follow-up CMR for risk stratification at the end of cancer therapy

Pericardial Disease

Repeat CMR as clinically indicated

This is a rare complication in the pediatric oncology population

- Patients with, or at risk for, cardiotoxic effects of cancer treatment require life-long follow up for continual reassessment of cardiovascular disease
- Ensure safe transition to adult care

Indications for Cardiac CT:

- Consider surveillance coronary artery calcium scan (CAC) after mediastinal/thoracic radiation therapy exposure in high risk childhood cancer survivors 5-10 years after exposure if 18 years or older. Consider repeating surveillance CAC at 5-10 year intervals thereafter. Acquired images should be carefully evaluated for valvular and pericardial calcifications.
- If symptomatic, consider cardiac computed tomography (CCT) angiography as first line.
- If poor acoustic windows and contraindications to CMR, consider CCT for left ventricular ejection fraction assessment.

Groarke JD, et al. Cardiovascular complications of radiation therapy for thoracic malignancies: the role for non-invasive imaging for detection of cardiovascular disease. Eur Heart J. 2014;35(10):612-23.

[1]Definition of Change in Systolic Performance:

Left Ventricular Ejection Fraction (LVEF) *AND/OR* Global Longitudinal Strain (GLS) less than normal for age *AND/OR* Z score less than -2 *OR* a decrease in EF of more than 10 percentage points from baseline

[2]SUGGESTED ACQUISITION PROTOCOL:

- Standard Protocol:
  - Steady-state free precession (SSFP) cine (short and/or long axis planes) for assessment of LV and RV end-systolic and end-diastolic volumes, left ventricular mass, and EF.
- May consider addition of other sequences:
  - Tissue deformation (DENSE, SENC-MRI, tagging, feature tracking, and synthetic strain) for assessment of global and segmental myocardial longitudinal and circumferential strain magnitude.
  - Parametric mapping techniques (T1 /ECV) for assessment of myocardial interstitial fibrosis. There is currently no data specific to cancer therapy-related cardiac dysfunction outcomes.
  - Late gadolinium enhancement imaging in patients exposed to radiation therapy (LGE in pediatric patients exposed to cardiotoxic chemotherapy is low, even in the presence of established cardiomyopathy).
  - Consider use of 4D-Flow CMR for assessment of arterial stiffness.
- To evaluate for other cardiovascular toxicity:
  - Valve disease: Phase contrast imaging
  - Pericardial disease: myocardial tagging, real time cine imaging, T2 weighted imaging, LGE
  - Myocarditis: 2018 updated Lake Louise Criteria[3]

[3]*Luetkens, J. A., Faron, A., Isaak, A., Dabir, D., Kuetting, D., Feisst, A., Schmeel, F. C., Sprinkart, A. M., & Thomas, D. (2019). Comparison of Original and 2018 Lake Louise Criteria for Diagnosis of Acute Myocarditis: Results of a Validation Cohort. Radiology. Cardiothoracic imaging, 1(3), e190010. https://doi.org/10.1148/ryct.2019190010*

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

Appendix E: Dexrazoxane Administration

Dexrazoxane used only with bolus dosing of anthracycline (NOT continuous infusion)

Dosing:

- Dexrazoxane dose is 5 times the DAUNOrubicin dose
- Dexrazoxane dose is 10 times the DOXOrubicin
- Dexrazoxane dose is 6.7 times the epiRUBicin dose
- Dexrazoxane dose is 50 times the IDArubicin dose
- Dexrazoxane dose is 40 times the mitoXANtrone dose

Administration:

- Administer immediately prior to anthracycline (AC)
    - Must be within 30 minutes of beginning the AC infusion
- Administer IV over 15 minutes

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

Appendix F: Carvedilol Administration

Dosing for Secondary and Tertiary Prevention

- Evidence for Use:
  - Beta-blockers are used extensively to treat Heart Failure (HF) because of their ability to block the neurohormonal cascade that progresses to heart disease.
  - A 2015 study of 30 mice found that LVEF was significantly lower in those receiving doxorubicin without carvedilol than in those receiving doxorubicin with carvedilol[1].
  - Considerations for patients in active therapy[1]:
    - Carvedilol administration for primary prevention of cardiotoxicity is not yet established as standard of care.
    - There is a known Risk X category warning (PGP interaction) for simultaneous use of carvedilol and doxorubicin which may increase the concentration of doxorubicin and may increase associated adverse effects. However, after thorough investigation, it is deemed appropriate to continue carvedilol while receiving doxorubicin for secondary and tertiary prevention of cardiotoxic effects.

- Titration of Dosing*:
  - *Age < 6 years old:*
    - Initial: 0.05 mg/kg/dose (max 3.125 mg/dose) twice a day (BID)
    - Titrate up in 4 weeks to 0.1 mg/kg/dose
    - Titrate up in 4 weeks to 0.2 mg/kg/dose
    - Titrate up in 4 weeks to 0.35 mg/kg/dose (max 6.25 mg/dose)
  - *Age ≥ 6 years old:*
    - Initial: 3.125 mg BID
    - Then titrate as follows every 4 weeks :
      1. 3.125 mg BID
      2. 6.25 mg BID (Max dose <12 years of age)
      3. 9.375 mg BID
      4. 12.5 mg BID
      5. 18.75 mg BID
      6. 25 mg BID (Max dose over 18 years)

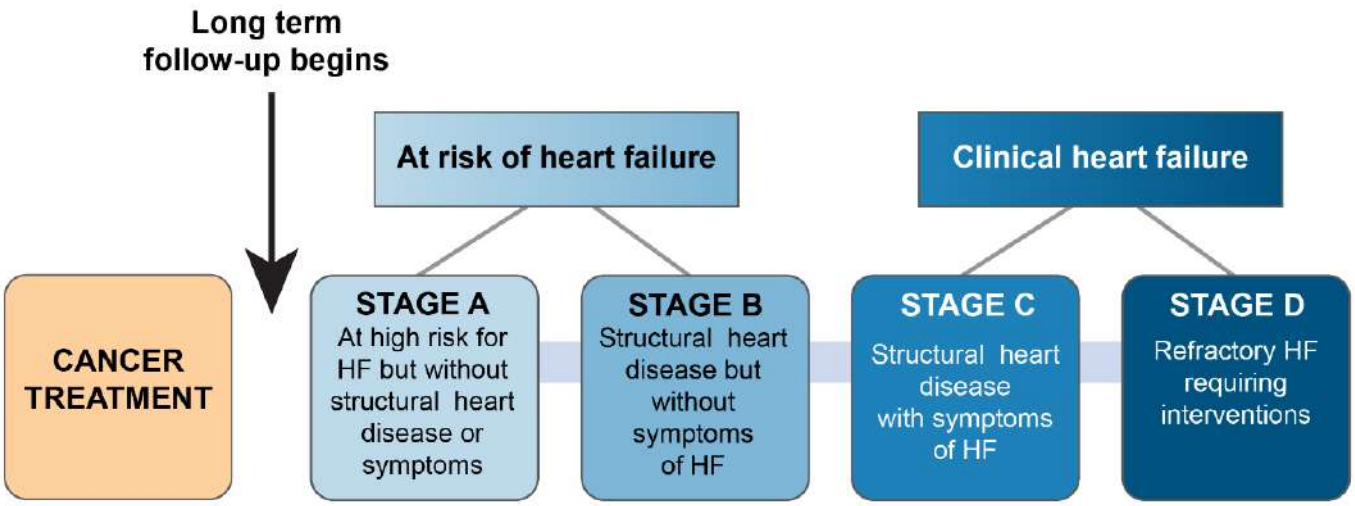
*If systolic performance is back to baseline no need to further titrate carvedilol.

- Assessment recommendations for the outpatient setting
  - Initiation/dose titration of carvedilol to be conducted in the outpatient setting.
  - For titration, patients will be instructed to take their daily carvedilol dose the evening prior to their clinic visit, and to refrain from taking the medication the morning of their visit.
  - Monitoring recommendations: Baseline blood pressure and heart rate pre-dose, and then obtain at 30-minute intervals x 3 after dose administered (30 min, 60 min, and 90 min).

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25



Armenian, S. H., Gelehrter, S. K., & Chow, E. J. (2012). Strategies to prevent anthracycline-related congestive heart failure in survivors of childhood cancer. *Cardiol Res Pract*, *2012*, 713294. https://doi.org/10.1155/2012/713294

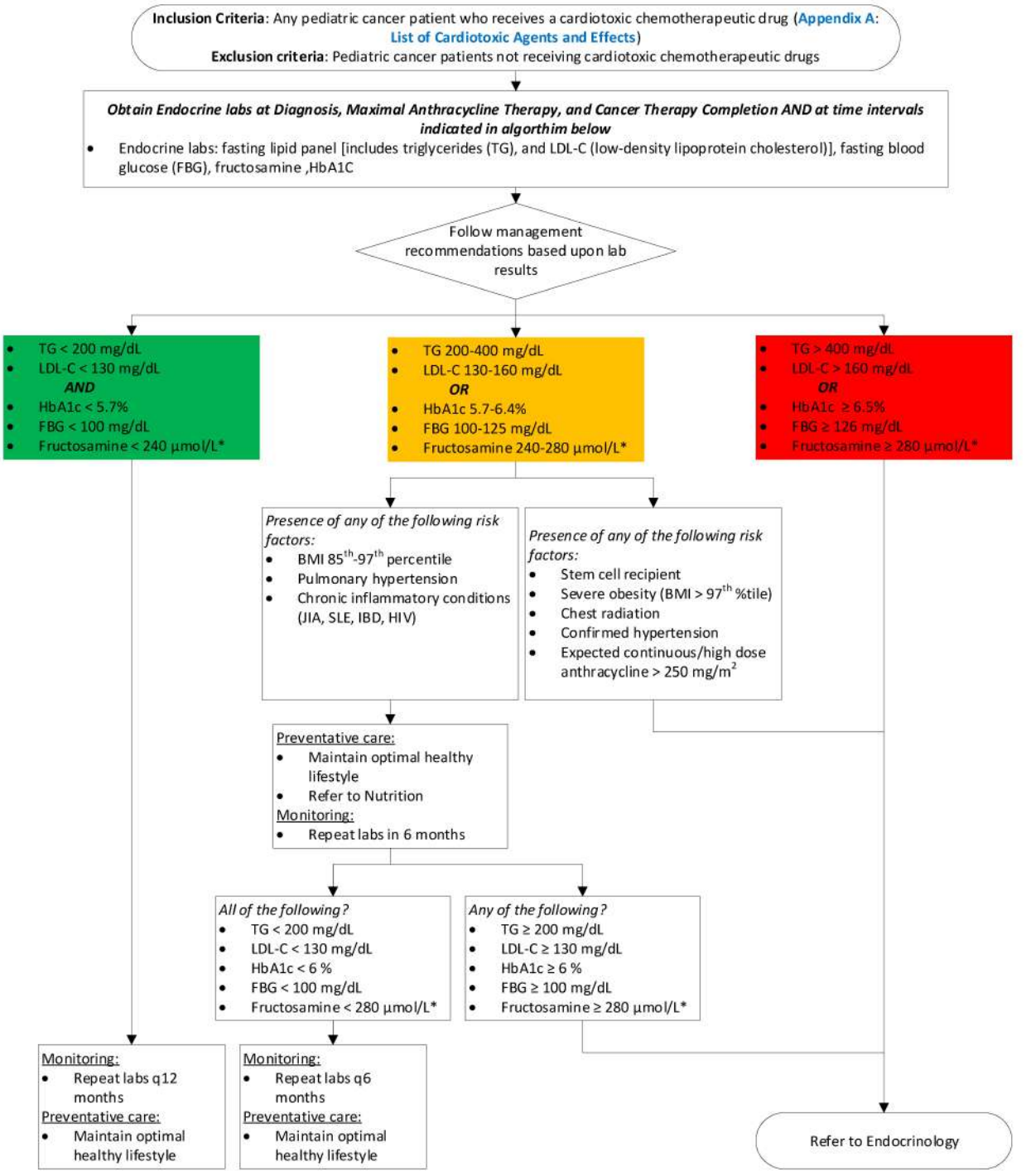
RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

CLINICAL PATHWAY: Pediatric Cardio-Oncology Acute Cardiotoxicity Primary and Secondary Prevention Strategies Appendix H: Endocrinology Lab Algorithm

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.



*Clinical guidelines for use of fructosamine are not as well established. To utilize, patient must have normal albumin levels

References:

- de Ferranti, S. D., Steinberger, J., Ameduri, R., Baker, A., Gooding, H., Kelly, A. S., Mietus-Snyder, M., Mitsnefes, M. M., Peterson, A. L., St-Pierre, J., Urbina, E. M., Zachariah, J. P., & Zaidi, A. N. (2019). Cardiovascular Risk Reduction in High-Risk Pediatric Patients: A Scientific Statement From the American Heart Association. Circulation, 139(13), e603–e634. https://doi.org/10.1161/CIR.0000000000000618
- Selvin, E., Rawlings, A. M., Grams, M., Klein, R., Sharrett, A. R., Steffes, M., & Coresh, J. (2014). Fructosamine and glycated albumin for risk stratification and prediction of incident diabetes and microvascular complications: a prospective cohort analysis of the Atherosclerosis Risk in Communities (ARIC) study. The lancet. Diabetes & endocrinology, 2(4), 279–288. https://doi.org/10.1016/S2213-8587(13)70199-2

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

References

Armenian, S. H., Gelehrter, S. K., & Chow, E. J. (2012). Strategies to prevent anthracycline-related congestive heart failure in survivors of childhood cancer. *Cardiol Res Pract*, *2012*, 713294. https://doi.org/10.1155/2012/713294

Armstrong, G. T., Liu, Q., Yasui, Y., Neglia, J. P., Leisenring, W., Robison, L. L., & Mertens, A. C. (2009). Late mortality among 5-year survivors of childhood cancer: a summary from the Childhood Cancer Survivor Study. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, *27*(14), 2328–2338.

Beavers, C. J., Rodgers, J. E., Bagnola, A. J., Beckie, T. M., Campia, U., Di Palo, K. E., Okwuosa, T. M., Przespolewski, E. R., & Dent, S. (2022). Cardio-Oncology Drug Interactions: A Scientific Statement From the American Heart Association. *Circulation*, *145*(15), e811-e838. https://doi.org/10.1161/cir.0000000000001056

Beck, T. C., Arhontoulis, D. C., Morningstar, J. E., Hyams, N., Stoddard, A., Springs, K., Mukherjee, R., Helke, K., Guo, L., Moore, K., Gensemer, C., Biggs, R., Petrucci, T., Kwon, J., Stayer, K., Koren, N., Harvey, A., Holman, H., Dunne, J., . . . Norris, R. A. (2022). Cellular and Molecular Mechanisms of MEK1 Inhibitor-Induced Cardiotoxicity. *JACC CardioOncol*, *4*(4), 535-548. https://doi.org/10.1016/j.jaccao.2022.07.009

Blair, S. N., Kohl, H. W., 3rd, Paffenbarger, R. S., Jr., Clark, D. G., Cooper, K. H., & Gibbons, L. W. (1989). Physical fitness and all-cause mortality. A prospective study of healthy men and women. *Jama*, *262*(17), 2395-2401. https://doi.org/10.1001/jama.262.17.2395

Bosch, X., Rovira, M., Sitges, M., Domènech, A., Ortiz-Pérez, J. T., de Caralt, T. M., Morales-Ruiz, M., Perea, R. J., Monzó, M., & Esteve, J. (2013). Enalapril and carvedilol for preventing chemotherapy-induced left ventricular systolic dysfunction in patients with malignant hemopathies: the OVERCOME trial (preventiOn of left Ventricular dysfunction with Enalapril and caRvedilol in patients submitted to intensive ChemOtherapy for the treatment of Malignant hEmopathies). *J Am Coll Cardiol*, *61*(23), 2355-2362. https://doi.org/10.1016/j.jacc.2013.02.072

Bottinor, W., Im, C., Doody, D. R., Armenian, S. H., Arynchyn, A., Hong, B., Howell, R. M., Jacobs, D. R., Jr, Ness, K. K., Oeffinger, K. C., Reiner, A. P., Armstrong, G. T., Yasui, Y., & Chow, E. J. (2024). Mortality After Major Cardiovascular Events in Survivors of Childhood Cancer. *Journal of the American College of Cardiology*, *83*(8), 827–838. https://doi.org/10.1016/j.jacc.2023.12.022

Butel-Simoes, L. E., Haw, T. J., Williams, T., Sritharan, S., Gadre, P., Herrmann, S. M., Herrmann, J., Ngo, D. T. M., & Sverdlov, A. L. (2023). Established and Emerging Cancer Therapies and Cardiovascular System: Focus on Hypertension-Mechanisms and Mitigation. *Hypertension*, *80*(4), 685-710. https://doi.org/10.1161/hypertensionaha.122.17947

Campbell, K. L., Winters-Stone, K. M., Wiskemann, J., May, A. M., Schwartz, A. L., Courneya, K. S., Zucker, D. S., Matthews, C. E., Ligibel, J. A., Gerber, L. H., Morris, G. S., Patel, A. V., Hue, T. F., Perna, F. M., & Schmitz, K. H. (2019). Exercise Guidelines for Cancer Survivors: Consensus Statement from International Multidisciplinary Roundtable. *Med Sci Sports Exerc*, *51*(11), 2375-2390. https://doi.org/10.1249/mss.0000000000002116

Cardinale, D., Colombo, A., Lamantia, G., Colombo, N., Civelli, M., De Giacomi, G., Rubino, M., Veglia, F., Fiorentini, C., & Cipolla, C. M. (2010). Anthracycline-induced cardiomyopathy: clinical relevance and response to pharmacologic therapy. *J Am Coll Cardiol*, *55*(3), 213-220. https://doi.org/10.1016/j.jacc.2009.03.095

Chaput, J. P., Willumsen, J., Bull, F., Chou, R., Ekelund, U., Firth, J., Jago, R., Ortega, F. B., & Katzmarzyk, P. T. (2020). 2020 WHO guidelines on physical activity and sedentary behaviour for children and

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

adolescents aged 5-17 years: summary of the evidence. *Int J Behav Nutr Phys Act*, *17*(1), 141. https://doi.org/10.1186/s12966-020-01037-z

Chen, Y. L., Chung, S. Y., Chai, H. T., Chen, C. H., Liu, C. F., Chen, Y. L., Huang, T. H., Zhen, Y. Y., Sung, P. H., Sun, C. K., Chua, S., Lu, H. I., Lee, F. Y., Sheu, J. J., & Yip, H. K. (2015). Early Administration of Carvedilol Protected against Doxorubicin-Induced Cardiomyopathy. *J Pharmacol Exp Ther*, *355*(3), 516-527. https://doi.org/10.1124/jpet.115.225375

Cheung, A. T., Li, W. H. C., Ho, L. L. K., Ho, K. Y., Chan, G. C. F., & Chung, J. O. K. (2021). Physical activity for pediatric cancer survivors: a systematic review of randomized controlled trials. *J Cancer Surviv*, *15*(6), 876-889. https://doi.org/10.1007/s11764-020-00981-w

Chovanec, J., Chovanec, M., & Mego, M. (2020). Levels of NT-proBNP and Troponin T in Cancer Patients - Mini-Review. *Klin Onkol*, *33*(3), 171-176. https://doi.org/10.14735/amko2020171 (Hladiny NT-proBNP a troponínu T u onkologických pacientov - stručný prehľad.)

de Baat, E. C., Feijen, E. A. M., Reulen, R. C., Allodji, R. S., Bagnasco, F., Bardi, E., Belle, F. N., Byrne, J., van Dalen, E. C., Debiche, G., Diallo, I., Grabow, D., Hjorth, L., Jankovic, M., Kuehni, C. E., Levitt, G., Llanas, D., Loonen, J., Zaletel, L. Z., . . . Kremer, L. C. M. (2023). Risk Factors for Heart Failure Among Pan-European Childhood Cancer Survivors: A PanCareSurFup and ProCardio Cohort and Nested Case-Control Study. *J Clin Oncol*, *41*(1), 96-106. https://doi.org/10.1200/jco.21.02944

de Ferranti, S. D., Steinberger, J., Ameduri, R., Baker, A., Gooding, H., Kelly, A. S., Mietus-Snyder, M., Mitsnefes, M. M., Peterson, A. L., St-Pierre, J., Urbina, E. M., Zachariah, J. P., & Zaidi, A. N. (2019). Cardiovascular Risk Reduction in High-Risk Pediatric Patients: A Scientific Statement From the American Heart Association. *Circulation*, *139*(13), e603-e634. https://doi.org/10.1161/cir.0000000000000618

Dillon, H. T., Foulkes, S. J., Baik, A. H., Scott, J. M., Touyz, R. M., Herrmann, J., Haykowsky, M. J., La Gerche, A., & Howden, E. J. (2024). Cancer Therapy and Exercise Intolerance: The Heart Is But a Part: *JACC: CardioOncology* State-of-the-Art Review. *JACC. CardioOncology*, *6*(4), 496–513. https://doi.org/10.1016/j.jaccao.2024.04.006

Fernandes, T., Baraúna, V. G., Negrão, C. E., Phillips, M. I., & Oliveira, E. M. (2015). Aerobic exercise training promotes physiological cardiac remodeling involving a set of microRNAs. *Am J Physiol Heart Circ Physiol*, *309*(4), H543-552. https://doi.org/10.1152/ajpheart.00899.2014

Foulkes, S. J., Howden, E. J., Haykowsky, M. J., Antill, Y., Salim, A., Nightingale, S. S., Loi, S., Claus, P., Janssens, K., Mitchell, A. M., Wright, L., Costello, B. T., Lindqvist, A., Burnham, L., Wallace, I., Daly, R. M., Fraser, S. F., & La Gerche, A. (2023). Exercise for the Prevention of Anthracycline-Induced Functional Disability and Cardiac Dysfunction: The BREXIT Study. *Circulation*, *147*(7), 532-545. https://doi.org/10.1161/circulationaha.122.062814

Glen, C., Tan, Y. Y., Waterston, A., Evans, T. R. J., Jones, R. J., Petrie, M. C., & Lang, N. N. (2022). Mechanistic and Clinical Overview Cardiovascular Toxicity of BRAF and MEK Inhibitors: JACC: CardioOncology State-of-the-Art Review. *JACC CardioOncol*, *4*(1), 1-18. https://doi.org/10.1016/j.jaccao.2022.01.096

Groarke, J. D., Nguyen, P. L., Nohria, A., Ferrari, R., Cheng, S., & Moslehi, J. (2014). Cardiovascular complications of radiation therapy for thoracic malignancies: the role for non-invasive imaging for detection of cardiovascular disease. *Eur Heart J*, *35*(10), 612-623. https://doi.org/10.1093/eurheartj/eht114

Groarke, J. D., Payne, D. L., Claggett, B., Mehra, M. R., Gong, J., Caron, J., Mahmood, S. S., Hainer, J., Neilan, T. G., Partridge, A. H., Di Carli, M., Jones, L. W., & Nohria, A. (2020). Association of post-diagnosis cardiorespiratory fitness with cause-specific mortality in cancer. *Eur Heart J Qual Care Clin Outcomes*, *6*(4), 315-322. https://doi.org/10.1093/ehjqcco/qcaa015

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

Gupta, V., Kumar Singh, S., Agrawal, V., & Bali Singh, T. (2018). Role of ACE inhibitors in anthracycline-induced cardiotoxicity: A randomized, double-blind, placebo-controlled trial. *Pediatr Blood Cancer*, *65*(11), e27308. https://doi.org/10.1002/pbc.27308

Hamer, M., Ingle, L., Carroll, S., & Stamatakis, E. (2012). Physical activity and cardiovascular mortality risk: possible protective mechanisms? *Med Sci Sports Exerc*, *44*(1), 84-88. https://doi.org/10.1249/MSS.0b013e3182251077

Hammoud, R. A., Mulrooney, D. A., Rhea, I. B., Yu, C., Johnson, J. N., Chow, E. J., Ehrhardt, M. J., Hudson, M. M., Ness, K. K., Armstrong, G. T., & Dixon, S. B. (2024). Modifiable Cardiometabolic Risk Factors in Survivors of Childhood Cancer: *JACC: CardioOncology* State-of-the-Art Review. *JACC. CardioOncology*, *6*(1), 16–32. https://doi.org/10.1016/j.jaccao.2023.12.008

Harries, I., Liang, K., Williams, M., Berlot, B., Biglino, G., Lancellotti, P., Plana, J. C., & Bucciarelli-Ducci, C. (2020). Magnetic Resonance Imaging to Detect Cardiovascular Effects of Cancer Therapy: JACC CardioOncology State-of-the-Art Review. *JACC CardioOncol*, *2*(2), 270-292. https://doi.org/10.1016/j.jaccao.2020.04.011

Heidenreich, P. A., Bozkurt, B., Aguilar, D., Allen, L. A., Byun, J. J., Colvin, M. M., Deswal, A., Drazner, M. H., Dunlay, S. M., Evers, L. R., Fang, J. C., Fedson, S. E., Fonarow, G. C., Hayek, S. S., Hernandez, A. F., Khazanie, P., Kittleson, M. M., Lee, C. S., Link, M. S., Milano, C. A., … ACC/AHA Joint Committee Members (2022). 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*, *145*(18), e895–e1032. https://doi.org/10.1161/CIR.0000000000001063

Herrmann, J. (2020). Adverse cardiac effects of cancer therapies: cardiotoxicity and arrhythmia. *Nat Rev Cardiol*, *17*(8), 474-502. https://doi.org/10.1038/s41569-020-0348-1

Hoffmann, T. C., Maher, C. G., Briffa, T., Sherrington, C., Bennell, K., Alison, J., Singh, M. F., & Glasziou, P. P. (2016). Prescribing exercise interventions for patients with chronic conditions. *Cmaj*, *188*(7), 510-518. https://doi.org/10.1503/cmaj.150684

Jeong, S. W., Kim, S. H., Kang, S. H., Kim, H. J., Yoon, C. H., Youn, T. J., & Chae, I. H. (2019). Mortality reduction with physical activity in patients with and without cardiovascular disease. *Eur Heart J*, *40*(43), 3547-3555. https://doi.org/10.1093/eurheartj/ehz564

Joshi, A. M., Prousi, G. S., Bianco, C., Malla, M., Guha, A., Shah, M., Brown, S. A., & Patel, B. (2021). Microtubule Inhibitors and Cardiotoxicity. *Current oncology reports*, *23*(3), 30. https://doi.org/10.1007/s11912-021-01014-0

Kavanagh, T., Mertens, D. J., Hamm, L. F., Beyene, J., Kennedy, J., Corey, P., & Shephard, R. J. (2003). Peak oxygen intake and cardiac mortality in women referred for cardiac rehabilitation. *J Am Coll Cardiol*, *42*(12), 2139-2143. https://doi.org/10.1016/j.jacc.2003.07.028

Kodama, S., Saito, K., Tanaka, S., Maki, M., Yachi, Y., Asumi, M., Sugawara, A., Totsuka, K., Shimano, H., Ohashi, Y., Yamada, N., & Sone, H. (2009). Cardiorespiratory fitness as a quantitative predictor of all-cause mortality and cardiovascular events in healthy men and women: a meta-analysis. *Jama*, *301*(19), 2024-2035. https://doi.org/10.1001/jama.2009.681

Korosoglou, G., Giusca, S., Montenbruck, M., Patel, A. R., Lapinskas, T., Götze, C., Zieschang, V., Al-Tabatabaee, S., Pieske, B., Florian, A., Erley, J., Katus, H. A., Kelle, S., & Steen, H. (2021). Fast Strain-Encoded Cardiac Magnetic Resonance for Diagnostic Classification and Risk Stratification of Heart Failure Patients. *JACC Cardiovasc Imaging*, *14*(6), 1177-1188. https://doi.org/10.1016/j.jcmg.2020.10.024

Lipshultz, S. E., Franco, V. I., Miller, T. L., Colan, S. D., & Sallan, S. E. (2015). Cardiovascular disease in adult survivors of childhood cancer. *Annual review of medicine*, *66*, 161–176. https://doi.org/10.1146/annurev-med-070213-054849

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

Lipshultz, S. E., Rifai, N., Dalton, V. M., Levy, D. E., Silverman, L. B., Lipsitz, S. R., Colan, S. D., Asselin, B. L., Barr, R. D., Clavell, L. A., Hurwitz, C. A., Moghrabi, A., Samson, Y., Schorin, M. A., Gelber, R. D., & Sallan, S. E. (2004). The effect of dexrazoxane on myocardial injury in doxorubicin-treated children with acute lymphoblastic leukemia. *N Engl J Med*, *351*(2), 145-153. https://doi.org/10.1056/NEJMoa035153

Lyon, A. R., López-Fernández, T., Couch, L. S., Asteggiano, R., Aznar, M. C., Bergler-Klein, J., Boriani, G., Cardinale, D., Cordoba, R., Cosyns, B., Cutter, D. J., de Azambuja, E., de Boer, R. A., Dent, S. F., Farmakis, D., Gevaert, S. A., Gorog, D. A., Herrmann, J., Lenihan, D., . . . van der Pal, H. J. H. (2022). 2022 ESC Guidelines on cardio-oncology developed in collaboration with the European Hematology Association (EHA), the European Society for Therapeutic Radiology and Oncology (ESTRO) and the International Cardio-Oncology Society (IC-OS). *Eur Heart J*, *43*(41), 4229-4361. https://doi.org/10.1093/eurheartj/ehac244

Mertens, L., Singh, G., Armenian, S., Chen, M. H., Dorfman, A. L., Garg, R., Husain, N., Joshi, V., Leger, K. J., Lipshultz, S. E., Lopez-Mattei, J., Narayan, H. K., Parthiban, A., Pignatelli, R. H., Toro-Salazar, O., Wasserman, M., & Wheatley, J. (2023). Multimodality Imaging for Cardiac Surveillance of Cancer Treatment in Children: Recommendations From the American Society of Echocardiography. *Journal of the American Society of Echocardiography : official publication of the American Society of Echocardiography*, *36*(12), 1227–1253. https://doi.org/10.1016/j.echo.2023.09.009

Patel, A. V., Friedenreich, C. M., Moore, S. C., Hayes, S. C., Silver, J. K., Campbell, K. L., Winters-Stone, K., Gerber, L. H., George, S. M., Fulton, J. E., Denlinger, C., Morris, G. S., Hue, T., Schmitz, K. H., & Matthews, C. E. (2019). American College of Sports Medicine Roundtable Report on Physical Activity, Sedentary Behavior, and Cancer Prevention and Control. *Med Sci Sports Exerc*, *51*(11), 2391-2402. https://doi.org/10.1249/mss.0000000000002117

Piña, I. L., Apstein, C. S., Balady, G. J., Belardinelli, R., Chaitman, B. R., Duscha, B. D., Fletcher, B. J., Fleg, J. L., Myers, J. N., & Sullivan, M. J. (2003). Exercise and heart failure: A statement from the American Heart Association Committee on exercise, rehabilitation, and prevention. *Circulation*, *107*(8), 1210-1225. https://doi.org/10.1161/01.cir.0000055013.92097.40

Plana, J. C., Thavendiranathan, P., Bucciarelli-Ducci, C., & Lancellotti, P. (2018). Multi-Modality Imaging in the Assessment of Cardiovascular Toxicity in the Cancer Patient. *JACC Cardiovasc Imaging*, *11*(8), 1173-1186. https://doi.org/10.1016/j.jcmg.2018.06.003

Ross, R., Blair, S. N., Arena, R., Church, T. S., Després, J. P., Franklin, B. A., Haskell, W. L., Kaminsky, L. A., Levine, B. D., Lavie, C. J., Myers, J., Niebauer, J., Sallis, R., Sawada, S. S., Sui, X., & Wisløff, U. (2016). Importance of Assessing Cardiorespiratory Fitness in Clinical Practice: A Case for Fitness as a Clinical Vital Sign: A Scientific Statement From the American Heart Association. *Circulation*, *134*(24), e653-e699. https://doi.org/10.1161/cir.0000000000000461

Ryan, T. D., Bates, J. E., Kinahan, K. E., Leger, K. J., Mulrooney, D. A., Narayan, H. K., Ness, K., Okwuosa, T. M., Rainusso, N. C., Steinberger, J., Armenian, S. H., & Pediatric Heart Failure & Transplantation Committee of the Council on Lifelong Congenital Heart Disease and Heart Health in the Young; Council on Cardiovascular and Stroke Nursing; and Council on Clinical Cardiology (2025). Cardiovascular Toxicity in Patients Treated for Childhood Cancer: A Scientific Statement From the American Heart Association. *Circulation*, 10.1161/CIR.0000000000001308. Advance online publication. https://doi.org/10.1161/CIR.0000000000001308

Scott, J. M., Lakoski, S., Mackey, J. R., Douglas, P. S., Haykowsky, M. J., & Jones, L. W. (2013). The potential role of aerobic exercise to modulate cardiotoxicity of molecularly targeted cancer therapeutics. *Oncologist*, *18*(2), 221-231. https://doi.org/10.1634/theoncologist.2012-0226

Selvin, E., Rawlings, A. M., Grams, M., Klein, R., Sharrett, A. R., Steffes, M., & Coresh, J. (2014). Fructosamine and glycated albumin for risk stratification and prediction of incident diabetes and

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

microvascular complications: a prospective cohort analysis of the Atherosclerosis Risk in Communities (ARIC) study. *Lancet Diabetes Endocrinol*, *2*(4), 279-288. https://doi.org/10.1016/s2213-8587(13)70199-2

Sepe, D. M., Ginsberg, J. P., & Balis, F. M. (2010). Dexrazoxane as a cardioprotectant in children receiving anthracyclines. *Oncologist*, *15*(11), 1220-1226. https://doi.org/10.1634/theoncologist.2010-0162

Testi, A. M., Pession, A., Diverio, D., Grimwade, D., Gibson, B., de Azevedo, A. C., Moran, L., Leverger, G., Elitzur, S., Hasle, H., van der Werff ten Bosch, J., Smith, O., De Rosa, M., Piciocchi, A., Lo Coco, F., Foà, R., Locatelli, F., & Kaspers, G. J. L. (2018). Risk-adapted treatment of acute promyelocytic leukemia: results from the International Consortium for Childhood APL. *Blood*, *132*(4), 405-412. https://doi.org/10.1182/blood-2018-03-836528

Tonorezos, E. S., Snell, P. G., Moskowitz, C. S., Eshelman-Kent, D. A., Liu, J. E., Chou, J. F., Smith, S. M., Dunn, A. L., Church, T. S., & Oeffinger, K. C. (2013). Reduced cardiorespiratory fitness in adult survivors of childhood acute lymphoblastic leukemia. *Pediatr Blood Cancer*, *60*(8), 1358-1364. https://doi.org/10.1002/pbc.24492

Toro-Salazar, O. H., Ferranti, J., Lorenzoni, R., Walling, S., Mazur, W., Raman, S. V., Davey, B. T., Gillan, E., O'Loughlin, M., Klas, B., & Hor, K. N. (2016). Feasibility of Echocardiographic Techniques to Detect Subclinical Cancer Therapeutics-Related Cardiac Dysfunction among High-Dose Patients When Compared with Cardiac Magnetic Resonance Imaging. *J Am Soc Echocardiogr*, *29*(2), 119-131. https://doi.org/10.1016/j.echo.2015.10.008

Toro-Salazar, O. H., Gillan, E., Ferranti, J., Orsey, A., Rubin, K., Upadhyay, S., Mazur, W., & Hor, K. N. (2015). Effect of myocardial dysfunction in cardiac morbidity and all cause mortality in childhood cancer subjects treated with anthracycline therapy. *Cardiooncology*, *1*(1), 1. https://doi.org/10.1186/s40959-015-0005-8

Tukenova, M., Guibout, C., Oberlin, O., Doyon, F., Mousannif, A., Haddy, N., Guérin, S., Pacquement, H., Aouba, A., Hawkins, M., Winter, D., Bourhis, J., Lefkopoulos, D., Diallo, I., & de Vathaire, F. (2010). Role of cancer treatment in long-term overall and cardiovascular mortality after childhood cancer. *J Clin Oncol*, *28*(8), 1308-1315. https://doi.org/10.1200/jco.2008.20.2267

Unnikrishnan, D., Dutcher, J. P., Varshneya, N., Lucariello, R., Api, M., Garl, S., Wiernik, P. H., & Chiaramida, S. (2001). Torsades de pointes in 3 patients with leukemia treated with arsenic trioxide. *Blood*, *97*(5), 1514-1516. https://doi.org/10.1182/blood.v97.5.1514

van der Schoot, G. G. F., Ormel, H. L., Westerink, N. L., May, A. M., Elias, S. G., Hummel, Y. M., Lefrandt, J. D., van der Meer, P., van Melle, J. P., Poppema, B. J., Stel, J. M. A., van der Velden, A. W. G., Vrieling, A. H., Wempe, J. B., Ten Wolde, M. G., Nijland, M., de Vries, E. G. E., Gietema, J. A., & Walenkamp, A. M. E. (2022). Optimal Timing of a Physical Exercise Intervention to Improve Cardiorespiratory Fitness: During or After Chemotherapy. *JACC CardioOncol*, *4*(4), 491-503. https://doi.org/10.1016/j.jaccao.2022.07.006

Wanderley, M. R. B., Jr., Ávila, M. S., Fernandes-Silva, M. M., Cruz, F. D. D., Brandão, S. M. G., Rigaud, V. O. C., Hajjar, L. A., Filho, R. K., Cunha-Neto, E., Bocchi, E. A., & Ayub-Ferreira, S. M. (2022). Plasma biomarkers reflecting high oxidative stress in the prediction of myocardial injury due to anthracycline chemotherapy and the effect of carvedilol: insights from the CECCY Trial. *Oncotarget*, *13*, 214-223. https://doi.org/10.18632/oncotarget.28182

Wenningmann, N., Knapp, M., Ande, A., Vaidya, T. R., & Ait-Oudhia, S. (2019). Insights into Doxorubicin-induced Cardiotoxicity: Molecular Mechanisms, Preventive Strategies, and Early Monitoring. *Mol Pharmacol*, *96*(2), 219-232. https://doi.org/10.1124/mol.119.115725

Wilson, R. L., Christopher, C. N., Yang, E. H., Barac, A., Adams, S. C., Scott, J. M., & Dieli-Conwright, C. M. (2023). Incorporating Exercise Training into Cardio-Oncology Care: Current Evidence and

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25

Opportunities: *JACC: CardioOncology* State-of-the-Art Review. *JACC. CardioOncology*, *5*(5), 553–569. https://doi.org/10.1016/j.jaccao.2023.08.008

Winter, C., Müller, C., Hoffmann, C., Boos, J., & Rosenbaum, D. (2010). Physical activity and childhood cancer. *Pediatr Blood Cancer*, *54*(4), 501-510. https://doi.org/10.1002/pbc.22271

Zukkoor Zorn, S., & Thohan, V. (2018). *Drug-Drug Interactions of Common Cardiac Medications and Chemotherapeutic Agents*. American College of Cardiology. https://www.acc.org/latest-in-cardiology/articles/2018/12/21/09/52/drug-drug-interactions-of-common-cardiac-medications-and-chemotherapeutic-agents

RETURN TO THE BEGINNING

CONTACTS: OLGA H TORO SALAZAR, MD, EMBA | TIFFANY BERTHOD MSN, RN, CPN, CCRC
ANDREA ORSEY, MD, MSCE | ILANA WAYNIK, MD

LAST UPDATED: 07.16.25