

## Drug-Induced Long QT Interval

Long QT interval syndrome (LQTS) results when ion channels and proteins responsible for ventricular repolarization fail to work normally. A long QTc interval is considered to be >470 ms for postpubertal males and >480 ms for postpubertal females. LQTS can be inherited, or acquired, often as a medication side effect. Patients with LQTS are at risk for the arrhythmia known as torsades de pointes, which can cause cardiac arrest. Fortunately, torsades de pointes is rare. It is more likely to occur in hospitalized patients because this population tends to have more risk factors. These include advanced age, female gender (2-fold risk), heart disease, LQTS, QTc >500 ms (2- to 3-fold risk), renal or hepatic insufficiency, hypokalemia, hypomagnesemia, hypocalcemia, diuretic use, bradycardia, use of more than one QT-prolonging drug, and rapid intravenous administration of certain medications.<sup>1</sup> The FDA and Health Canada have published guidance for industry on assessing a new drug's QT interval effect. Drug-induced QT prolongation of 10 ms or greater suggests potential for clinically significant QT prolongation.<sup>2,3</sup> The following chart lists drugs that may prolong the QT interval or pose a torsades risk. A **decision support tool** is available at <https://medsafetyscan.org/>.

**\*\*Chart may not include all marketed drugs with QT prolongation/torsades risk.\*\***

<b>Attention-Deficit/Hyperactivity Disorder (ADHD) Agents</b>	
Amphetamine/dextroamphetamine ( <i>Adderall XR</i> ) <sup>b</sup> Dexmethylphenidate (e.g., <i>Focalin</i> [U.S. only]) <sup>b</sup> Lisdexamfetamine ( <i>Vyvanse</i> ) <sup>b</sup>	Atomoxetine ( <i>Strattera</i> ) <sup>a,b</sup> Dextroamphetamine ( <i>Dexedrine</i> ) <sup>b</sup> Methylphenidate (e.g., <i>Ritalin</i> , <i>Concerta</i> ) <sup>b</sup>
<b>Alzheimer's Agents</b>	
Donepezil (e.g., <i>Aricept</i> ) <sup>b,c</sup> Memantine (e.g., <i>Namenda XR</i> [U.S.]; <i>Ebixa</i> [Canada]) <sup>a,b</sup>	Galantamine ( <i>Razadyne</i> , <i>Razadyne ER</i> [U.S.]; <i>Reminyl ER</i> [Canada]) <sup>b,d</sup>
<b>Analgesics and Anesthetics</b>	
Buprenorphine (e.g., <i>Butrans</i> ) <sup>a,b</sup> Hydrocodone extended-release (e.g., <i>Hysingla</i> [U.S. only]) <sup>a,b</sup> Oxycodone <sup>d,h</sup> Sevoflurane <sup>b,c</sup>	Dexmedetomidine ( <i>Precedex</i> ) <sup>a,b</sup> Methadone (e.g., <i>Dolophine</i> [U.S.]; <i>Metadol</i> [Canada]) <sup>b,c</sup> Propofol ( <i>Diprivan</i> ) <sup>b,c</sup> Tramadol (e.g., <i>Ultram</i> ) <sup>a,b</sup>
<b>Antiarrhythmics</b>	
Amiodarone <sup>b,c</sup> Dofetilide ( <i>Tikosyn</i> [U.S. only]) <sup>b,c</sup> Flecainide <sup>b,c</sup> Procainamide <sup>b,c</sup> Quinidine <sup>b,c</sup>	Disopyramide ( <i>Norpace</i> , <i>Norpace CR</i> [U.S.]; <i>Rythmodan</i> [Canada]) <sup>b,c</sup> Dronedarone ( <i>Multaq</i> ) <sup>b,c</sup> Ibutilide ( <i>Corvert</i> ) <sup>b,c</sup> Propafenone ( <i>Rhythmol SR</i> [U.S.], <i>Rhythmol</i> [Canada]) <sup>b,d</sup> Sotalol <sup>b,c</sup>

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<b>Anticancer</b>		
Abiraterone (e.g., <i>Zytiga</i> ) <sup>b,d</sup> Arsenic trioxide ( <i>Trisenox</i> ) <sup>b,c</sup> Cabozantinib (e.g., <i>Cabometyx</i> ) <sup>a,b</sup> Cobimetinib ( <i>Cotellic</i> ) <sup>a,b</sup> Dasatinib ( <i>Sprycel</i> ) <sup>a,b</sup> Entrectinib ( <i>Rozlytrek</i> ) <sup>a,b</sup> Fluorouracil <sup>a,b</sup> Inotuzumab ozogamicin ( <i>Besponsa</i> ) <sup>a,b</sup> Lenvatinib ( <i>Lenvima</i> ) <sup>a,b</sup> Osimertinib ( <i>Tagrisso</i> ) <sup>a,b</sup> Pazopanib ( <i>Votrient</i> ) <sup>a,b</sup> Tamoxifen <sup>a,b</sup> Vandetanib ( <i>Caprelsa</i> ) <sup>b,c</sup>	Amsacrine ( <i>Amsa PD</i> [Canada only]) <sup>b,d</sup> Bortezomib ( <i>Velcade</i> ) <sup>a,b</sup> Capecitabine ( <i>Xeloda</i> ) <sup>a,b</sup> Crizotinib ( <i>Xalkori</i> ) <sup>a,b</sup> Degarelix ( <i>Firmagon</i> ) <sup>a,b</sup> Epirubicin ( <i>Ellence</i> [U.S.]) <sup>a,b</sup> Gilteritinib ( <i>Xospata</i> ) <sup>a,b</sup> Ivosidenib ( <i>Tibsovo</i> [U.S. only]) <sup>a,b</sup> Leuprolide (e.g., <i>Lupron</i> ) <sup>a,b</sup> Oxaliplatin ( <i>Eloxatin</i> [U.S.]) <sup>b,c</sup> Sorafenib ( <i>Nexavar</i> ) <sup>a,b</sup> Tazemetostat ( <i>Tazverik</i> [U.S. only]) <sup>a,b</sup> Vemurafenib ( <i>Zelboraf</i> ) <sup>a,b</sup>	Apalutamide ( <i>Erleada</i> ) <sup>a,b</sup> Bosutinib ( <i>Bosulif</i> ) <sup>a,b</sup> Ceritinib ( <i>Zykadia</i> ) <sup>a,b</sup> Dabrafenib ( <i>Tafinlar</i> ) <sup>a,b</sup> Encorafenib ( <i>Braftovi</i> ) <sup>a,b</sup> Eribulin ( <i>Halaven</i> ) <sup>a,b</sup> Glasdegib ( <i>Daurismo</i> [U.S. only]) <sup>a,b</sup> Lapatinib ( <i>Tykerb</i> ) <sup>a,b</sup> Nilotinib ( <i>Tasigna</i> ) <sup>a,b</sup> Panobinostat ( <i>Farydak</i> [U.S. only]) <sup>a,b</sup> Sunitinib ( <i>Sutent</i> ) <sup>a,b</sup> Toremifene ( <i>Fareston</i> [U.S. only]) <sup>a,b</sup> Vorinostat ( <i>Zolinza</i> ) <sup>a,b</sup>
<b>Anticonvulsants</b>		
Felbamate ( <i>Felbatol</i> [U.S. only]) <sup>a,b</sup>	Fosphenytoin ( <i>Cerebyx</i> ) <sup>a,h</sup>	
<b>Antidepressants</b> (see footnote g)		
Amitriptyline <sup>b,d</sup> Clomipramine ( <i>Anafranil</i> ) <sup>a,d</sup> Desvenlafaxine (e.g., <i>Pristiq</i> ) <sup>a,h</sup> Doxepin <sup>b,d</sup> Fluvoxamine <sup>b,d</sup> Maprotiline (U.S. only) <sup>a,b</sup> Nortriptyline <sup>a,b</sup> Protriptyline (U.S. only) <sup>a,h</sup> Trazodone <sup>b,d</sup> Venlafaxine ( <i>Effexor XR</i> ) <sup>a,b</sup>	Citalopram ( <i>Celexa</i> ) <sup>b,c</sup> Desipramine ( <i>Norpramin</i> [U.S.]) <sup>a,b</sup> Escitalopram ( <i>Lexapro</i> [U.S.]; <i>Cipralext</i> [Canada]) <sup>b,c</sup> Fluoxetine (e.g., <i>Prozac</i> ) <sup>b,d</sup> Imipramine <sup>a,b</sup> Mirtazapine ( <i>Remeron</i> ) <sup>a,b</sup> Paroxetine ( <i>Paxil</i> , <i>Paxil CR</i> ) <sup>b,d</sup> Sertraline ( <i>Zoloft</i> ) <sup>b,d</sup> Trimipramine <sup>a,b</sup>	
<b>Antiemetics/Antinausea</b>		
Dolasetron ( <i>Anzemet</i> [U.S. only]) <sup>a,b</sup> Granisetron (e.g., <i>Sancuso</i> [U.S.]) <sup>a,b</sup> Ondansetron (e.g., <i>Zofran</i> ) <sup>b,c</sup> Promethazine <sup>a,b</sup>	Droperidol (U.S. only) <sup>b,c</sup> Metoclopramide <sup>b,d</sup> Palonosetron (e.g., <i>Aloxi</i> ) <sup>a,b</sup>	

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<b>Antihistamines</b>		
Hydroxyzine ( <i>Atarax</i> [Canada]) <sup>b,d</sup>	Diphenhydramine (e.g., <i>Benadryl</i> ) <sup>b,d,i</sup>	
<b>Antimicrobials</b> (see footnote f)		
Amantadine <sup>b,d,i</sup> Atazanavir ( <i>Reyataz</i> ) <sup>b,d</sup> Chloroquine <sup>b,c</sup> Erythromycin <sup>b,c</sup> Gemifloxacin ( <i>Factive</i> [U.S. only]) <sup>a,b</sup> Ketoconazole <sup>b,d</sup> Lopinavir/ritonavir ( <i>Kaletra</i> ) <sup>a,b</sup> Nelfinavir ( <i>Viracept</i> ) <sup>b,d</sup> Pentamidine <sup>b,c</sup> Pretomanid (U.S. only) <sup>a,b</sup> Rilpivirine ( <i>Edurant</i> ) <sup>a,b</sup> Trimethoprim-Sulfamethoxazole (e.g., <i>Septtra</i> ) <sup>b</sup>	Amphotericin B <sup>b,d</sup> Azithromycin (e.g., <i>Zithromax</i> ) <sup>b,c</sup> Ciprofloxacin ( <i>Cipro</i> ) <sup>b,c</sup> Fluconazole ( <i>Diflucan</i> ) <sup>b,c</sup> Hydroxychloroquine <sup>b,c</sup> Lefamulin ( <i>Xenleta</i> [U.S. only]) <sup>a,b</sup> Metronidazole <sup>b,d</sup> Norfloxacin (Canada only) <sup>a,b</sup> Piperacillin/tazobactam <sup>b,d</sup> Primaquine <sup>a,b</sup> Saquinavir ( <i>Invirase</i> ) <sup>a,b</sup> Voriconazole ( <i>Vfend</i> ) <sup>b,d</sup>	Artemether/Lumefantrine ( <i>Coartem</i> [U.S.]) <sup>a,b</sup> Bedaquiline ( <i>Sirturo</i> [U.S. only]) <sup>a,b</sup> Clarithromycin ( <i>Biaxin</i> [Canada]) <sup>b,c</sup> Foscarnet ( <i>Foscavir</i> [U.S. only]) <sup>a,b</sup> Itraconazole ( <i>Sporanox</i> ) <sup>b,d</sup> Levofloxacin <sup>b,c</sup> Moxifloxacin ( <i>Avelox</i> ) <sup>b,c</sup> Ofloxacin <sup>a,b</sup> Posaconazole ( <i>Noxafil</i> [U.S.], <i>Posanol</i> [Canada]) <sup>b,d</sup> Quinine <sup>b,d</sup> Telavancin ( <i>Vibativ</i> ) <sup>a,b</sup>
<b>Antipsychotics</b> (see footnote e)		
Aripiprazole (e.g., <i>Abilify</i> ) <sup>a,b</sup> Clozapine ( <i>Clozaril</i> ) <sup>a,b</sup> Iloperidone ( <i>Fanapt</i> [U.S. only]) <sup>a,b</sup> Olanzapine (e.g., <i>Zyprexa</i> ) <sup>b,d</sup> Pimozide <sup>b,c</sup> Thioridazine <sup>b,c</sup>	Asenapine ( <i>Saphris</i> ) <sup>a,b</sup> Flupentixol ( <i>Fluanxol</i> [Canada only]) <sup>a,b</sup> Lumateperone ( <i>Caplyta</i> ) <sup>a,b</sup> Paliperidone (e.g., <i>Invega</i> ) <sup>a,b</sup> Quetiapine ( <i>Seroquel</i> , <i>Seroquel XR</i> ) <sup>b,d</sup> Ziprasidone ( <i>Geodon</i> [U.S.]; <i>Zeldox</i> [Canada]) <sup>b,d</sup>	Chlorpromazine <sup>b,c</sup> Haloperidol <sup>b,c</sup> Lurasidone ( <i>Latuda</i> ) <sup>a,b</sup> Pimavanserin ( <i>Nuplazid</i> [U.S. only]) <sup>a,b</sup> Risperidone (e.g., <i>Risperdal</i> ) <sup>b,d</sup> Zuclopenthixol ( <i>Clopixol</i> [Canada only]) <sup>a,b</sup>
<b>Bronchodilators</b>		
Albuterol (e.g., <i>Proventil HFA</i> , <i>Ventolin HFA</i> ) <sup>b</sup> Formoterol (e.g., <i>Foradil</i> ) <sup>b</sup> Levalbuterol ( <i>Xopenex</i> [U.S. only]) <sup>b</sup> Olodaterol (e.g., <i>Striverdi Respimat</i> [U.S.], <i>Inspiroto Respimat</i> [Canada]) <sup>b</sup> Salmeterol (e.g., <i>Serevent</i> ) <sup>b</sup>	Arformoterol ( <i>Brovana</i> [U.S. only]) <sup>b</sup> Indacaterol (e.g., <i>Onbrez</i> [Canada only]) <sup>b</sup> Metaproterenol (U.S. only) <sup>b</sup> Salbutamol (Canada; see albuterol) Terbutaline <sup>b</sup>	

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<b>Cardiac Agents, Misc.</b>		
Amiodarone <sup>b,c</sup> Dopamine <sup>b</sup> Isoproterenol ( <i>Isuprel</i> [U.S.]) <sup>b</sup> Moexipril/HCTZ <sup>a,b</sup> Phenylephrine (injectable) <sup>b</sup>	Cilostazol <sup>b,c</sup> Ephedrine <sup>b</sup> Isradipine (U.S. only) <sup>a,b</sup> Nicardipine (U.S. only) <sup>a,b</sup> Ranolazine ( <i>Ranexa</i> [U.S. only]) <sup>b,d</sup>	Dobutamine <sup>b</sup> Epinephrine <sup>b</sup> Ivabradine ( <i>Corlanor</i> [U.S.]; <i>Lancora</i> [Canada]) <sup>b,d</sup> Norepinephrine ( <i>Levophed</i> ) <sup>b</sup>
<b>Decongestants</b>		
Oxymetazoline (e.g., <i>Afrin</i> [U.S.], <i>Drixoral</i> [Canada]) <sup>b</sup> Pseudoephedrine (e.g., <i>Sudafed</i> ) <sup>b</sup>	Phenylephrine oral (e.g., <i>Sudafed PE</i> ) <sup>b</sup> Xylometazoline (e.g., <i>Otrivin</i> [Canada]) <sup>b</sup>	
<b>Diuretics</b>		
Bendroflumethiazide (e.g., <i>Naturetin</i> [Canada]) <sup>b,d</sup> Hydrochlorothiazide <sup>b,d</sup> Metolazone ( <i>Zaroxolyn</i> ) <sup>a,d</sup>	Furosemide <sup>b,d</sup> Indapamide <sup>b,d</sup> Torsemide ( <i>Demadex</i> [U.S. only]) <sup>b,d</sup>	
<b>Gastrointestinal (GI) Meds, Misc.</b>		
Cimetidine <sup>b,d</sup> Domperidone (Canada only) <sup>b,c</sup> Famotidine <sup>b,d</sup> Loperamide (e.g., <i>Imodium</i> ) <sup>b,d</sup> Omeprazole <sup>b,d</sup>	Cisapride ( <i>Propulsid</i> [U.S.]; <i>Prepulsid</i> [Canada]) – restricted use <sup>b,c</sup> Esomeprazole (e.g., <i>Nexium</i> ) <sup>b,d</sup> Lansoprazole (e.g., <i>Prevacid</i> ) <sup>b,d</sup> Metoclopramide <sup>b,d</sup> Pantoprazole ( <i>Protonix</i> [U.S.], <i>Pantoloc</i> [Canada]) <sup>b,d</sup>	
<b>Multiple Sclerosis Agents</b>		
Fingolimod ( <i>Gilenya</i> ) <sup>a,b</sup>	Siponimod ( <i>Mayzent</i> ) <sup>a,b</sup>	
<b>Muscle Relaxants</b>		
Cyclobenzaprine <sup>d,h</sup> Tizanidine <sup>a,b</sup>	Orphenadrine <sup>d,h</sup>	
<b>Urinary Agents</b>		
Alfuzosin ( <i>Uroxatral</i> [U.S.]; <i>Xatral</i> [Canada]) <sup>a,b</sup> Tolterodine ( <i>Detrol</i> , <i>Detrol LA</i> ) <sup>a,b</sup>	Solifenacin ( <i>Vesicare</i> ) <sup>b,d</sup>	

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<b>Miscellaneous</b>	
Anagrelide ( <i>Agrylin</i> ) <sup>b,c</sup>	Apomorphine ( <i>Apokyn</i> [U.S.]; <i>Movapo</i> [Canada]) <sup>a,b</sup>
Betrixaban (Bevyxxa [U.S. only]) <sup>a,b</sup>	Chloral Hydrate (Canada only) <sup>b,d,i</sup>
Cocaine <sup>b,c</sup>	Deutetrabenazine ( <i>Austedo</i> [U.S. only]) <sup>a,b</sup>
Lithium (e.g., <i>Lithobid</i> [U.S.]; <i>Carbolith</i> [Canada]) <sup>a,b</sup>	Lofexidine ( <i>Lucremyra</i> [U.S.]) <sup>a,b</sup>
Midodrine <sup>b</sup>	Mifepristone ( <i>Korlym</i> , <i>Mifeprex</i> [U.S.]; <i>Mifegymiso</i> [Canada]) <sup>a,b</sup>
Nusinersen ( <i>Spinraza</i> ) <sup>a,b</sup>	Octreotide (e.g., <i>Sandostatin LAR</i> ) <sup>a,h</sup>
Oxytocin ( <i>Pitocin</i> [U.S.]) <sup>a,b</sup>	Pasireotide (e.g., <i>Signifor</i> ) <sup>a,b</sup>
Perflutren lipid microsphere ( <i>Definity</i> ) <sup>a,b</sup>	Phentermine (e.g., <i>Adipex-P</i> [U.S. only]) <sup>b</sup>
Pitolisant ( <i>Wakix</i> [U.S. only]) <sup>a,b</sup>	Tacrolimus (e.g., <i>Prograf</i> ) <sup>a,b</sup>
Tetrabenazine ( <i>Xenazine</i> [U.S.], <i>Nitoman</i> [Canada]) <sup>a,b</sup>	Vardenafil (e.g., <i>Levitra</i> ) <sup>a,b</sup>

- a. Drug may cause QT prolongation, but has either not been associated with torsades or has been rarely associated with torsades when used as directed.\* Product labeling may warn against use in patients with torsades risk factors, such as LQTS, hypokalemia, or concomitant use of QT-prolonging drugs.
- b. A drug to be avoided in LQTS, per <https://crediblemeds.org> (Accessed April 18, 2020). (Per product labeling, *Foscavir*, November 2017). Recommendation may differ from product labeling.
- c. Even when taken as directed, the drug has a recognized risk of torsades, per <https://crediblemeds.org> (Accessed April 18, 2020).
- d. The drug may cause torsades under certain conditions (e.g., high dose, overdose, drug interaction, hypokalemia, hypomagnesemia, bradycardia), but otherwise is not likely to cause torsades, per <https://crediblemeds.org> (Accessed April 18, 2020) or PubMed search results (cyclobenzaprine, orphenadrine, oxycodone).
- e. Aripiprazole, brexpiprazole, cariprazine, olanzapine, and lurasidone may pose relatively lower torsades risk vs other antipsychotics based on product labeling and literature review. Risperidone may pose more moderate risk vs higher-risk atypical antipsychotics.
- f. Risk with azithromycin is likely less than with clarithromycin or erythromycin.<sup>4</sup> Moxifloxacin may pose a higher risk than levofloxacin or ciprofloxacin.<sup>5</sup> Beta-lactams do not generally pose risk based on literature review. Piperacillin/tazobactam may cause hypokalemia (conditional risk).
- g. Fluoxetine, paroxetine, and sertraline may pose relatively lower torsades risk vs citalopram based on product labeling and literature review. Torsades reported with escitalopram overdose very rarely per U.S. product labeling (January 2019).
- h. Risk not classified by <https://crediblemeds.org>.
- i. <https://crediblemeds.org> suggests torsades is unlikely at normal doses.

\*Based on <https://crediblemeds.org> (Accessed April 18, 2020), **FDA-approved labeling** for *Abilify* (February 2020), *Aloxi* (April 2020), *Anzemet* (June 2018), *Apokyn* (February 2020), *Austedo* (October 2019), *Besponsa* (March 2018), *Bevyxxa* (July 2019), *Bosulif* (October 2019), *Braftovi* (April 2020), *Cabometyx* (February 2020), *Caplyta* (December 2019), *Cardene I.V.* (January 2019), *Cerebyx* (January 2020), *Clozaril* (March 2020), *Coartem* (August 2019), *Cotellic* (January 2018), *Detrol LA* (July 2018), *Daurismo* (March 2020), *Edurant* (May 2019), *Effexor XR* (December

More . . .

2018), *Erleada* (September 2019), *Factive* (May 2016), *Fanapt* (January 2016), *Fareston* (May 2017), *Farydak* (June 2016), *Felbatol* (February 2018), *Firmagon* (February 2020), *Foscavir* (November 2017), *Gilenya* (December 2019), *Halaven* (December 2017), *Hysingla* (October 2019), *Invega* (July 2018), *Invirase* (December 2019), isradipine (Glenmark, August 2018), *Kaletra* (April 2020), *Korlym* (November 2019), *Latuda* (December 2019), *Lenvima* (February 2020), *Levitra* (November 2018), *Lucemyra* (May 2018), *Mavyret* (March 2019), *Nexavar* (March 2020), moexipril/hydrochlorothiazide (Heritage, October 2017), norfloxacin (AA Pharma, June 2019), *Norpramin* (November 2018), *Nuplazid* (September 2019), ofloxacin (Cadila, September 2019), *Precedex* (April 2016), pretomanid (September 2019), primaquine (July 2018), *Pristiq* (November 2018), *Prograf* (June 2019), *Remeron* (March 2020), *Rozlytrek* (August 2018), *Sancuso* (January 2017), *Sandostatin LAR* (April 2019), *Saphris* (February 2017), *Signifor* (January 2020), *Sirturo* (December 2019), *Spinraza* (December 2019), *Sprycel* (December 2018), *Strattera* (February 2020), *Sutent* (May 2019), *Tafinlar* (October 2019), *Tagrisso* (December 2019), *Tasigna* (September 2019), *Tazverik* (January 2020), *Tibsovo* (May 2019), *Tykerb* (December 2018), *Ultram* (October 2019), *Uroxatral* (September 2019), *Velcade* (April 2019), *Vibativ* (February 2020), *Votrient* (May 2017), *Wakix* (November 2019), *Xalkori* (June 2019), *Xenazine* (November 2019), *Xenleta* (October 2019), *Xospata* (May 2019), *Zelboraf* (November 2017), *Zolinza* (January 2020), *Zykadia* (March 2019), **Canadian monograph** for *Clopixol* (July 2016), *Definity* (October 2011), *Ebixa* (July 2016), *Fluanxol* (December 2017), and **PubMed search results** (buprenorphine, capecitabine, clomipramine, epirubicin, fluorouracil, imipramine, leuprolide, lithium, maprotiline, nortriptyline, oxycodone, oxytocin, promethazine, protriptyline, tamoxifen, tizanidine, trimipramine).

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*Users of this resource are cautioned to use their own professional judgment and consult any other necessary or appropriate sources prior to making clinical judgments based on the content of this document. Our editors have researched the information with input from experts, government agencies, and national organizations. Information and internet links in this article were current as of the date of publication.*

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