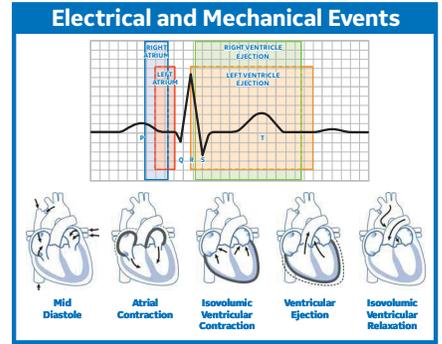
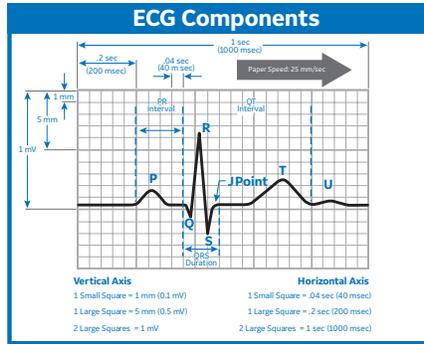
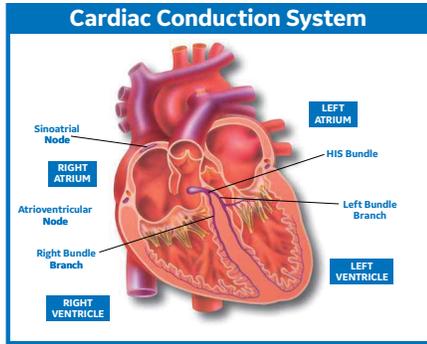


# Arrhythmia Recognition



### Sinus Rhythms

Normal Sinus Rhythm	Sinus Arrhythmia	Sinus Tachycardia	Sinus Bradycardia	Sinus Arrest or SA Block
Heart Rate: 60-100 bpm Rhythm: Regular P Wave: Before each QRS, identical PR Interval: 0.12 to 0.20 (in seconds) QRS: < 0.12	Heart Rate: 60-100 bpm Rhythm: Irregular P Wave: Before each QRS, identical PR Interval: 0.12 to 0.20 (in seconds) QRS: < 0.12	Heart Rate: > 100 bpm Rhythm: Regular P Wave: Before each QRS, identical PR Interval: 0.12 to 0.20 (in seconds) QRS: < 0.12	Heart Rate: > 60 bpm Rhythm: Regular P Wave: Before each QRS, identical PR Interval: 0.12 to 0.20 (in seconds) QRS: < 0.12	Heart Rate: 40-100 bpm Rhythm: Irregular P Wave: Identical before each QRS. P to P interval may be fixed before and after the pause PR Interval: 0.12 to 0.20 (in seconds) QRS: < 0.12

### Supraventricular Rhythms

Premature Atrial Complexes - PACs	Premature Atrial Complex - Isolated PAC	Premature Atrial Complexes (Atrial Bigeminy) Every other beat is a PAC	Premature Atrial Complex with Aberrancy	Nonconducted Premature Atrial Complex
Heart Rate: N/A Rhythm: Irregular P Wave: Premature and abnormal. May be hidden PR Interval: 0.12 to 0.20 (in seconds) QRS: < 0.12	Heart Rate: N/A Rhythm: Irregular P Wave: Premature and abnormal. May be hidden PR Interval: 0.12 to 0.20 (in seconds) QRS: < 0.12	Heart Rate: N/A Rhythm: Irregular P Wave: Premature and abnormal. May be hidden PR Interval: 0.12 to 0.20 (in seconds) QRS: < 0.12	Heart Rate: N/A Rhythm: Irregular P Wave: Premature and abnormal. May be hidden PR Interval: 0.12 to 0.20 (in seconds) QRS: < 0.12	Heart Rate: N/A Rhythm: Irregular P Wave: Premature and abnormal. May be hidden PR Interval: None QRS: Absent

### Supraventricular Rhythms (Continued)

Atrial Tachycardia	Atrial Flutter	Atrial Fibrillation	Junctional Rhythm	Accelerated Junctional Rhythm	Junctional Tachycardia
Heart Rate: 140-250 bpm Rhythm: Regular P Wave: Abnormal P before each QRS (difficult to see) PR Interval: 0.12 to 0.20 (in seconds) QRS: < 0.12	Heart Rate: 240-350 bpm Rhythm: Irregular P Wave: Regular P waves usually the negative component of the flutter wave in II, III, aVF and positive in V1 PR Interval: N/A QRS: < 0.12	Heart Rate: A: 350-650 bpm Rhythm: Irregular P Wave: V: Slow to rapid PR Interval: N/A QRS: < 0.12	Heart Rate: 40-60 bpm Rhythm: Regular P Wave: Inverted in inferior leads, before, during or after the QRS, may be absent PR Interval: < 0.12 (in seconds) QRS: < 0.12	Heart Rate: 60-100 bpm Rhythm: Usually AV dissociation because of digitalis toxicity P Wave: May be sinus dissociation because of AV dissociation PR Interval: < 0.12 (in seconds) QRS: < 0.12	Heart Rate: Usually < 140 bpm Rhythm: Regular P Wave: Inverted, Absent or after QRS PR Interval: < 0.12 (in seconds) QRS: < 0.12

### Conduction Defects

Right Bundle Branch Block	Left Bundle Branch Block	Pre-excitation Syndrome	First-Degree AV Block	Second-Degree AV Block - Type I (AV Wenckebach or Mobitz type I)	Second-Degree AV Block-Type II (Mobitz type II)	Second-Degree AV Block - 2:1 AV Block	Third Degree (Complete) AV Block
Heart Rate: N/A Rhythm: Irregular P Wave: Before each QRS, identical PR Interval: 0.12 to 0.20 (in seconds) QRS: > 0.12 Characteristics: RSR in V1	Heart Rate: N/A Rhythm: Irregular P Wave: Before each QRS, identical PR Interval: 0.12 to 0.20 (in seconds) QRS: > 0.12 Characteristics: QS or rS in V1 & V2, ST elevation	Heart Rate: N/A Rhythm: Irregular P Wave: Before each QRS, identical PR Interval: < 0.12 (in seconds) QRS: Usually > 0.12 (in seconds) Characteristics: Delta wave distorts initial QRS	Heart Rate: N/A Rhythm: Regular P Wave: Before each QRS, identical PR Interval: > 0.20 (in seconds) QRS: < 0.12 Characteristics: Regular rhythm	Heart Rate: N/A Rhythm: Irregular P Wave: Before each QRS, identical PR Interval: Increasingly prolonged QRS: < 0.12 (in seconds) Characteristics: QRS dropped in a repeating pattern	Heart Rate: N/A Rhythm: Irregular P Wave: Before each QRS, identical PR Interval: Normal or prolonged QRS: Broad Characteristics: Some P waves are not conducted	Heart Rate: N/A Rhythm: Irregular P Wave: Before each QRS, identical PR Interval: Normal but not related to QRS QRS: Narrow or broad Characteristics: 2:1 AV conduction	Heart Rate: N/A Rhythm: Irregular P Wave: Before each QRS, identical PR Interval: Normal but not related to QRS QRS: Narrow or broad Characteristics: AV dissociation

### Arrhythmia Recognition (poster 1 of 2)

This is part one of two posters to assist healthcare professionals in recognizing basic arrhythmias. According to the Practice Standards for Electrocardiographic Monitoring in Hospital Settings (Circulation, 2004;110:2722-2746) in general, the mechanisms of arrhythmias are the same in both adults and children. However, the ECG appearance of the arrhythmias may differ due to developmental issues such as heart size, baseline heart rate, sinus and AV node function, and automatic innervation.

ECG terminology and diagnostic criteria often vary from text to text and from one teacher to another. There are often several terms describing similar findings (for example: Premature Atrial Contraction, Atrial Premature Complex, Atrial Extrasystole, Supraventricular Ectopic Beat, etc.). It is important to correlate the ECG interpretation with the clinical observation of the patient.

### Normal ECG Standards for Children Age

Age	0-3	3-6	6-12	12-18	18-24	24-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-80
Heart Rate (bpm)	100-160	90-150	80-140	70-130	60-120	50-110	40-100	30-90	20-80	10-70	5-60	0-50	0-40	0-30	0-20	0-10
PR Interval (sec)	0.12-0.18	0.12-0.16	0.12-0.16	0.12-0.16	0.12-0.16	0.12-0.16	0.12-0.16	0.12-0.16	0.12-0.16	0.12-0.16	0.12-0.16	0.12-0.16	0.12-0.16	0.12-0.16	0.12-0.16	0.12-0.16
QRS Duration (sec)	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10	0.06-0.10

All values 2nd - 98th percentile; numbers in parentheses, means. Adapted from: Doctor Corral 1979:123.

This poster includes Premature Ventricular Conduction, Pacemaker Lead Placement, ST Segment Depression, Ventricular Rhythms, Pacemaker Rhythms, Full Compensatory Pause and ECG Artifact. The ECG rhythm strips display lead II as the top waveform and lead V1 as the bottom waveform. Classic examples are shown for each rhythm to provide basic visualization and avoid complexities. The intended use of this poster is to complement a text and/or course - in addition to a reference guide for arrhythmia recognition.

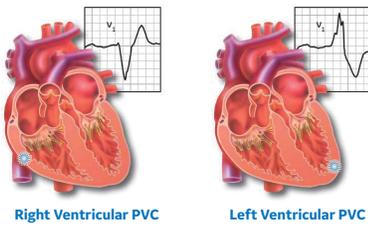
The most common ECG rate, interval, and duration measurements are from the following publications:

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# Arrhythmia Recognition



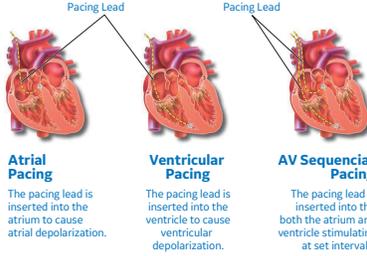
## Premature Ventricular Conduction



Right Ventricular PVC

Left Ventricular PVC

## Pacemaker Lead Placement



Atrial Pacing

The pacing lead is inserted into the atrium to cause atrial depolarization.

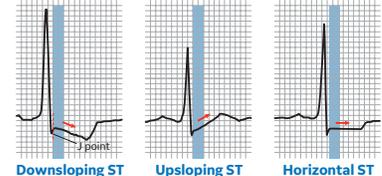
Ventricular Pacing

The pacing lead is inserted into the ventricle to cause ventricular depolarization.

AV Sequential Pacing

The pacing lead is inserted into both the atrium and ventricle stimulating at set intervals.

## ST Segment Depression



The J point occurs at the end of the QRS complex. The ST segment begins at the J point and extends to a user-defined interval.

## Ventricular Rhythms

Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
N/A	Irregular with PVCs	N/A	N/A	≥ 0.12

**Premature Ventricular Complex - PVC**

**Unifocal PVCs: Identical shapes**

**Multifocal PVCs: More than one shape**

**Paired PVCs (Couplet)**

**R on T Phenomenon: PVC occurs at the peak of the T wave of the preceding beat**

**Ventricular Bigeminy: Every other beat is a PVC**

**Ventricular Trigeminy: Every third beat is a PVC**

**Ventricular Quadrigeminy: Every fourth beat is a PVC**

**Ventricular Asystole**

Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
N/A	N/A	Present	Same as sinus rhythm or shorter	≥ 0.12

**Ventricular Fusion Beat**

**Ventricular Escape Beat**

Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
< 40 bpm	Irregular	Absent	Absent	≥ 0.12

**Idioventricular Rhythm**

Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
20 - 40 bpm	Regular	Absent or not related	N/A	≥ 0.12

**Accelerated Idioventricular Rhythm (AIVR)**

Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
40 - 100 bpm	Regular	Absent, not related or retrograde conduction	N/A	≥ 0.12

**Ventricular Tachycardia (3 or more consecutive ventricular complexes)**

Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
> 100 bpm	Regular	Absent, not related or retrograde conduction 1:1, 1:2, or VA Wenckebach	N/A	≥ 0.12

**Ventricular Fibrillation**

Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
300 - 600 bpm	Extremely Irregular	Absent	Absent	Absent

## Pacemaker Rhythms

**Electronic Pacemaker Spikes**

Electrical stimuli delivered by the electronic pacemaker to the endocardium are seen as a spike on the surface ECG.

**Ventricular Pacemaker (single chamber)**

Single spike producing a wide QRS complex (ventricular capture).

**Atrial Pacemaker (single chamber)**

Single spike producing a paced P wave (atrial capture) followed by an intrinsic QRS complex.

**AV Sequential Pacemaker (dual chamber)**

First spike followed by a paced P wave (atrial capture) followed by a second spike producing a wide QRS complex (ventricular capture).

**Paced Fusion Beat**

The electronic pacemaker and the patient's own cardiac rhythm occur simultaneously producing a combination of a paced beat and an intrinsic beat.

**Full Compensatory Pause vs. Noncompensatory Pause**

**To measure a Full Compensatory Pause:**

1. Mark off three normal cycles.
2. Place the first mark on the P wave of the normal cycle preceding the premature complex.
3. The third mark should fall exactly on the P wave following the premature complex to be called a compensatory pause.

**Failure to Capture**

The pacemaker generates a pacemaker spike but does not cause an intrinsic beat (P wave or QRS).

**Failure to Sense**

The pacemaker does not recognize the intrinsic beats and generates an unnecessary pacemaker spike.

**Failure to Fire**

The pacemaker does not generate a pacemaker spike when it is needed.

**ECG Artifact**

Any waveform on the ECG that is not related to the patient's cardiac events

**Calibration Pulses**

Deliberate artifact caused to show the interpreter the relationship of the complexes with a known electrical stimulus (standardization procedure).

**AC Interference (60 cycle)**

Sixty even, regular spikes in a one-second interval caused by electrical current near the patient.

**Muscle Tremor (Somatic)**

Electrical interference caused by the patient's tensed muscles.

**Wandering Baseline (Draft)**

An undulating baseline with waveform present.

## Arrhythmia Recognition (poster 2 of 2)

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Heart Rate (bpm)	100-160	90-150	80-140	70-130	60-120	50-110	40-100	30-90	20-80
PR Interval (sec)	0.12-0.18	0.12-0.18	0.12-0.18	0.12-0.18	0.12-0.18	0.12-0.18	0.12-0.18	0.12-0.18	0.12-0.18
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QT Interval (sec)	0.08-0.12	0.08-0.12	0.08-0.12	0.08-0.12	0.08-0.12	0.08-0.12	0.08-0.12	0.08-0.12	0.08-0.12
QTc Interval (sec)	0.03-0.04	0.03-0.04	0.03-0.04	0.03-0.04	0.03-0.04	0.03-0.04	0.03-0.04	0.03-0.04	0.03-0.04

All values 2nd - 98th percentile; numbers in parenthesis, mean. Adapted from: *Medical Cardiology*, 10:79, 11:23.

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