CPPN wants to provide you information regarding the new ECG Interpretation challenge option offered to experienced new hires. Two considerations must be met for an experienced hire to be eligible to take the ECG challenge test:

1. Nurse Manager must have approved this as an option they want available to their experienced new hires

   **AND**

2. The experienced new hire needs to self-identify their clinical competence for "dysrhythmia detection and treatment" as competent, proficient, or expert (per Benner's stages of clinical competence).
   - Competent: At least 2-3 years of experience and able to practice independently with minimal support.
   - Proficient: Performs frequently. Able to proactively identify potential issues related to skills, patient condition or equipment.
   - Expert: Practice is intuitive. Able to generate new knowledge related to skills, patient condition or equipment.

**Test Information:** If these two conditions are met the experienced new hire will be given proctored time (not to exceed 2-hours) during CPPN's portion of Nursing Orientation to complete a 60-questions multiple choice test. This will be a closed book/note/resource test with no remediation available. CPPN will provide calipers for the examination. The following packet provides information on the different EKG rhythms that you may have to interpret during the challenge test.

If the experienced new hire scores 84% or higher this will replace attending the 3-day ECG Interpretation course. If the experienced new hire scores less than 84% CPPN will assist them in signing up for the 3-day ECG Interpretation course # DAHS-NADEKGI17-ANCC.
### SINUS RHYTHM

- **Rate:** SA node firing at 60-100 bpm
- **Rhythm:** Regular
- **P-Waves:** Present, similar morphology
- **PR Interval:** Normal (0.12-0.20 secs), consistent
- **P:QRS Ratio:** QRS is present after each P wave (1:1 ratio of P’s to QRS’s)
- **QRS Width:** Narrow (≤.11) or Wide (≥.12)
- **T-Waves:** Present

### SINUS BRADY

- **Rate:** SA node firing at <60 bpm
- **Rhythm:** Regular
- **P-Waves:** Present, similar morphology
- **PR Interval:** Normal, consistent
- **P:QRS Ratio:** 1:1
- **QRS Width:** Narrow or Wide
- **T-Waves:** Present
- **Etiology:** Ischemia/infarction of SA node, hypothermia, cardiac drugs, hypothyroidism, ↑ vagal tone, ↓ sympathetic tone
- **Clinical Significance:** Decreased Cardiac output (CO), predisposes to ectopic beats

### SINUS TACHYCARDIA

- **Rate:** SA node firing at >100 bpm
- **Rhythm:** Regular
- **P-Waves:** Present, normal unless merged with T-Wave, similar morphology
- **PR Interval:** Normal, consistent
- **P:QRS Ratio:** 1:1
- **QRS Width:** Narrow or Wide
- **T-Waves:** Present
- **Etiology:** Compensatory response to physiologic stressor (pain, emotions, anxiety, blood loss, hypovolemia, early sepsis, heart failure, allergic reaction, fever, exercise), substances (smoking, alcohol, caffeine, drugs)
- **Clinical Significance:** ↑ oxygen consumption, ↑ workload on heart, ↓ CO if rate too fast for cardiac filling

### SINUS ARRHYTHMIA/DYSRHYTHMIAS

- **Rate:** Usually around 60-100 but can be slow or fast
- **Rhythm:** Regularly irregular but can be irregularly irregular
- **P-Waves:** Present, similar morphology
- **PR Interval:** Normal, consistent
- **P:QRS Ratio:** Variable
- **QRS Width:** Narrow or Wide
- **T-Waves:** Present
- **Etiology:** Common and normal finding in children and young adults, underlying heart disease, digitalis, exercise, mental stress, circadian rhythms
- **Clinical Significance:** Usually none, can make heart more susceptible to ventricular dysrhythmias

### SINUS ARREST/SINUS PAUSE

- **Rate:** Single or multiple pauses can occur
- **Rhythm:** Irregular (due to break in rhythm)
- **P-Waves:** Delayed or nonconducted (after a pause there may or may not be a p wave)
- **PR Interval:** Normal except during the pause event
- **P:QRS Ratio:** Usually 1:1 except during the pause event
- **QRS Width:** Narrow or Wide
- **T-Waves:** Present
- **Etiology:** Hypoxemia, ischemia, diseased SA node, drugs (digoxin, beta blockers), cardiac disorders, vagal stimulation
- **Clinical Significance:** Depends on patient’s symptoms, if short and infrequent the patient may be symptomatic. If patient is symptomatic can have symptoms of ↓ CO

### SICK SINUS SYNDROME

- **Rate:** Variable (bradycardia to tachycardia)
- **Rhythm:** Irregular
- **P-Waves:** Variable, can be delayed or nonconducted
- **PR Interval:** Variable
- **P:QRS Ratio:** Variable
- **QRS Width:** Narrow or Wide
- **Etiology:** Coronary artery disease, fibrosis of SA node, Trauma to SA node, antidysrhythmic drug side effects (digoxin, beta blockers, calcium channel blockers)
- **Clinical Significance:** Loss of reliable pacemaker, ↑ workload on heart, ↓ CO
ATRIAL DYSRHYTHMIAS

### PREMATURE ATRIAL CONTRACTION (PAC)
- **Rate**: PAC is a single complex. May occur in patterns: pairs, every other beat or every three beats.
- **Regularity**: Ectopic beat makes it irregular
- **P-Waves**: P-Wave for PAC is usually abnormally shaped or buried in preceding T-Wave, different morphology than underlying P waves
- **PR Interval**: Changes with the premature beat(s)
- **QRS Width**: Narrow
- **Etiology**: Stimulants, stress, anxiety, electrolyte imbalances, hypoxia, drug toxicity, coronary heart disease, fatigue, fever
- **Clinical Significance**: Depends on frequency, if more then 5-6/min then it is frequent and more significant, could ↓ CO. Predisposes to other dysrhythmias.

### ATRIAL FLUTTER
- **Rate**: Usually Atrial: 200-400 bpm, Ventricular: 100-300. Rate can be slower, depends on the AV conduction ratio.
- **Rhythm**: Variable presentation. Regular if consistent ratio of F-waves:QRS (2:1, 3:1, 4:1), irregular if variable ratio
- **P-Waves**: Absent, rather there are flutter “F-Waves” with a “sawtooth” appearance, F waves are consistent
- **PR Interval**: None
- **QRS Width**: Narrow or Wide
- **T-Waves**: Not able to distinguish d/t F-Waves
- **Etiology**: Enlarged atrial tissue, elevated atrial pressures, digoxin toxicity, pulmonary embolism, ETOH abuse, following open heart surgery
- **Clinical Significance**: Abnormal movement of electrical depolarization in reentry circuit, ↓ CO, blood stasis=increased incidence of clotting, ↑ myocardial oxygen consumption

### ATRIAL FIBRILLATION
- **Rate**: Usually Atrial: 400-700 bpm, Ventricular: Variable. Depends on AV conduction. Controlled if HR<100, Uncontrolled/Rapid Ventricular Response (RVR) HR >100
- **Rhythm**: Irregularly irregular
- **P-Waves**: Absent, rather there are fibrillatory “f-Waves”
- **PR Interval**: None
- **QRS Width**: Narrow
- **T-Waves**: Can be difficult to distinguish d/t f-Waves
- **Etiology**: Acute MI, digitalis toxicity, long standing hypertension, left atrial enlargement
- **Clinical Significance**: Loss of atrial kick, ↓ filling time, ↓ CO

### SUPRAVENTRICULAR TACHYCARDIA (SVT)
- **Rate**: 140-250
- **Rhythm**: Regular
- **P-Waves**: usually buried in QRS or T-Wave
- **PR Interval**: Not measurable
- **QRS Width**: Narrow unless distorted by buried P-Waves
- **T-Waves**: Present, can be merged with P waves
- **Etiology**: Structurally related, heart failure, thyroid disease, excess of stimulants, pregnancy, surgery, chronic lung disease
- **Clinical Significance**: usually benign and self-limiting when the cause is removed, ↓ filling time, ↓ CO

### WANDERING ATRIAL PACEMAKER
- **Rate**: <100 (considered multifocal atrial tachycardia (MAT) if >100
- **Rhythm**: Irregularly irregular (sites of impulses vary)
- **P-Waves**: Present with variable morphologies. Minimum of 3 different morphologies required.
- **PR Interval**: Variable
- **P:QRS Ratio**: 1:1
- **QRS Width**: Narrow or Wide
- **Etiology**: ↑ vagal tone, digoxin toxicity, heart disease, COPD, Respiratory failure, atrial enlargement, electrolyte abnormalities, stimulants
- **Clinical Significance**: Can be normal in young pts and common in athletes, no clinical significance if patients are asymptomatic, correct underlying condition
### Junctional Dysrhythmias

#### PJ C
- **Rate:** Usually a single complex
- **Rhythm:** The ectopic beat makes it irregular
- **P-Waves:** Variable for the ectopic beat. 3 different P wave presentations are possible (before, during or after QRS). Can be positive or negative deflection (inverted).
- **PR Interval:** Variable for ectopic beat, short if P wave present before QRS
- **P:QRS Ratio:** Variable for ectopic beat, 1:1 if P wave before QRS
- **QRS Width:** Narrow unless distorted by p wave
- **T-Waves:** Present
- **Etiology:** Digoxin toxicity, excessive caffeine intake, inferior MI, rheumatic heart disease, valvular heart disease, hypoxia, swelling of AV junction
- **Clinical Significance:** depends on frequency and if patient is symptomatic, ↓ CO, may have a pause after a PJC

#### Junctional Rhythm/Junctional Escape Rhythm
- **Rate:** 40-60 bpm
- **Rhythm:** Regular
- **P-Waves:** Variable. 3 different P wave presentations are possible (before, during or after QRS). Can be positive or negative deflection (inverted).
- **PR Interval:** Variable, short if P wave present before QRS
- **P:QRS Ratio:** Variable, 1:1 if P wave before QRS
- **QRS Width:** Narrow unless distorted by p wave
- **T-Waves:** Present
- **Etiology:** Sick sinus syndromes, vagal stimulation, electrolyte imbalances, digoxin toxicity, inferior wall MI, rheumatic heart disease
- **Clinical Significance:** ↓ HR and ↓ CO

#### Accelerated Junctional Rhythm
- **Rate:** 60-100 bpm
- **Rhythm:** Regular
- **P-Waves:** Variable. 3 different P wave presentations are possible (before, during or after QRS). Can be positive or negative deflection (inverted).
- **PR Interval:** Variable, short if P wave present before QRS
- **P:QRS Ratio:** Variable, 1:1 if P wave before QRS
- **QRS Width:** Narrow unless distorted by p wave
- **T-Waves:** Present
- **Etiology:** Digoxin toxicity, hypokalemia, hypercalcemia, inferior and posterior MI, rheumatic heart disease
- **Clinical Significance:** loss of atrial kick and ↓ filling time if retrograde, ↓ CO

#### Junctional Tachycardia
- **Rate:** 100-130 bpm
- **P-Waves:** Variable. 3 different P wave presentations are possible (before, during or after QRS). Can be positive or negative deflection (inverted).
- **PR Interval:** Variable, short if P wave present before QRS
- **P:QRS Ratio:** Variable, 1:1 if P wave before QRS
- **QRS Width:** Narrow unless distorted by p wave
- **T-Waves:** Present
- **Etiology:** inferior or posterior MI, SA node disease, hypoxia, ischemia, digoxin toxicity, ↑ vagal tone
- **Clinical Significance:** loss of atrial kick and ↓ filling, ↓ CO, predisposes to other dysrhythmias, less dependable pacemaker, predisposes to heart failure

### Cardiac Conduction Blocks

#### First Degree Heart Block
- **Rate:** Variable, Atrial rate = ventricular rate
- **Rhythm:** Regular
- **P-Waves:** Present, similar morphology
- **PR Interval:** Prolonged >.20, consistent
- **P:QRS Ratio:** 1:1
- **QRS Width:** Narrow or Wide
- **T-Waves:** Present
- **Dropped Beats:** No
- **Etiology:** Ischemia, myocardial infarction, rheumatic heart disease, CAD, cardiac medications (digoxin, beta blockers, calcium channel blockers)
- **Clinical Significance:** Not dangerous by itself, typically no symptoms, it can progress to something worse.
SECOND DEGREE AV BLOCK TYPE I (MOBITZ I, WENCKEBACH)

- **Rate**: Ventricular rate is less than atrial rate due to dropped QRS complexes
- **Rhythm**: Variable—Atrial is regular, ventricular is irregular due to non-conducted beat
- **P-Waves**: Present, similar morphology
- **PR Interval**: Variable, progressively gets longer before dropping a QRS complex. The shortest PRI is the one immediately before the dropped beat.
- **P:QRS Ratio**: Variable, P>QRS
- **QRS Width**: Narrow or Wide
- **Dropped Beats**: Yes
- **Etiology**: Ischemia, MI, CAD, drug toxicity such as digoxin, rheumatic fever, myocarditis, transient after heart surgery, cardiac medications (beta blockers, calcium channel blockers)
- **Clinical Significance**: Depends on the frequency of dropped QRS complexes, ↓CO, predisposes to progression to more serious block

SECOND DEGREE AV BLOCK TYPE II (MOBITZ II)

- **Rate**: Ventricular rate is less than atrial rate due to dropped QRS complexes
- **Rhythm**: Variable—Atrial is regular, ventricular is regular or irregular depending on number of blocks
- **P-Waves**: Present, similar morphology
- **PR Interval**: Normal and consistent
- **P:QRS Ratio**: Variable, P>QRS. There can be a pattern of conducted beats to dropped beats (example: 2:1—2 P waves for every QRS)
- **QRS Width**: Narrow or Wide
- **Dropped Beats**: Yes
- **Etiology**: Septal wall necrosis, anterior septal MI, myocarditis, CAD, drug toxicity, cardiomyopathy
- **Clinical Significance**: Depends on the frequency of dropped QRS complexes, ↓CO, predisposes to progression to more serious block, unpredictable rhythm

THIRD DEGREE AV BLOCK (COMPLETE HEART BLOCK)

- **Rate**: Variable. Atrial rate usually 60-100 and ventricular rate 40-60 if AV node, 20-40 if Purkinje fibers are pacemaker cells
- **Rhythm**: Regular, P waves will march out, R waves will march out. The P waves and QRS complexes have no correlation.
- **P-Waves**: Present, similar morphology
- **PR Interval**: Variable
- **P:QRS Ratio**: P>QRS, there is no correlation between P-wave and QRS
- **QRS Width**: Narrow or Wide
- **Etiology**: MI, digoxin toxicity, acute myocarditis, degenerative changes in the heart, calcium channel blockers, beta-adrenergic blockers, cardiac surgery
- **Clinical Significance**: Slow ventricular rate, ↓CO, unreliable pacemaker, predisposes to lethal dysrhythmias, severity of symptoms depends on ventricular rate

BUNDLE BRANCH BLOCK

- **Rate**: Abnormal conduction in ventricle, can be right or left side of the pathway.
- **QRS Width**: Wide ≥ 0.12
- **Right BBB**: V1-Rabbit ear appearance with RSR' and inverted T-Wave; V6-widened S-Wave and upright T-wave
- **Left BBB**: V1- Wide S-Wave and positive T-Wave; V6- notch at top of QRS, inverted T-Wave
- **Etiology**: Right—congenital, anterior MI, CAD, PE. Left—hypertension, aortic stenosis, heart disease, CAD
- **Clinical Significance**: LBBB more serious than RBBB, examine V1 to determine if right or left, need 12 lead to diagnose

VENTRICULAR DYSRHYTHMIAS

PVC

- **Rate**: PVC is a single complex. May occur in patterns: pairs, every other beat or every three beats.
- **Rhythm**: Irregular d/t premature ectopic beat
- **P-Waves**: Absent with the ectopic beat
- **PR Interval**: None with the ectopic beat
- **QRS Width**: Early, wide, ≥ 0.12 and larger than normal QRS
- **T-Waves**: Usually in the opposite direction than the QRS of the PVC, wide and bizarre
- **Etiology**: Electrical irritability, hypoxia, MI, ischemia, electrolyte imbalance, acid base imbalance, stimulants, drugs, stress and anxiety
- **Clinical Significance**: Depends on frequency, can lead to more serious dysrhythmias, ↓CO, PVCs do not perfuse adequately, can cause R-on-T phenomenon
- **Terminology**:
  - Bigeminy: PVC every other beat
  - Trigeminy: PVC every three beats
  - Couplet: 2 PVCs in a row
  - Unifocal: coming from one focus, same shape and size
  - Multifocal: coming from more than one irritable foci, different shapes and sizes
<table>
<thead>
<tr>
<th>Condition</th>
<th>Rate</th>
<th>Rhythm</th>
<th>P-Waves</th>
<th>PR Interval</th>
<th>P:QRS Ratio</th>
<th>QRS Width</th>
<th>Etiology</th>
<th>Clinical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>VENTRICULAR TACHYCARDIA</td>
<td>100-250 bpm (Monomorphic)</td>
<td>Regular (may be slightly irregular at onset)</td>
<td>Absent</td>
<td>None</td>
<td>Absent</td>
<td>Wide and bizarre</td>
<td>Myocardial ischemia, MI, CAD, valvular heart disease, heart failure,</td>
<td>Very unpredictable and dangerous. Unreliable pacemaker. ↓ ventricular filling time, ↓ CO, quickly deteriorate to V Fib and complete cardiac failure. There are 3 presentations--  o Stable VT with pulse  o Unstable VT with pulse  o VT without a pulse</td>
</tr>
<tr>
<td>TORSADES DE POINTES</td>
<td>150-250 bpm</td>
<td>Irregular</td>
<td>Absent</td>
<td>None</td>
<td>Absent</td>
<td>Wide with changing amplitudes</td>
<td>Prolonged QT from drugs, myocardial ischemia, electrolyte abnormalities—hypokalemia and hypomagnesemia</td>
<td>dangerous rhythm that can lead to ventricular standstill</td>
</tr>
<tr>
<td>VENTRICULAR FIBRILLATION</td>
<td>Absent</td>
<td>Irregular</td>
<td>Absent</td>
<td>None</td>
<td>Absent</td>
<td>None</td>
<td>Myocardial ischemia, MI, heart block, untreated V tach, acid base imbalance, electrolyte imbalance, drug toxicity, severe hypoxia, terminal event in many disease states</td>
<td>Vortices are quivering instead of contracting, cardiac output is nonexistent, pacemaker cells are still working, leads to ventricular standstill and cardiac death</td>
</tr>
<tr>
<td>PULSELESS ELECTRICAL ACTIVITY</td>
<td>Variable</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Look at the H's and T's: H—hypovolemia, hypoxia, hydrogen ions, hyperkalemia, hypokalemia, hypothermia. T—Tablets, toxins, tension pneumothorax, thrombosis, thromboembolism, trauma</td>
<td>Heart muscles loses its ability to contract even though electrical activity is preserved. No heart contraction, no blood flow, no heart rate, no cardiac output</td>
</tr>
<tr>
<td>IDIOVENTRICULAR RHYTHM</td>
<td>20-40 bpm, if 40-100 then accelerated idioventricular rhythm, &gt;100 V tach</td>
<td>Regular (ventricular rhythm only, no atrial rhythm)</td>
<td>Absent</td>
<td>None</td>
<td>None</td>
<td>Wide ≥ .12</td>
<td>Digoxin toxicity, heart disease, pacemaker failure, metabolic imbalance, common following reperfusion therapy</td>
<td>Slow ventricular rate and loss of atrial kick reduce CO, progress to more lethal dysrhythmia. If just one idioventricular beat is generated it is called a ventricular escape beat</td>
</tr>
<tr>
<td>ASYSTOLE</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>MI, severe electrolyte disturbance, massive PE, prolonged hypoxemia, severe uncorrected acid-base imbalance, electric shock, drug overdose, cardiac tamponade, hypothermia</td>
<td>atrial and ventricular activity is at a standstill, terminal rhythm, critical to determine if rhythm is true asystole or a pause, need to look in a minimum of 2 leads</td>
</tr>
</tbody>
</table>
# PACEMAKER RHYTHMS

## ATRIAL PACED

- **Undersensing**: Pacemaker has failed to sense that the heart has initiated an intrinsic beat (Pacing when it shouldn’t).
- **Oversensing**: Electrical activity is registered as cardiac activity that is not coming intrinsically and is counted as a cardiac beat (Not pacing when it should).
- **Capture**: When the pacemaker delivers an electrical impulse strong enough to result in depolarization.
- **Failure to capture**: When the pacemaker delivers an electrical impulse that does not result in depolarization.
- **Failure to pace**: No electrical impulse is delivered, complete failure to sense the need or deliver the impulse to initiate pacing.

## VENTRICULAR PACED

## DUAL CHAMBER PACED