## Factors affecting ECG trace quality

### Monitor
- **CMRR (Common Mode Rejection Ratio)** used to separate ECG from other signals
- **Filters**
- **Bandwidth** (frequency response)
- **Amplifier noise**
- **Ground loops**
- **Saturation distortion** (e.g., defibrillation recovery)
- **Input impedance**
- **Differential input** (required to generate ECG tracing)

### Skin
- **Impedance**
- **Diaphoresis**
- **Dryness**
- **Oiliness**
- **EMG, respiration and other biopotentials** (physiological electrical signals)
- **Skin preparation techniques**
- **Obesity**
- **Skin stretch**
- **Motion artifact**

### Electrode
- **Adhesion**
- **Conductor**
- **Gel**
- **Backing**
- **Size**
- **Design**
- **Motion**
- **Shelf life**
- **Application technique**
- **Electrical/mechanical properties**
- **Location on the body**

### Environment
- **Electrical field** (60 Hz)
- **Humidity**
- **Temperature**
- **Static electricity**
- **Magnetic field**
- **Radiofrequency**
- **Vicinity of other machines** (nebulizers, fans, power cords, etc.)

### Cables & lead wires
- **Mechanical/electrical properties** of materials
- **Shielded cable and shielded lead wires**
- **Open lead wires** (avoid loops)
- **Triboelectric effect** (generated by cable movement)
# ECG Troubleshooting Guide

## ECG Electrode Placement

### 3-Lead Placement Monitoring Electrodes
- RA: Second intercostal space lateral right side
- LA: Second intercostal space lateral left side
- LL: Lower left lateral chest or left leg

### 5-Lead Placement Monitoring Electrodes
- RA: Second intercostal space lateral right side
- LA: Second intercostal space lateral left side
- LL: Lower left lateral chest or left leg
- RL: Lower right lateral chest or right leg
- V2: Fourth intercostal space to the left of the sternum

### 12-Lead Placement Resting Electrodes
- RA: Second intercostal space lateral right side
- LA: Second intercostal space lateral left side
- LL: Lower left lateral chest or left leg
- RL: Lower right lateral chest or right leg
- V2: Fourth intercostal space to the left of the sternum
- V3: Between V2 and V4
- V4: Fifth intercostal space along the mid-clavicular line
- V5: Fifth intercostal space between V4 and V6
- V6: Fifth intercostal space along the mid-axillary line

### Troubleshooting ECG Traces

**Troubleshoot each artifact in order, starting with 1**

<table>
<thead>
<tr>
<th>Artifacts</th>
<th>Skin Impedance</th>
<th>Muscle Movement</th>
<th>Electrical Continuity</th>
<th>Electrodes</th>
<th>Cabling</th>
<th>Interference</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Base Line</td>
<td></td>
<td></td>
<td>2 Check all connections/perform continuity check</td>
<td></td>
<td></td>
<td>3 Check for proper cable</td>
<td>1 Check lead switch and ECG machine set-up</td>
</tr>
<tr>
<td>Base Line Wander</td>
<td>Abrade skin</td>
<td>Stop patient movement</td>
<td>1</td>
<td></td>
<td>2 Check ground connections</td>
<td>4 Use same type of electrode at all sites</td>
<td>5 Check for proper cable</td>
</tr>
<tr>
<td>AC Noise</td>
<td>Abrade skin</td>
<td>May be untreatable involuntary muscle tremor</td>
<td>3</td>
<td></td>
<td>1 Check ground connections</td>
<td>6 May need fully shielded cable and lead wires</td>
<td>7 Keep cable away from AC cord</td>
</tr>
<tr>
<td>Intermittent Signal</td>
<td>Check for loose connections</td>
<td>1 Check for loose electrode or dry-out</td>
<td>2 Check for loose electrode or dry-out</td>
<td>3 Perform continuity check</td>
<td>4 Check for static build-up</td>
<td>5 Check for static build-up</td>
<td>6 Turn off fluorescent lights and/or other equipment</td>
</tr>
<tr>
<td>Motion Artifact</td>
<td>Abrade skin</td>
<td>Move electrodes off muscle mass</td>
<td>2</td>
<td></td>
<td>1 Check for loose connections</td>
<td>4 Perform continuity check</td>
<td>5 Turn off fluorescent lights and/or other equipment</td>
</tr>
<tr>
<td>Low Amplitude</td>
<td>Abrade skin</td>
<td></td>
<td>3</td>
<td></td>
<td>1 Check all connections</td>
<td>4 Check for dry-out</td>
<td>5 Turn off radio, TV and/or other equipment</td>
</tr>
</tbody>
</table>