# 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

## Environmental Factors
- Electrical field (60 Hz)
- Humidity
- Temperature
- Static electricity
- Magnetic field
- Radiofrequency
- Vicinity of other machines (nebulizers, fans, power cords, etc.)
**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
V1: Fourth intercostal space to the right of the sternum
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 ➀

<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></td>
<td></td>
<td></td>
<td></td>
<td>➀ Check lead switch and ECG machine set-up</td>
</tr>
<tr>
<td>Base line wander</td>
<td>➊ Abrade skin</td>
<td>➋ Stop patient movement</td>
<td>➌ Check all connections/perform continuity check</td>
<td>➍ Check for dry-out</td>
<td>➎ Check for proper cable</td>
<td>➋ Check for static build-up</td>
<td></td>
</tr>
<tr>
<td>AC noise</td>
<td>➊ Abrade skin</td>
<td>➋ May be untreatable involuntary muscle tremor</td>
<td>➌ Check ground connections</td>
<td>➍ Check for dry-out</td>
<td>➋ Check for proper cable</td>
<td>➋ Keep cable away from AC cord</td>
<td>➋ Turn off fluorescent lights and/or other equipment</td>
</tr>
<tr>
<td>Intermittent signal</td>
<td></td>
<td></td>
<td>➋ Check for loose connections</td>
<td>➋ Check for loose electrode or dry-out</td>
<td>➋ Perform continuity check</td>
<td>➋ Check for static build-up</td>
<td></td>
</tr>
<tr>
<td>Motion artifact</td>
<td>➊ Abrade skin</td>
<td>➋ Move electrodes off muscle mass</td>
<td>➋ Check for loose connections</td>
<td>➋ Check for loose electrode or dry-out</td>
<td>➋ Perform continuity check</td>
<td>➋ Turn off fluorescent lights and/or other equipment</td>
<td>➋ Check for proper EKG machine set-up</td>
</tr>
<tr>
<td>Low amplitude</td>
<td>➊ Abrade skin</td>
<td></td>
<td>➋ Check all connections</td>
<td>➋ Check for dry-out</td>
<td>➋ Turn off radio, TV and/or other equipment</td>
<td>➋ Check gain settings</td>
<td></td>
</tr>
</tbody>
</table>

© 2023 3M. All rights reserved.
3M and the other marks shown are marks and/or registered marks. Unauthorized use prohibited.
US_70-2009-1505-9