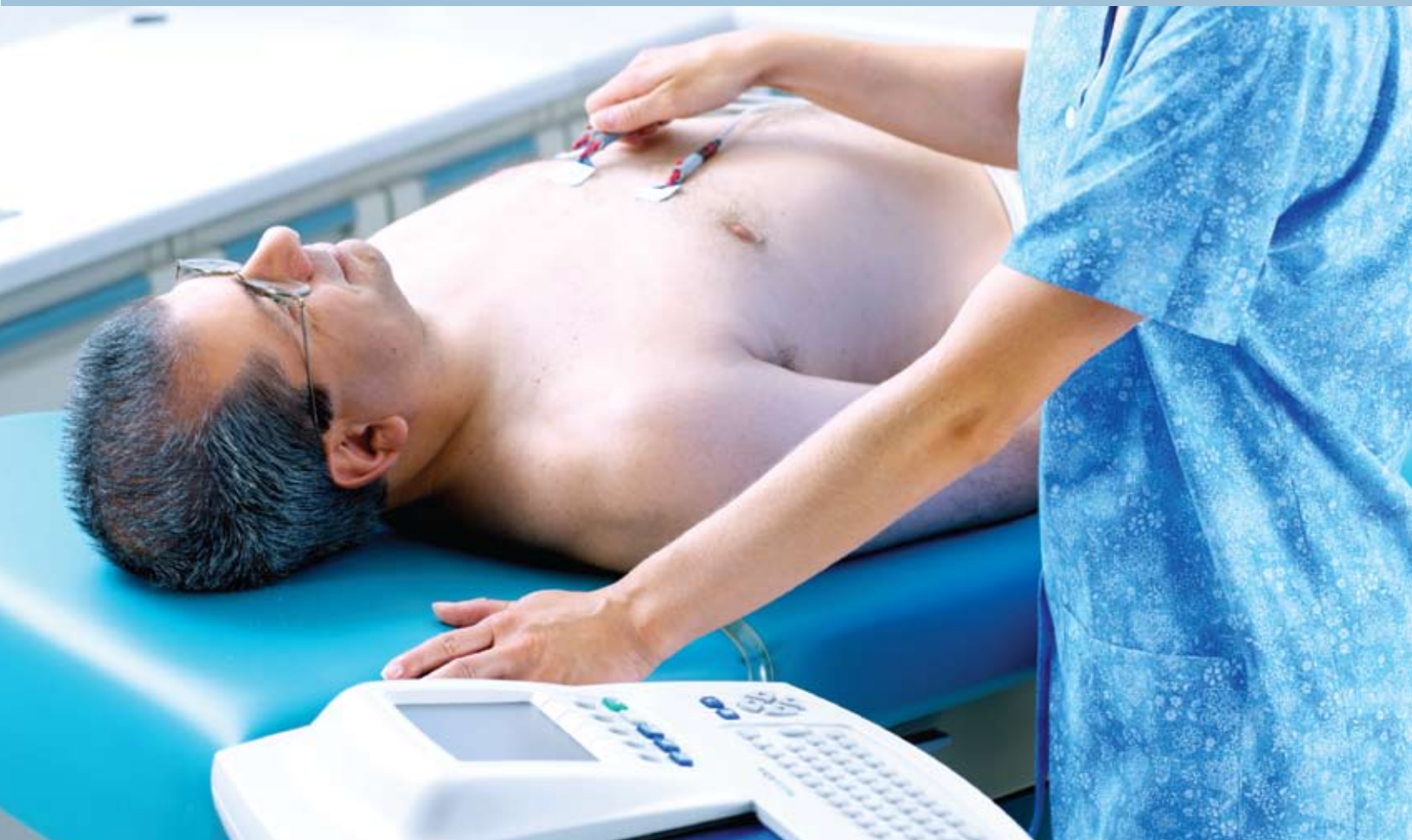


# STEPS

## REDUCING ARTIFACTS ON ELECTROCARDIOGRAPHS



In today's busy practice it's not uncommon to have artifacts on ECGs. As you know, the electrical activity of the heart is sensed by electrodes that are placed on the skin's surface. The heart's electrical signal is very small (normally 0.0001 to 0.003 volt), and unfortunately this can be combined with artifactual signals of similar frequency and often larger amplitude.

Each patient's ECG is unique. The patient's size, skin type, age, and pathology, as well as where the electrodes are placed, influence the results of the tracing. Poor signal quality can cause noise or artifacts on the ECG, which in turn leads to inaccurate analysis of the ECG.<sup>1</sup>

This document will guide you through all the elements that can affect ECG tracings and provide you with tips on how to reduce artifacts in your practice.

**WelchAllyn**<sup>®</sup>

Advancing Frontline Care<sup>™</sup>

## 1 Perform good skin preparation

The build-up of skin oils and residues increases the resistance to the conduction of the electrical signal. Therefore, it is crucial to prepare the skin properly. Ideal skin preparation should follow the steps below:

- Shave or clip hair if present. This allows for better electrode contact and reduces patch removal pain. Shaving may increase skin irritation under the electrode.
- Rub vigorously with a gauze pad. Five to 10 strokes can effectively decrease the electrical resistance with minimal reddening of the skin. This will ensure that the heart's electrical signals can travel to the electrodes.
- Rub the skin with either isopropyl alcohol or soap and water to remove skin oils. Soap and water can minimize skin irritation. Let skin dry thoroughly. This will allow for better electrode-to-skin contact, as the adhesive base on the electrode will then grip the skin. *Let dry thoroughly.*

## 2 Check the electrodes

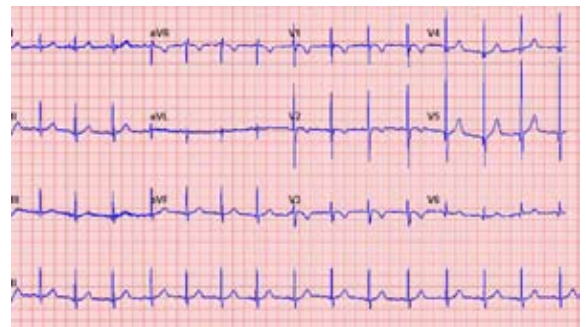
Check the electrode gel to make sure it is fresh and moist. The electrode gel greatly affects the transmission of signals from the skin to the electrode. A dry electrode with inadequate conducting gel will not work properly since it reduces the conduction of the ECG signal. In most instances, electrode gel dry-out is simply a result of incorrect storage. Electrodes are packaged in metal foil pouches to prevent gel evaporation, therefore it is important to remember the following:

- Use electrodes prior to their expiration date.
- Do not remove the electrodes from their pouch until they are ready to be used.
- Do not place electrodes in open bins or drawers. If a pouch is already open, place it in a zip lock bag to preserve moisture and prevent evaporation.
- Avoid warm storage areas.

Do not use different brands of electrodes during a test. Resistance varies from brand to brand, and the signal is best when an equal signal comes from all of the electrodes. In fact, using electrodes of dissimilar composition can actually prevent an ECG trace. Pre-gelled silver/silver chloride electrodes are recommended.

## 3 Make sure the patient is warm, relaxed and does not move or speak

- It is important to make sure the patient is warm and relaxed during the test because we want to reduce muscle tremors and movement as much as possible since they can impair the quality of recordings. When a patient is cold, he/she may tense or shiver, which can cause muscle artifacts on the tracings.
- The patient's arms should lie flat along the sides of the body. If the patient does not fit comfortably on the exam table, have them cross their arms on their stomach to reduce muscle tension. Large patients might tense their arms if they do not fit on the table.
- Patients should not read or talk when an ECG test is being performed.
- Make sure the patient does not sweat or have moist skin because it causes poor electrode contact with the skin.
- Instruct patients to breath calmly. Low-frequency noise, such as that produced by respiration, causes the tracing to wander above and below the baseline. Welch Allyn devices are equipped with digital filters that correct baseline drift while preserving the fidelity of ST-segment levels. Make sure the baseline filter is ON.
- Muscle movement is increased by placing electrodes over bones or in areas where there is a lot of muscle movement. Proper placement of electrodes will help reduce interference from artifacts caused by movement. See checkpoint # 4 below for proper electrode placement.



Sample Muscle Noise

## 4 Apply electrodes

When you are recording ECGs, you should ensure that chest leads are placed in the proper position and the electrodes have good skin contact to minimize artifacts. Incorrect placement of precordial leads may lead to a false diagnosis of infarction. The reversal of limb leads and the switching of precordial leads have been well documented as causes of alterations in ECGs.<sup>2</sup>

**DO NOT** place electrodes over:

- Bones
- Areas where there is a lot of muscle movement
- Irritated skin
- Incisions

If you are using snap electrodes, attach the electrodes to the snap connectors first to increase patient comfort. Do not squeeze the gel out by pressing in the center of the electrode.

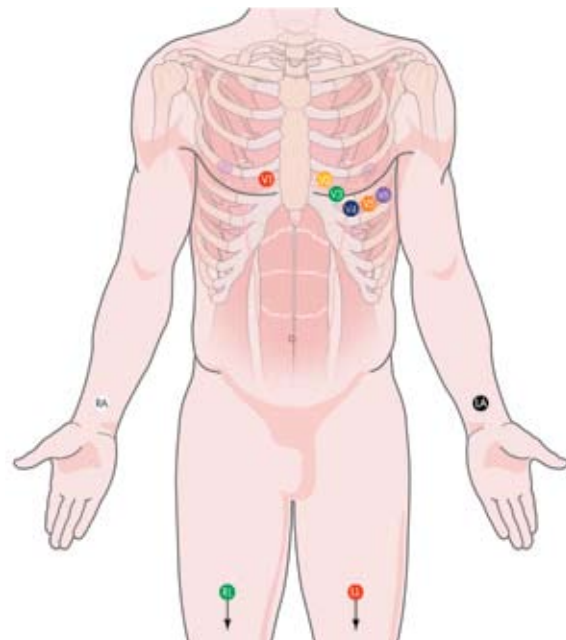
Do not use different brands of electrodes during a test. Resistance varies from brand to brand, and the signal is best when an equal signal comes from all of the electrodes. In fact, using electrodes of dissimilar metals can actually prevent an ECG trace. Pre-gelled silver/silver chloride electrodes are recommended.

### AHA Electrode Placement

RA and LA electrodes should be placed on the wrists.

RL and LL electrodes should be placed a few inches above the ankle.

- V1** Fourth intercostal space at the right border of the sternum
- V2** Fourth intercostal space at the left border of the sternum
- V3** Midway between locations V2 and V4
- V4** At the mid-clavicular line in the fifth intercostal space
- V5** At the anterior axillary line on the same horizontal level as V4
- V6** At the mid-axillary line on the same horizontal level as V4 and V5



AAMI	V1	V2	V3	V4	V5	V6	RA	LA	RL	LL
IEC	C1	C2	C3	C4	C5	C6	R	L	N	F

**Clinical note:** For female patients, lateral chest electrodes should be placed underneath the left breast.

## 5 Check alligator clips

Alligator clip connections should be cleaned prior to use. Gel build-up on the electrode alligator clips can occur over time and could affect conductivity. Alligator clips should rest flat on the patient's skin. For good conduction, make sure the metallic side is in contact with the skin.

## 6 Check lead wires

- Periodically inspect cables and lead wires for breaks and cracks and replace as needed. Breaks in the wires and connections between the electrode and the ECG device will always be a source of problems. Poor contact at any snap connection, loose pins at the cable end of the lead wire, and breaks in the conductors of the lead wire or patient cable can cause intermittent loss of the ECG tracing, 50/60 Hz. pickup, or trace instability.<sup>3</sup>
- Lead wires should not be pulling on the electrodes, as it will result in poor contact with the skin. Untangle wires or reposition electrodes if necessary.

## 7 Check the patient cable connection to the ECG device

Verify that the patient cable is securely connected to the ECG device and that no gaps exist between connectors.

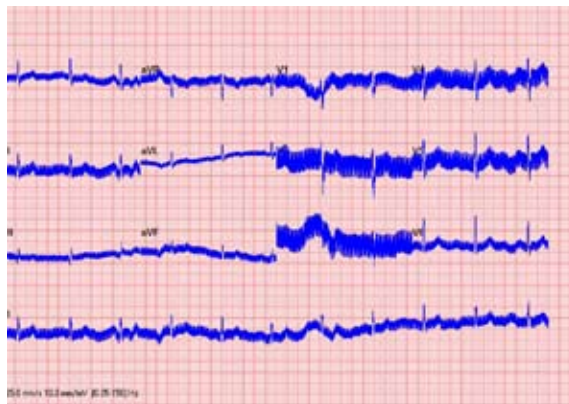
## 8 Check for AC interference

50/60 Hz. interference looks like small regular peaks and produces a wide, fuzzy baseline. It is traced to the 50/60 Hz. current which supplies power to the electrical wall outlets. The 50/60 Hz. energy radiates from the electrical wiring in the patient's room and can be picked up by the patient and/or the lead wires. This will result in AC interference on the ECG tracing. There are several causes of AC interference:

- Electrical wires in the walls, ceiling or floor.  
*Suggestion:* Move the examination table away from walls.
- Presence of other electrical equipment in the room.  
*Suggestion 1:* Unplug any equipment which could interfere with the ECG signal:
  - Electrical beds and/or examination table
  - Surgical head lights and chokes in fluorescent lamps
  - Autoclaves
  - Chargers for PCs, otoscopes etc.

*Suggestion 2:* Move the ECG device, patient cable and patient away from equipment emitting electromagnetic interference.

- Improper grounding of the ECG device.  
*Suggestion 1:* Verify that the outlet the ECG device is plugged into is properly grounded.  
*Suggestion 2:* Operate the ECG device on battery.



Sample AC Interference

## 9 Verify filter settings in the device

Finally, if the tracings are still showing artifact, make sure that the following filters are turned on:

- Muscle filter
- AC filter
- Wandering baseline filter

*Note for CardioPerfect users:*

Filters can be applied during the recording but might not appear on the report based on your settings. We recommend turning filters OFF prior to recording to make sure you have eliminated the artifacts as much as possible by performing good skin preparation and electrode positioning. Once the signal has stabilized you can turn the filter back ON in the recording window.

### References:

1. Knight, BP; Pelosi, F; Michaud, GF; Strickberger, SA; Morady, F; Clinical consequences of electrocardiographic artifact mimicking ventricular tachycardia. N Engl J Med 1999; 341:1270–1274.
2. Hurst, JW. Images in cardiovascular medicine: "switched" precordial leads. Circulation 2000; 101:2870–2871.
3. Michael Smith M.S., B.S.E.E. Rx for ECG monitoring artifact. Critical Care Nurse 1984.
4. The Society for Cardiological Science and Technology, Clinical Guidelines by Consensus, Number 1, Recording a standard 12-lead electrocardiogram, April 2005, Review Date: April 2006.