

CPR Rate Advisor™ Revolutionary ICG-Based Technology

Overview

CPR Rate Advisor™ for the HeartSine® samaritan® PAD 450P (SAM 450P) automated external defibrillator provides real-time visible and audible feedback to the rescuer on the rate of compressions during a sudden cardiac arrest (SCA) resuscitation.

Because Cardiopulmonary Resuscitation, commonly known as CPR, is crucial to deliver oxygenated blood to the body's vital organs, CPR Rate Advisor helps the rescuer perform CPR at an optimal rate in line with the AHA and ERC guidelines.

To measure the rate of compressions, alternative AED solutions require a third sensor (or puck) to be placed on the patient's chest. With its revolutionary technology HeartSine's proprietary CPR Rate Advisor uses only the defibrillator electrodes to detect changes in patient impedance, in real time, requiring no extra sensors or devices commonly used by other AEDs to provide CPR feedback. These changes in impedance are related to the rate of compressions and correlate to a predicate device in the market with over 95% sensitivity.

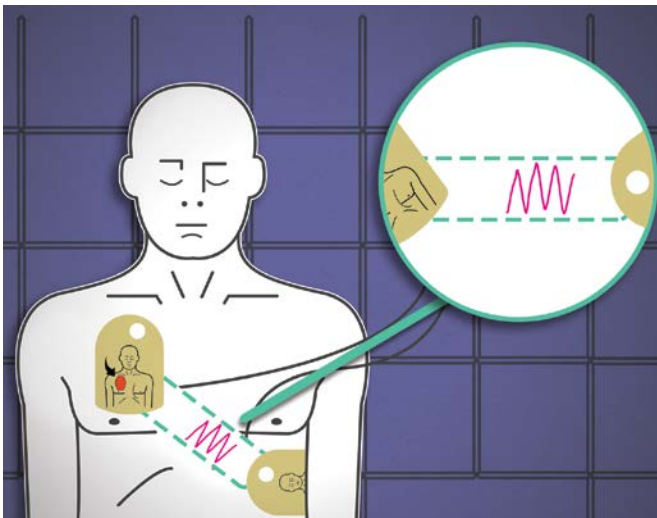


Figure 1. HeartSine's defibrillator detects changes in patient impedance.

How CPR Advisor Works

When a patient collapses and a rescuer performs CPR, the compressions applied by the rescuer cause the patient's chest to change shape. This change in shape results in an increase in the patient's chest impedance, or electrical resistance. CPR Rate Advisor captures this change in an ICG (impedance cardiography) waveform which it uses to count the number of compressions a rescuer administers. CPR Rate Advisor determines the compression rate by

counting deflections in the ICG waveform and advises the rescuer to "Push faster" if the compression rate below the AHA and ERC guidelines of 100-120 cpm.

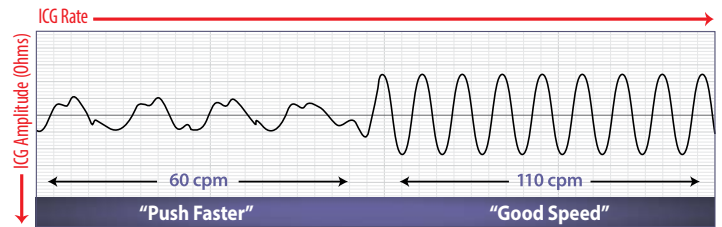


Figure 2. Rescuer's CPR compression rate is too slow, as determined by the low number of deflections detected by the ICG waveform. The SAM 450P will issue the audible prompt "Push faster" until the correct compression rate is achieved.

Likewise, if the rescuer's rate is greater than 120 compressions per minute, CPR Rate Advisor will tell the rescuer to "Push slower".

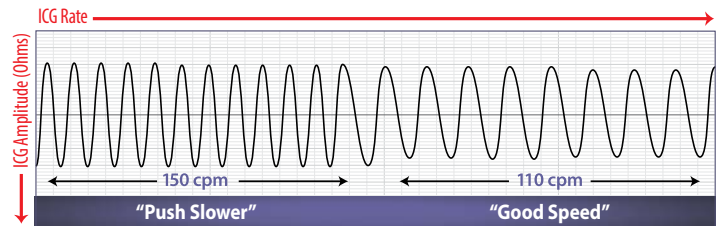


Figure 3. Rescuer's CPR compression rate is too fast, as determined from the high number of deflections detected by the ICG waveform. The SAM 450P issues the audible prompt "Push slower" until the correct compression rate is achieved.

The AHA also recognizes the need to keep interruptions to a minimum prior to and during CPR. To do this, the SAM 450P uses the signals detected through the electrode pads to prompt the rescuer to "Begin CPR" if not already doing so. The SAM 450P also will detect when compressions have stalled between shock decision cycles and give feedback to the rescuer to ensure that interruptions are minimized.

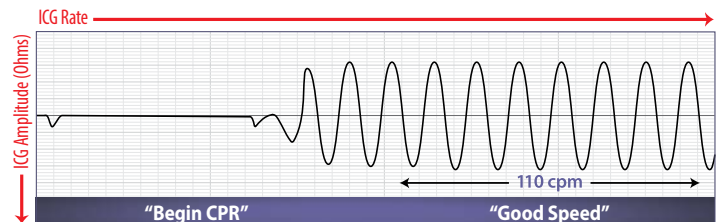


Figure 4. No movement detected in the ICG waveform. In an effort to maximize CPR compression time by the rescuer, the SAM 450P will issue the audible prompt "Begin CPR" repeatedly until CPR is started.

This real-time feedback is important as even though most trained rescuers understand the need to push hard and push fast, rescuer fatigue may set in after as little as one minute, resulting in slower compression rates. The SAM 450P provides compression rate feedback to the rescuer via both visual indicators on the SAM 450P user interface and audible voice prompts.

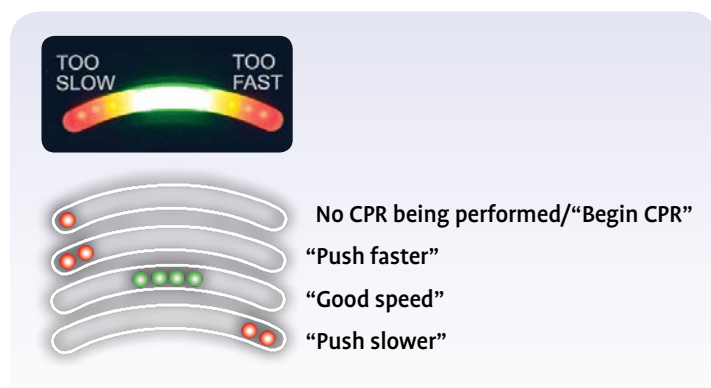


Figure 5. Visual indicators and audible feedback tell the rescuer if the rate of CPR is in line with the AHA guidelines.

Improved CPR Efficacy

CPR Rate Advisor was assessed in 140 test candidates (who had no prior use of a HeartSine defibrillator) using one of two devices with or without CPR Rate Advisor. The proportion of participants achieving good CPR compression speed within 45 seconds was calculated at 96% when compared to the device without feedback during which only 63% of participants achieved good speed within 45 seconds ($p < 0.0001$).

This study also demonstrated an improvement in compression depth when CPR Rate Advisor was enabled versus a non-feedback device (p -value of 0.001) even though only 47% of participants in this study had any previous exposure to CPR training. This demonstrates the ease-of-use of the SAM 450P in an untrained user environment¹.

Studies have shown that effectiveness of CPR is most likely limited by poor performance in any of its components and that inadequate rate, even in the presence of sufficient depth and technique, likely

reduces the effectiveness of CPR compressions². Evidence suggests that even healthcare professionals do not always achieve the correct CPR compression rates according to AHA guidelines^{2,3}, and that chest compression rate is associated with the return of spontaneous circulation (ROSC)⁴.

Effective CPR, provided alone or in conjunction with a lifesaving shock, can dramatically increase the chance of survival. CPR Rate Advisor, in conjunction with the metronome, is intended to help rescuers perform CPR at an optimum rate by monitoring their real-time CPR performance and helping to guide them toward the correct rate of compressions. It has been shown that up to 95.6% of users can achieve the correct CPR compression rate within 45 seconds of beginning CPR for the SAM 450P, compared to 62.5% of users who achieved correct rate within 45 seconds with a similar device without feedback¹.

As the samaritan PAD is a defibrillator specifically designed for public access, all HeartSine defibrillators can be used with minimal training in any environment.

Integrated CPR Rate Advisor serves to improve compliance with CPR rate and CPR fraction guidelines while instilling more confidence in the rescuer. And because CPR Rate Advisor is integrated within an industry-leading HeartSine defibrillator, it can deliver a shock if needed.

By accompanying the rescuer right through the rescue process, helping to ensure CPR is continuously performed at an effective rate and delivering a shock when necessary, the samaritan PAD 450P with integrated CPR Rate Advisor helps improve survival rates.

References

1. Data on file at HeartSine Technologies.
2. Abella, B. et. al., "Chest Compression Rates During Cardiopulmonary Resuscitation are Suboptimal," *Circulation*, 2005; 111:428-434.
3. Milander MM, Hiscok PS, Sanders AB. et al. Chest compression and ventilation rates during cardiopulmonary resuscitation: the effects of audible tone guidance. *Acad Emerg Med*. 1995;2:708-713
4. Idris, A. et. al., "Relationship Between Chest Compression Rates and Outcomes from Cardiac Arrest," *Circulation*, 2012; 125; 3004-3012.

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