

ZOLL[®]



GETTING TO
HIGH-QUALITY CPR

With Confidence, Consistency, and Results

Success Depends on Your CPR Quality

High-quality CPR is the cornerstone of a system of care that can optimize resuscitation outcomes beyond the return of spontaneous circulation (ROSC).¹ Our understanding of how important good CPR is to successful resuscitation has grown enormously over the last decade. The latest guidelines from the American Heart Association and the European Resuscitation Council underscore just how crucial CPR quality is to improving outcomes.



High quality means providing compressions at proper depth, at proper rate, with correct release, and with limited interruptions. Achieving these parameters is undeniably difficult, and studies show rescuers are often unable to deliver high-quality CPR. Until recently, technology to help rescuers was virtually non-existent. They were on their own when performing this critical skill under highly stressful circumstances. In systems that have focused on improving their CPR quality, both in and out of the hospital, survival rates from sudden cardiac arrest have doubled, or even tripled.^{2,3}

When it comes to assisting rescuers in providing the best CPR possible, no one is more experienced or can offer you as much as ZOLL. Our Real CPR Help[®] technology delivers real-time feedback on every important component of quality during CPR. This is what rescuers need and want, and what patients deserve. Real CPR Help also records all CPR efforts for post-event debriefing and training, additional elements important to improving CPR quality. If you want real help improving your CPR, you want Real CPR Help from ZOLL.

The Challenges of Successful CPR

Victims of cardiac arrest need compressions that meet recommended guidelines in four key areas: depth, rate, interruptions, and release. Easier said than done. CPR is difficult, and even trained professionals don't do it well on a consistent basis. For example, a 2009 survey indicated that three-quarters of health care professionals perceive their skill level to be quite high. However, when performing CPR, only 26% of these respondents were actually fully compliant with the depth, rate, and compression-ventilation ratio established in the 2005 American Heart Association (AHA) and European Resuscitation Council (ERC) Guidelines.⁴

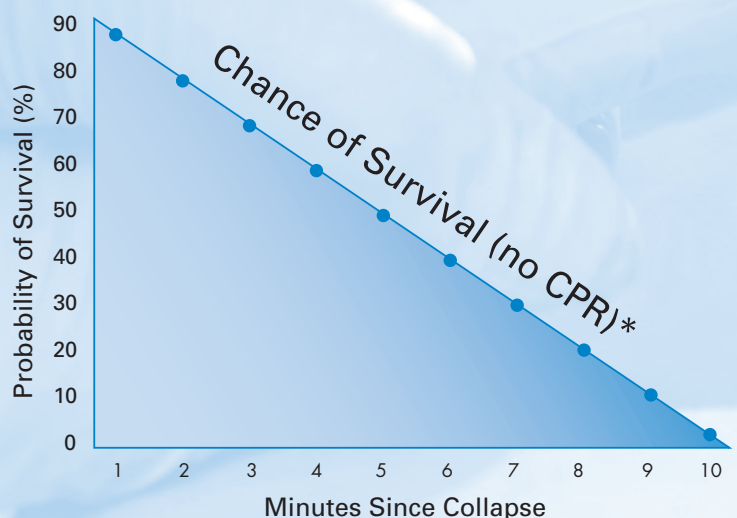
A number of factors contribute to poor-quality CPR. Few people perform CPR on a regular enough basis to be completely proficient, and it's easy to miss aspects of quality in the midst of such a stressful event. Plus, CPR requires considerable stamina, burning 322 kcal per hour, so rescuer fatigue can quickly set in. Another hurdle is that, unfortunately, some clinicians don't think CPR matters, mistakenly believing it prolongs the inevitable, death of patients.

CPR Help that Works

Rescuers at every experience level need assistance in performing better CPR. Numerous studies have found that audiovisual CPR feedback significantly improves the quality of chest compressions performed by health care providers.^{5,6}

ZOLL's Real CPR Help technology guides rescuers by providing feedback in real time on their CPR quality (i.e., depth and rate), while our See-Thru CPR® technology, which filters out compression artifact on the ECG monitor, reduces the duration of pauses during resuscitation. Studies show that prolonged interruption of chest compressions reduces the effectiveness of rescue efforts.

ZOLL is so committed to improving manual CPR that we put Real CPR Help into not only all of our AEDs, but virtually every defibrillator we build. In fact, the 2010 AHA/ERC Guidelines state that CPR prompt and feedback devices may be useful for training rescuers and as part of an overall strategy to improve the quality of CPR in actual arrests and resuscitations.



*Assumes a theoretical 90% chance of survival immediately after sudden cardiac arrest

Components of High-quality CPR:

Depth, Rate, Limited Interruptions, and Release

Depth

The 2010 AHA/ERC Guidelines continue to emphasize the need for high-quality CPR. Greater importance is now placed on chest compressions, which have gained priority over ventilations in the sequence of CPR steps. Guidelines recommend a compression depth of at least two inches (5.1 cm).



Why it matters: Chest compressions sustain the heart's typical activity and help move oxygenated blood through the body to protect vital organs. Rescuers need proper depth to appropriately "trap" the heart between the sternum and the spine, and effectively squeeze blood out of it.

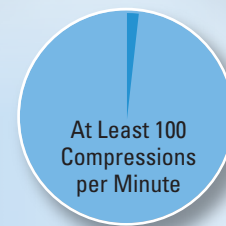
How ZOLL technology helps: Real CPR Help technology is built into most ZOLL defibrillator electrodes, which contain sensors that gather CPR data and transfer it to the AED or basic life support (BLS)/advanced life support (ALS) defibrillator. After a few compressions, if proper depth has not been achieved, rescuers will be prompted to push harder through audible and/or visual prompts. Once proper depth is reached, it's reinforced with a "Good compressions" message.

Rate

The 2010 AHA/ERC Guidelines recommend that rescuers perform at least 100 compressions per minute.

Why it matters: A healthy heart beats 80 times per minute to allow optimal circulation. Because manual CPR is less effective, a rate of at least 100 compressions per minute is necessary to achieve perfusion sufficient to support minimal circulation until a normal heart rhythm is restored.

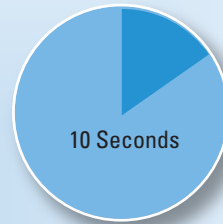
How ZOLL technology helps: The same Real CPR Help sensors that measure depth also track compression rate. An easy-to-follow metronome beep helps rescuers achieve the Guidelines-recommended compression rate. And to minimize CPR idle time, rescuers are also reminded to "Continue CPR" if they have paused for too long.



ZOLL solutions provide CPR feedback that's "just right"—enough information to improve performance without being distracting—so that rescuers can reach and maintain proficiency in each of the four key areas critical to high-quality CPR.

Interruptions

A key recommendation of the 2010 AHA/ERC Guidelines is to minimize interruptions in CPR and increase CPR fraction (the percentage of time that compressions are delivered during resuscitation) by maintaining consistent compressions over time.



Why it matters: Interruptions in chest compressions during CPR substantially reduce blood flow to the heart and brain. Shock success is directly tied to pauses; the likelihood of successful shock conversion begins to fall significantly with pauses greater than 10 seconds, and drops to 38% with a 30-second pause.⁶

How ZOLL technology helps: One of the most common reasons for interruptions is stopping CPR to determine whether an organized, shockable rhythm has developed. While pauses are inevitable, with ZOLL's patented See-Thru CPR technology, a filtered signal is displayed on the screen, so the duration of pauses can be minimized. In addition, Real CPR Help displays the time elapsed from when the last compression was delivered, raising awareness of CPR interruptions.

Interruptions

Release

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Release

Each CPR compression is really two parts. The down stroke forces blood from the heart into circulation, and, in particular, feeds the brain. The up stroke, or release, allows the heart to fill and feeds the heart muscle at the same time.

Why it matters: This important process is impeded when rescuers fail to fully release the compression by coming off the chest. Pressure builds as a result, making CPR increasingly ineffective.

How ZOLL technology helps: ZOLL's release algorithm is able to detect release velocity during CPR and will prompt users when full release does not occur.



CPR QUALITY SCORECARD

2010 AHA GUIDELINES CALL TO ACTION	QUALITY ELEMENT	ZOLL CPR TECHNOLOGY	ZOLL PRODUCTS	PHILIPS	PHYSIO-CONTROL	CARDIAC SCIENCE
<p>“There is an increased focus on methods to ensure that high-quality CPR is performed. Adequate chest compressions require that compressions be provided at the appropriate depth and rate, allowing complete recoil of the chest after each compression and an emphasis on minimizing any pauses in compressions and avoiding excessive ventilation.” (p. S643)</p>	Proper compression depth	Real CPR Help® Depth measurement and display. Visual and audible prompts.	AED Plus® M Series® AED Pro® R Series® E Series® X Series™*	Q-CPR™ on HeartStart MRx		
<p>“The number of compressions delivered per minute is an important determinant of return of spontaneous circulation (ROSC) and neurologically intact survival.” (p. S690)</p>	Proper compression rate	Real CPR Help® Rate metronome	AED Plus® M Series® AED Pro® R Series® E Series® X Series™*	Metronome only HeartStart FRx HeartStart FR3 HeartStart OnSite	LIFEPAK® 15 Metronome only	Metronome only G3, G3 Plus, G3 Pro
		CPR Dashboard™ Visual rate display	E Series®† R Series®‡ X Series™*			
<p>“Importantly, the incidence of incomplete chest wall recoil can be reduced during CPR by using electronic recording devices that provide real-time feedback.” (p. S690)</p>	Full release	CPR Dashboard™ Release prompt and release indicator	E Series® R Series® X Series™*	Q-CPR™ on HeartStart MRx and HeartStart FRx		
<p>“Healthcare providers should interrupt chest compressions as infrequently as possible and try to limit interruptions to no longer than 10 seconds, except for specific interventions such as insertion of an advanced airway or use of a defibrillator.” (p. S691)</p>	Minimize CPR interruptions	See-Thru CPR® Minimizes duration of pauses by filtering CPR artifact out of ECG	AED Pro® E Series® R Series® X Series™*		CPRMAX on LIFEPAK® 1000	
<p>“Shortening the interval between the last compression and the shock by even a few seconds can improve shock success (defibrillation and ROSC). Thus, it is reasonable for healthcare providers to practice efficient coordination between CPR and defibrillation to minimize the hands-off interval between stopping compression and administering shock (Class IIa, LOE C).” (p. S707)</p>	Minimize CPR interruptions	See-Thru Charge™ Automatically charges defibrillator during CPR	E Series® X Series™*	Quick Shock on HeartStart FRx HeartStart OnSite HeartStart FR2+ and HeartStart FR3		
<p>“AED manufacturers should seek innovative methods to decrease the amount of time chest compressions are interrupted for AED operation.” (p. S707)</p>	Minimize CPR interruptions	AMSA Predicts shock success before stopping CPR	E Series®	SMART CPR on HeartStart FR2+ and HeartStart FR3		
<p>“More sophisticated devices actually monitor chest compression rate, depth, relaxation, and pauses in real time and provide visual and auditory feedback. When recorded, this information can also be useful in providing feedback to the entire team of providers after the resuscitation has ended.” (p. S740)</p>	Accurate CPR performance data for post-event review and debriefing	RescueNet® Code Review/CodeNet® Collects, records, analyzes, and displays all compressions. Accurate data on depth, rate, interruptions, and times. Calculates compression fraction for each event. Provides overall CPR quality score.	AED Plus® M Series® AED Pro® R Series® E Series® X Series™*	HeartStart Event Review and Event ReviewPro on HeartStart MRx	CODE-STAT™ on LIFEPAK® 15	

*This product is not available for distribution in Canada as it has not been reviewed and cleared by Health Canada.

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American Heart Association 2010 Guidelines for CPR and Emergency Cardiovascular Care: High-quality adult CPR requires chest compressions at a rate of 100 per minute and a depth of two or more inches, complete recoil after compression, minimal interruptions in compressions, and avoidance of excessive ventilation. This table clearly shows ZOLL's unmatched commitment to improve CPR quality and undisputed leadership in providing organizations with the tools needed to advance performance.

SUPPORTING STATEMENTS FROM 2010 AHA GUIDELINES

"Several studies have demonstrated improvement in chest compression rate, depth, chest recoil, ventilation rate, and indicators of blood flow such as end-tidal CO₂ (PETCO₂) when real-time feedback or prompt devices are used to guide CPR performance." (p. S697)

"Significant fatigue and shallow compressions are common after 1 minute of CPR, although rescuers may not recognize that fatigue is present for ≥ 5 minutes." (p. S690)

"CPR prompt and feedback devices can be useful as part of an overall strategy to improve the quality of CPR during actual resuscitations (Class IIa, LOE B); effect on patient survival has not been demonstrated." (p. S923)

"CPR quality can be improved by using a number of nonphysiologic techniques that help the provider adhere to recommended CPR parameters such as rate and depth of compression and rate of ventilation. The most simple are auditory or visual metronomes

to guide providers in performing the recommended rate of chest compressions or ventilations. More sophisticated devices actually monitor chest compression rate, depth, relaxation, and pauses in real time and provide visual and auditory feedback." (p. S739–740)

"Correct performance of chest compressions requires several essential skills. . . . Allow the chest to completely recoil after each compression (Class IIa, LOE B), with chest compression and chest recoil/relaxation times approximately equal." (p. S690)

"Therefore despite some data to the contrary, it is reasonable for rescuers to minimize interruptions of chest compressions for checking the pulse, analyzing rhythm, or performing other activities throughout the entire resuscitation, particularly in the period immediately before and after a shock is delivered." (p. S690)

"Defibrillation outcome is improved if interruptions (for rhythm assessment, defibrillation, or advanced care) in chest compressions are kept to a minimum." (p. S678)

"Furthermore, in animal studies, frequent or long interruptions in precordial chest compressions for rhythm analysis or rescue breathing were associated with post-resuscitation myocardial dysfunction and reduced survival rates." (p. S707)

"The preponderance of efficacy data suggests that limiting the frequency and duration of interruptions in chest compressions may improve clinically meaningful outcomes in cardiac arrest patients. . . . Therefore, despite some data to the contrary, it is reasonable for rescuers to minimize interruption of chest compressions for checking the pulse, analyzing rhythm, or performing other activities throughout the entire resuscitation, particularly in the period immediately before and after a shock is delivered (Class IIa, LOE B)." (p. S690)

"Analyses of VF waveform characteristics predictive of shock success have documented that the shorter the time interval between the last chest compression and shock delivery, the more likely the shock will be successful. A reduction of even a few seconds in the interval from pausing compressions to shock delivery can increase the probability of shock success." (p. S738)

"Several retrospective case series, animal studies, and theoretical models suggest that it is possible to predict, with varying reliability, the success of attempted defibrillation by analyzing the VF waveform." (p. S711)

"Retrospective analysis of VF waveforms in multiple clinical studies suggests that it is possible to predict the success of defibrillation from the fibrillation waveform with varying reliability." (p. S738)

"Additional measures can be incorporated to meet a system's individual quality improvement strategy. For example, individual CPR components can be measured through review of the electronic defibrillator recording and can provide a useful set of metrics for EMS and hospital providers." (p. S680)

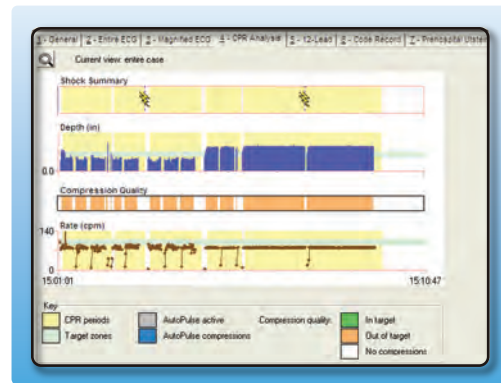
CPR Quality Review

All ZOLL products with Real CPR Help not only provide real-time CPR feedback but also record CPR performance data for easy download to ZOLL RescueNet® Code Review and ZOLL CodeNet® software for post-event review and analysis. Review is recommended as part of staff training and quality improvement, and is considered in accreditation surveys from The Joint Commission. Code Review enables rescuers to see events as they occurred, providing ECG, vital signs, and the depth and rate of compressions for a full post-event analysis of the rescue, from the field to the hospital. It automatically captures and organizes all resuscitation data for case-by-case review, quality assurance assessment, trending of program results, and meeting applicable standards and requirements. The comprehensiveness of the software is unmatched in the industry.

Get More from an Electrode



Rescuers shouldn't settle for "just electrodes" when they can use ZOLL's multifunction OneStep™, CPR Stat-padz®, and CPR-D-padz® electrodes. No other company comes close to ZOLL in electrode selection for routine monitoring, defibrillation, cardioversion, and pacing. The real advantage lies in the electrodes' CPR sensors, which enable real-time CPR feedback (Real CPR Help). This resuscitation data can be easily captured and documented through RescueNet Code Review and CodeNet for post-event performance analysis. ZOLL electrodes speed defibrillation, ensure code-readiness, and simplify resuscitation.



Code Review



- ¹ 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science.
- ² B] Bobrow, et al. *Circulation*. 2011;124 (21 Supplement): A208.
- ³ RE Sell, et al. *Circulation*. 2009;120 (18 Supplement): S1441.
- ⁴ Multi-national Attitudes Among Healthcare Professionals Concerning CPR. The CPR Improvement Working Group, www.improvecpr.com. 2010.
- ⁵ Peberdy M, et al. *Resuscitation*. 2009;80:1169-1174.
- ⁶ Edelson D, et al. *Resuscitation*. 2006;71:137-145.

ZOLL Medical Corporation develops and markets medical devices and software solutions that help advance emergency care and save lives, while increasing clinical and operational efficiencies. With products for defibrillation and monitoring, circulation and CPR feedback, data management, fluid resuscitation, and therapeutic temperature management, ZOLL provides a comprehensive set of technologies that help clinicians, EMS and fire professionals, and lay rescuers treat victims needing resuscitation and critical care.

A NASDAQ Global Select company and a three-time Forbes 100 Most Trustworthy Company, ZOLL was designated in 2011 as one of Forbes Top 100 Small Public Companies in America with annual revenues under \$1 billion. ZOLL develops and manufactures its products in the United States, in California, Colorado, Illinois, Massachusetts, Pennsylvania, and Rhode Island. More than 400 direct sales and service representatives, 1,100 business partners, and 200 independent representatives serve our customers in over 140 countries around the globe. For more information, visit www.zoll.com.

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