

CPR—Beyond the Basics

Now more than ever we know cardiopulmonary resuscitation (CPR) performance is vital to the survival of victims of sudden cardiac arrest.

Despite great efforts, many systems fall short of meeting the CPR guidelines recommended by the American Heart Association (AHA), the European Resuscitation Council (ERC) and other international organizations, which place increased emphasis on CPR.^{1,2}

Physio-Control takes a comprehensive approach to help individual rescuers deliver more effective, consistent CPR at the scene, and systems as a whole to improve CPR quality in accordance with the AHA/ERC Guidelines. We build our products based on solid research and on feedback from emergency medical providers around the world — paramedics, EMTs, firefighters, physicians and nurses.



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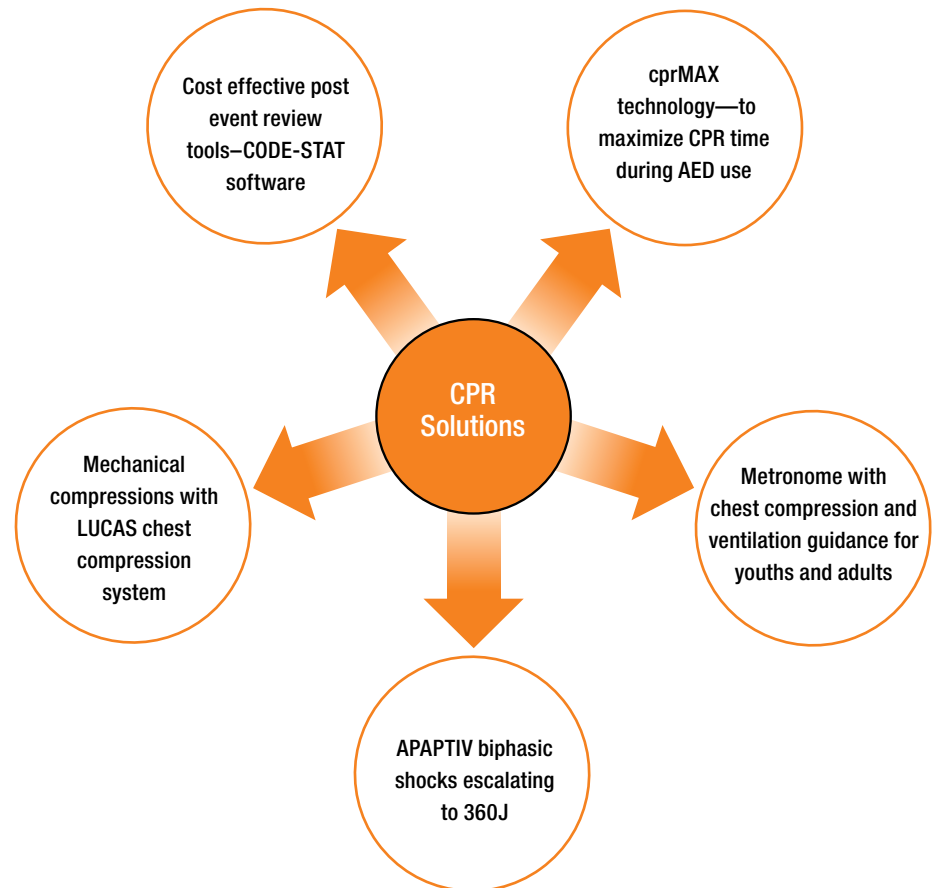
Effective, Simple Tools to Improve CPR Performance

Our comprehensive solution reflects the AHA/ERC emphasis on CPR quality, particularly more hands-on time for chest compressions, fewer interruptions in CPR, and controlled breaths to avoid over-ventilation and hyperventilation. In developing our products, we are guided by clinical evidence demonstrating that post-event review and targeted feedback to resuscitation team members are key to improving CPR performance.

We understand the chaotic environments in which our products are used—at roadside accidents and in the homes of panicked families, at code scenes and in emergency rooms of hospitals around the world. We know you need simple, effective, evidence-based tools to support your lifesaving work.

Our innovative solutions are cost-effective and easy to implement:

- **CPR Metronome**, integrated into the LIFEPAK® 15 monitor/defibrillator. The CPR Metronome has been proven to be highly effective in guiding rescuers to the correct compression and ventilation rates with dramatically less variation.³
- **CODE-STAT™ Data Review Software with Advanced CPR Analytics**, a post-event feedback tool that enables EMS and hospital personnel to review CPR statistics and provide training and feedback where it is most needed. Post-event review of data and delivering feedback to the team has been shown to be effective in improving CPR quality in both hospital and out-of-hospital settings.^{4,5,6}
- **LUCAS™ Chest Compression System**, a mechanical chest compression device designed to deliver chest compressions to the recommended AHA/ERC guidelines, while eliminating rescuer fatigue.
- **ADAPTIV™ Biphasic Technology** delivers energy up to 360J throughout our product line of defibrillators, to maximize shock effectiveness, thus minimizing unnecessary interruptions in chest compressions due to failed defibrillation shocks during CPR.⁷
- **cprMAX™ Technology** built into our LIFEPAK AEDs, giving the flexibility to maximize CPR time even when protocols change.



CPR Metronome

Use of metronomes to improve CPR delivery is well-supported by a number of studies:

- A significant improvement in consistency of chest compressions occurred when Paris firefighters used a musicians' metronome to guide chest compressions in 358 ventricular fibrillation cardiac arrest patients.⁸
- Compression rates significantly improved when EMTs and paramedics were provided musicians' metronomes and given post-event feedback.⁶
- In a simulated use study, EMTs using the Physio-Control CPR Metronome achieved 97% compliance with AHA/ERC target compression and ventilation ratios. Only one participant in the control (no metronome) group met target ranges for chest compressions and ventilations (Figures 1 and 2).^{3,9}

Furthermore, compression rate control appears to be related to compression depth. A recent study of out-of-hospital cardiac arrest patients found an inverse association between compression rate and depth.¹⁰

CPR Metronome from Physio-Control

First introduced in the LIFEPAK 15 monitor/defibrillator, the CPR Metronome is built in and can be adjusted to meet a broad range of potential protocol variations. It uses distinctive audible prompts to set the pace for compressions and ventilations. It does not require rescuers to interpret verbal feedback or distract them with on-screen displays.

Physio-Control CPR Metronome:

- Is easy to activate with the press of a button and requires no cumbersome extra gear
- Prompts for both compressions and ventilations
- Coaches for the appropriate compression-to-ventilation ratio according to the Guidelines, once the rescuer indicates whether the patient is an adult or a youth, and whether an advanced airway has been inserted
- Allows ALS providers to adjust the metronome for a patient with a secured airway
- Allows rescuers to silence the metronome temporarily or when CPR is over, with the press of a button

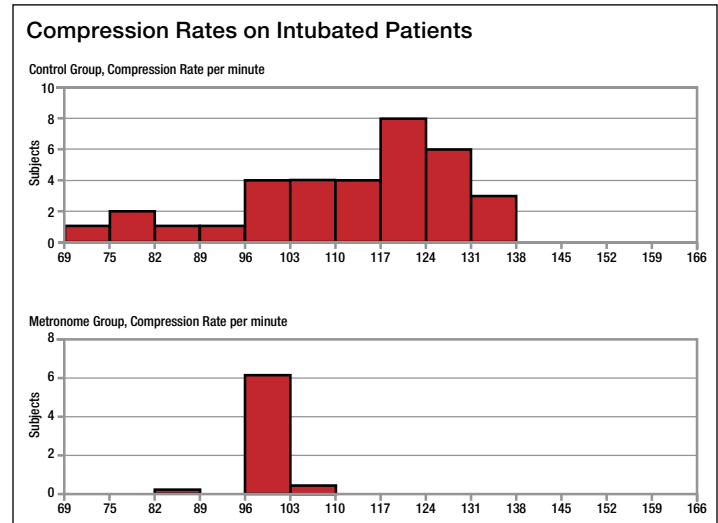


Figure 1

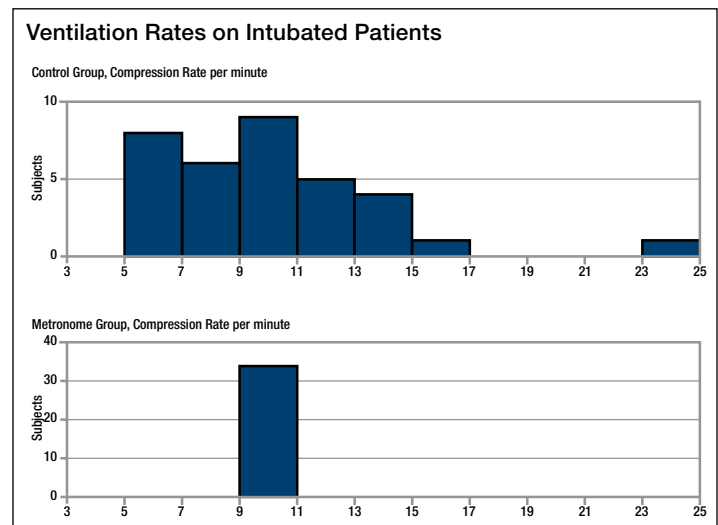


Figure 2

CPR—Beyond the Basics

How Effective are Today's Real-time CPR Feedback Devices?

The Physio-Control CPR Metronome is fully integrated with device operation, requiring no cumbersome extra gear. Our competitors currently offer a different approach, with real-time CPR feedback products that use a hockey puck-sized sensor placed on the patient's sternum. Responders place the heel of their hand on the sensor when delivering chest compressions. These devices intend to help rescuers deliver better compression rate and depth. While there are clear benefits for these devices in training, studies in real-life situations—both in-hospital and out-of-hospital—show limited improvement with these tools unless they are combined with post-event feedback.^{4,11,12}

In addition, real-time feedback devices, as currently implemented, have many drawbacks:

- Add cost and complexity, as they require extra sensors for collecting CPR performance data.
- The use of sensors to collect feedback limits CPR data collection on younger pediatric patients as the sensors can only be used on children 8 years of age and older.
- May guide the rescuer to significant under-compression of the chest when a patient is on a compliant surface such as a mattress. One study showed that mattress compression accounted for 40% of total compression depth, even when a backboard was used.¹³
- They provide correction rather than guidance. The corrective prompts are not immediate and provide feedback only after the rescuer spends some amount of time doing a task incorrectly.
- Run the risk of overwhelming rescuers with too much information via corrective vocal prompts or busy on-screen displays.
- May provide inaccurate measurements in a moving vehicle.¹⁴
- Some provide no ventilation feedback at all even though research shows professional rescuers tend to over-ventilate, which has been linked to poorer patient outcomes.^{15,16}
- Some do not correct an overly fast compression rate.¹⁵ Compressing at a very fast rate tends to quickly tire rescuers and may harm patient outcomes if the rate does not allow for the filling of the heart between compressions.

Post-Event CPR Review Tools

Studies in both hospital and out-of-hospital settings provide good evidence supporting post-event CPR review to improve CPR performance.

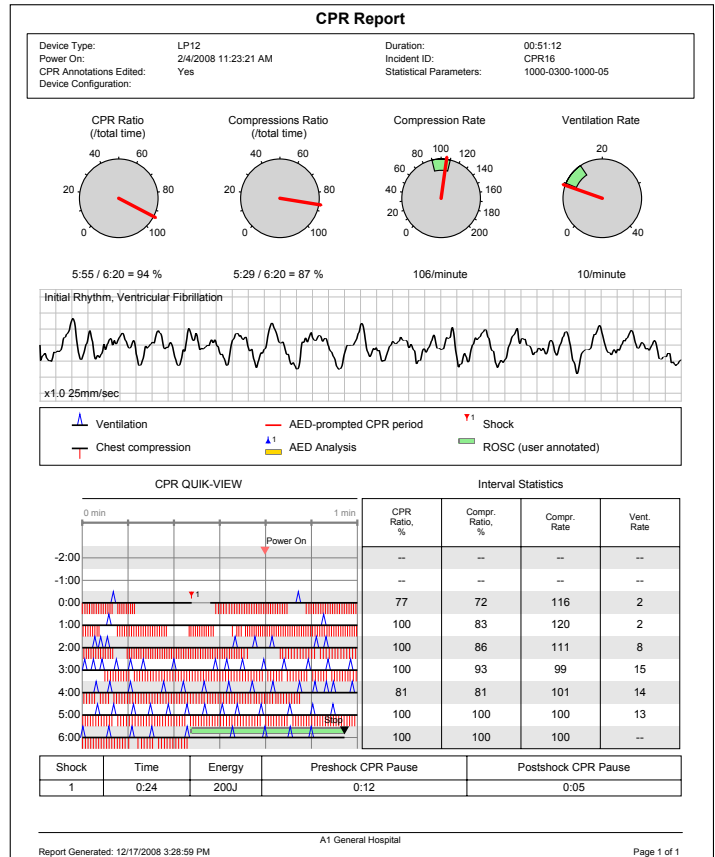
- Post-event data review and debriefing sessions improved CPR performance of hospital resuscitation teams, especially depth of compressions, ventilation rate and hands-off time.⁴ Real-time feedback alone leads to only limited improvement in CPR performance.⁴
- System-wide CPR quality improvement in the Oslo (Norway) EMS system—particularly decreased hands-off time and correction of hyperventilation problems—occurred after the organization adopted weekly debriefing sessions with medical staff, system managers emphasized the importance of CPR quality, and the 2005 Guidelines were implemented. Measuring CPR parameters enabled medical staff to see the effects of training.⁵
- Compression rates improved when EMTs and paramedics in the U.K. were given post-event feedback and provided with a CPR metronome.⁶

CODE-STAT™ Data Review Software with Advanced CPR Analytics

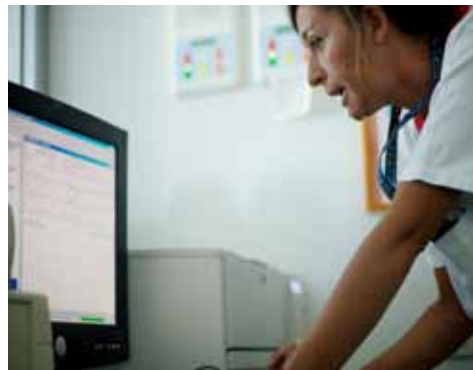
A post-event review tool that annotates chest compressions onto the patient's continuous ECG report, CODE-STAT software calculates CPR statistics and helps rescuers comply with the current Guidelines. It enables EMS and hospital personnel to evaluate the effectiveness of training and provide feedback where it's needed most.

The combination of LIFEPAK defibrillators and CODE-STAT software offers several distinct advantages, as it:

- Is cost-effective, gathering data silently in the background through conventional therapy electrodes instead of requiring dedicated sensors
- Provides trending reports over the entire record, such as CPR ratio, compression rate, compressions per minute and ventilation rate, which helps responders evaluate areas needed for further improvement in CPR delivery
- Enables the reviewer to annotate comments onto the record, such as ROSC and ventilation
- Can review previously downloaded data and is compatible with other current Physio-Control defibrillators
- Can establish baseline CPR statistics before implementing changes in protocol



Intuitive, easy to read reports can be generated. Feedback from the reports can be shared with the responders.



Data can easily be downloaded and viewed with CODE-STAT software with CPR Analytics.

CPR data is gathered automatically through conventional therapy electrodes. No need for extra sensors between the responder and the patient.

CPR—Beyond the Basics

LUCAS™ Chest Compression System

Although CPR guidance and post-event review have been shown to improve CPR quality, they cannot address the issue of rescuer fatigue, especially during transport. Performing manual chest compressions is exceedingly difficult, and quality deteriorates over time.

Mechanical chest compression systems are beneficial to both the patient and the rescuer, because they are designed to provide hands-free, effective and consistent chest compressions, making it possible to transport the patient with good circulation to the hospital and throughout the hospital for further treatment. This frees the rescuer to focus on other aspects of patient care and to wear a seatbelt during transport.

Physio-Control is the worldwide distributor (outside Scandinavia) for the LUCAS chest compression system. LUCAS is a lightweight pneumatic device designed to perform consistent and uninterrupted compressions throughout a cardiac arrest in accordance with the AHA/ERC Guidelines. It is portable and easy to use in a variety of situations, from the field to the emergency department or cardiac catheterization lab.



The LUCAS chest compression system is designed to:

- Be cost-effective, requiring no costly disposables
- Deliver compressions at a rate of 100 per minute without interruptions
- Provide a consistent compression/decompression (50/50) duty cycle
- Allow for full chest wall recoil after each compression
- Provide a compression depth of 1.5-2 inches (3.8-5 cm)
- Be applied to the patient in less than 20 seconds

As LUCAS can be used at the scene, during transport in an ambulance, and throughout the hospital, interruptions to compressions are minimized, which helps maintain circulation.

Conclusion

With the aim of improving patient survival, changes in the 2005 AHA/ERC guidelines focused on improving CPR, particularly providing uninterrupted, high-quality chest compressions and delivering breaths more quickly and with less force to avoid over-ventilation and hyperventilation. Manufacturers have taken a variety of approaches to support delivery of CPR that meets the AHA/ERC Guidelines. Although real-time CPR feedback seems intriguing, current implementation has shown limited improvement in overall CPR quality in the hospital and OOH settings.^{11,12}

Not every manufacturer has a complete solution to help the rescuer improve CPR quality and not every solution has solid data behind it. Physio-Control offers a suite of solutions that are innovative, cost effective, and easy to implement:

- CPR Metronome proactively prompts for chest compressions and ventilations in adult and pediatric patients
- A cost-effective post-event review tool—CODE-STAT data review software with advanced CPR analytics
- Mechanical chest compressions with the LUCAS system
- ADAPTIV biphasic technology with escalating shocks to 360J
- cprMAX technology to maximize CPR time during AED use

How the Offerings Compare Today

CPR Solutions	LIFEPAK 15 monitor/defibrillator	Philips MRx ¹⁴	ZOLL E-SERIES [®] and R-SERIES ^{® 15}
Metronome with prompts for chest compressions and ventilations	X		
Youth or pediatric setting prompts for CPR	X		
Settings to maximize CPR during AED use	X	X	X
CPR data acquired for post event review tool without additional sensors	X		
Can collect chest compression data on pediatric patients less than 8 years of age	X		
Can collect data from all commonly used mechanical chest compression devices (LUCAS, AutoPulse [®] , LIFE-STAT™ (Thumper))	X		
Chest compression data collection is transparent to rescuers	X		
Escalating energy to 360J to maximize shock effectiveness and minimize interruptions	X		
Measures depth		X	X
Mechanical chest compression	X with LUCAS		X with AutoPulse

Rather than rush to market with products that promise more than they deliver, Physio-Control develops features that will truly minimize CPR interruptions. We will continue to introduce thoughtfully designed solutions that are cost-effective, evidenced-based, and that work in the chaotic environments where our customers battle to save lives every day.



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All information in this brochure, including comparative statements are valid as of January 2010.

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