IMPROVING PEDIATRIC CPR WITH REAL-TIME FEEDBACK
Stacie McCauley worked as an RN at a children’s hospital for eight years, primarily in a pediatric cardiovascular surgery step-down unit. In 2011, she had what she calls an “a-ha” moment that changed her perspective on pediatric resuscitation—and the course of her career.

At work one night, McCauley suddenly heard a nurse yelling for help, followed shortly by the code alarm sounding. An infant who had just been admitted for a feeding dysfunction and heart murmur had stopped breathing while feeding. He had no pulse.

The nurses on the unit followed the pediatric advanced life support (PALS) protocol. During the emergency, McCauley manned the medication drawer, praying she wouldn’t be called upon to do chest compressions. The team managed to restore a pulse before transferring the infant to the ICU.

While this patient had a good outcome, the event shook McCauley to the core because it highlighted her lack of confidence in her ability to perform CPR.

Looking back, McCauley says, “We practice in advanced cardiac life support and basic cardiac life support, but are we really sure of what we’re doing? Are we pushing hard enough? Are we going fast enough? I would’ve wanted to be certain I was doing everything I could for this child.”

After this experience, McCauley knew she had to do more for young patients needing resuscitation. This led her to work with ZOLL on resuscitation improvement programs.

INTRODUCTION

This booklet provides guidance on how to improve pediatric CPR using real-time feedback. Topics covered include:

- What makes pediatric patients unique
- The importance of high-quality CPR
- Studies analyzing caregiver ability to achieve high-quality CPR
- How ZOLL solutions can enhance in-hospital CPR

This booklet is based on a presentation by Stacie McCauley, RN, BSN, a hospital clinical support specialist at ZOLL. It features information that was current as of May 2015. Please follow your local protocols if any of the material in this booklet conflicts with your current practices.
Each year, there are about 16,000 pediatric cardiac arrests in the United States, and more than triple that number worldwide.¹ For those children sustaining in-hospital cardiopulmonary arrest, the reported survival rates to discharge range from 23% to 37%.²,³,⁴

Clearly, we need to do a better job of managing cardiac arrests in children.

Differences Between Pediatric and Adult Codes
Improving the quality of pediatric CPR first requires understanding what makes pediatric codes so different from adult codes. After all, children aren’t just small adults—and protocol should recognize that.

First, children present with different rhythms during cardiac arrest than adults. About 85% of children present with pulseless electrical activity (PEA) or asystole, compared with approximately 77% of adults. In these cases, you can’t administer a shock, but you can administer high-quality CPR to maximize your chances of success.

Second, we need to look at where children are coding. A 2013 study found that due to the utilization of rapid response teams, the vast majority of pediatric codes are now occurring in the ICU rather than on ward units.⁵ Based on these findings, you might think resuscitation training should focus on caregivers in the ICU. After all, you’d want these caregivers to feel more comfortable using lifesaving equipment during such events. But we have to be careful not to neglect caregivers on the ward units. They must be able to provide high-quality basic life support so that patients receive the necessary life-sustaining care until ICU staff arrive. For this reason, the use of automated external defibrillators (AEDs) on ward units—along with associated training—should be strongly encouraged.

How the AHA defines high-quality pediatric CPR
- Depth: ~1.5 inches for infants, ~2 inches for children
- Rate: 100-120 compressions per minute
- Allow complete recoil of the chest with each compression
- Minimize interruptions in compressions
- Avoid excessive ventilation

High-Quality CPR Really Matters
How important is high-quality CPR? According to a consensus statement from the American Heart Association (AHA), delivery of high-quality CPR will be the factor that determines whether a patient survives sudden cardiac arrest with a good neurological outcome.⁶

This is such a powerful message for the AHA to send. It means the effectiveness of PALS is dependent on high-quality CPR. You can shock, administer drugs, etc. But if you don’t do CPR right, then you won’t move blood through the child’s body.

What does high-quality CPR look like? Figure 1 summarizes the AHA Guidelines for high-quality pediatric CPR.⁷
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Falling Short of the Standard

Unfortunately, as two recent studies show, many caregivers fail to meet the standard for high-quality CPR.

One study looked at emergency department and PICU patients at The Children’s Hospital of Philadelphia. Even after going through mock codes featuring competencies, practice with manikins, rolling refreshers, and feedback from leadership, staff was performing compressions at the correct depth only 8% of the time.

In other words, we might think we’re pushing hard enough on these children, but we really aren’t.

A second study was done at 10 pediatric hospitals throughout the United States. It included two variables:

- Just-in-time (JIT) training (five-minute CPR video followed by two minutes of practice prior to simulated cardiac arrest)
- Real-time visual feedback

The participants were assigned to one of four groups:

- No intervention
- JIT training only
- Real-time visual feedback only
- JIT training and real-time feedback

While study participants administered CPR on manikins during simulated cardiac arrest scenarios, data was recorded. Afterwards, they filled out a survey asking how well they thought they performed according to the AHA Guidelines in terms of depth and rate. They were also asked to estimate the chest compression fraction (CCF), the percentage of time that compressions were performed during an arrest.

As Figure 2 shows, participants across all categories had a very poor grasp of how deep they were pushing. Those without either training or feedback had absolutely no success in perceiving depth. The most successful group in perceiving depth—those with feedback only—still only scored a paltry 21%. The two groups with access to real-time visual feedback were much more successful than the other groups in their perception of rate.

Based on the results, the study authors made the following recommendations:

- Make the CPR feedback device visible to everyone in the code.
  During the study, the participant administering chest compressions could see the feedback device sitting on the manikin’s chest. However, the team leader, who was giving prompts, couldn’t really see it. By making the device fully visible to the leader—or at least to another team member—the compressor could receive input on how to improve performance.

- Use quantitative data during debriefing.
  Immediately after or up to a week following a code, the team should pull the data off the defibrillator to see how they did. Focusing on the numbers takes the subjectivity out of the process. What was the depth? The rate? The CPR fraction? And based on the data, how can everyone work together to produce better results?

- Increase the use of quantitative data during training.
  Similarly, make quantitative data a bigger part of CPR instruction during PALS courses. Use a measurement device to get an objective view on how well compressors are performing.

Figure 2
Participants who accurately estimated CPR quality

See-Thru CPR Technology

ZOLL’s See-Thru CPR technology filters out compression artifact on the ECG monitor. The filtered signal is clearly displayed, reducing the duration of pauses.

Figure 3

CPR Dashboard displays depth and rate on the screen.

Using the R Series in conjunction with the OneStep Pediatric CPR electrodes allows for:

- Real CPR Help® real-time feedback
- See-Thru CPR® technology
- Pediatric algorithm in AED mode
- Effective post-code review

Here’s a look at each of these features.

Real-Time CPR Feedback

According to the AHA, monitoring CPR quality should be part of every resuscitation program. However, only 4% of U.S. hospitals report the utilization of CPR feedback devices. The rest are simply using visual perception to determine CPR quality.

ZOLL is the only manufacturer to offer CPR feedback for children under the age of 8. The OneStep Pediatric CPR Electrodes include a CPR sensor that measures CPR performance during a code.

Using Real CPR Help technology, the depth and rate of compressions are displayed on the CPR Dashboard™ on the defibrillator screen. If the rate falls below the targeted range (100-120 compressions per minute), the defibrillator provides a metronome to get you back on track.

Pediatric Algorithm for AED Mode

Although utilization of rapid response teams has shifted more codes from the ward units to the ICU. So how do we make sure the nurses on ward units are equipped to handle these patients?

When used with the OneStep Pediatric CPR Electrodes, the R Series automatically lowers the shock energy to a lower protocol, to start at 50 rather than 120 joules. So changing the joule setting and worrying about giving the patient too much energy are non-issues.

When the R Series is in AED mode, the OneStep Pediatric CPR Electrodes also enable a unique pediatric algorithm, which can distinguish between shockable and non-shockable pediatric rhythms. As a result, nurses with less experience in reading rhythms can deliver safe care in a timely manner.

Solutions from ZOLL

The ZOLL R Series® Monitor/Defibrillator is the first defibrillator that offers the option of using pediatric electrodes with a built-in CPR sensor. ZOLL OneStep™ Pediatric CPR Electrodes are similar to ZOLL adult electrodes, but designed especially for children under 8 years of age and up to 55 lbs (25 kg).
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Effective Post-Code Review
ZOLL’s RescueNet® Code Review is the first software program for analyzing the complete resuscitation event.

It provides a quick and easy way to:
- Pull objective data from the defibrillator immediately following the code
- Accurately assess user performance during the code

You can use this information right away for debriefing purposes and later on for benchmarking code quality.

As Figure 4 shows, RescueNet Code Review provides detailed information.
- **Shock summary**: Each lightning bolt represents a shock.
- **Depth of compressions**: The user is scored on each compression based on the target depth. You want the score to fall within the green shaded area.
- **Compression quality**: This data is based on depth and rate. In this example, good compressions were performed only 31% of the time.
- **Rate of compressions**: Each dot represents a compression. In this example, the rate consistently fell below the targeted range of 100-120 compressions per minute.

Figure 5 shows another cut at data gathered during the same mock code. Here, you can see data such as:
- **Mean compression depth**: 2.43 inches (pretty good)
- **Mean compression rate**: 95.59 compressions/minute (too slow)
- **Time in CPR**: 77.50% (just below the AHA-recommended 80% for CPR fraction)

Conclusion
The AHA has said that monitoring CPR quality may be one of the most significant advances in resuscitation in the past 20 years. We now have technology that can do just that while also providing real-time feedback on user performance. By incorporating this technology into clinician training and every resuscitation—and by debriefing using objective data—we can attain the goal of improving CPR quality and thus patient outcomes following pediatric cardiac arrest.