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FIVE STEPS TO IMPLEMENTING A CPR QUALITY PROGRAM



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Introduction

Each year in the United States, more than 350,000 children and adults suffer out-of-hospital cardiac arrest (OHCA), with an overall survival rate of around 10%.¹ Yet such numbers tell only part of the story; *where* you suffer cardiac arrest can have a profound impact on your chances for survival. The American Hospital Association (AHA) states that survival rates for cardiac arrest range from 3–16%.² Even more differentiation is seen when we consider cardiac arrest associated with ventricular fibrillation (v fib)—the rhythm with the best chance of resuscitation. Under these circumstances, some communities report survival rates of 50% or higher.³

Clearly, demographics, EMS resources and the type of community all have an effect on cardiac arrest survival rates. But communities as varied as King County, Wash.; Seattle; Richmond, Va.; Rochester, Minn.; and others have seen significant survival rate increases after implementing CPR quality initiatives and new CPR protocols.⁴ Such success compels all systems to examine their own processes and ask, can we do better? In almost all cases, the answer will be a resounding yes.

Clinically, we know how to improve CPR:

- Minimize interruptions to chest compressions.
- Provide 100 to 120 compressions per minute.
- Give deep enough compressions, at least 2 inches for adults.
- Allow the chest to bounce back completely so the heart can refill.
- Give no more than 12 rescue breaths a minute.²

Ensuring that providers are consistently meeting these guidelines, however, is a more complicated process, one that requires a significant investment at all levels of the organization. It goes far beyond a clinical protocol. The Resuscitation Academy (RA), a non-profit organization dedicated to improving cardiac arrest survival, has laid out many steps communities need to take in order to enhance survival rates for OHCA, including public education on CPR, deployment of AEDs throughout the community, and changing dispatch protocols to support rapid response to and pre-arrival CPR

instruction. Any organization determined to improve cardiac arrest survival rates in their community would be well-served to consult the RA's curriculum.

In this white paper, we take a closer look at just one aspect of improving cardiac survival—how EMS organizations can improve the effectiveness of provider-delivered CPR. And because achieving this goal is much more than simply improving CPR technique, this white paper emphasizes the need for a process approach and the important role that measuring and tracking provider performance plays in any CPR quality improvement program.

The success of many communities compels all systems to examine their own processes and ask, can we do better? In almost all cases, the answer will be yes.

We identify five critical steps to CPR quality improvement:

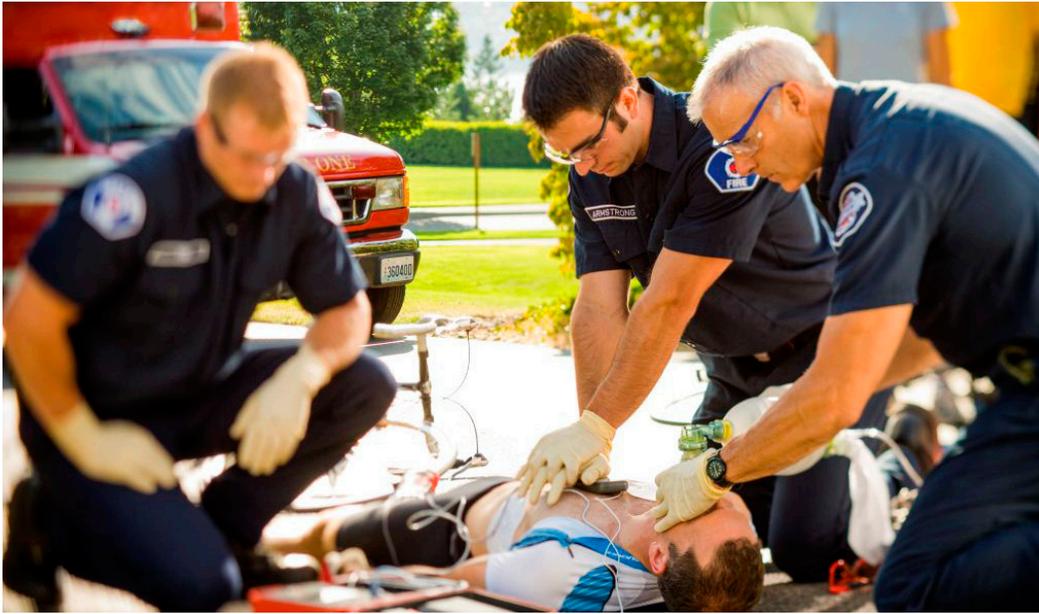
Step One: Build the Case

Step Two: Measure Where You Are Right Now

Step Three: Set a Plan for Improvement

Step Four: Retrain and Re-Educate Providers

Step Five: Track, Refine, Repeat



The obvious reasons to invest in the effort to improve CPR quality are to improve resuscitation rates and survival to discharge. But the benefits go far beyond that. A concentrated effort in improving your agency's CPR quality enhances providers' investment in their jobs, raising the bar for professionalism in prehospital care. By monitoring, tracking and sharing data, your agency will contribute to a body of science that continues to refine the CPR technique, increasing survival rates. Just think of how much the AHA Guidelines changed from 2005 to 2010, and what data led to those changes.

Finally, CPR "save stories" build community support for EMS while also underscoring the important role of bystander CPR. After implementing a CPR improvement program that improved witnessed v fib cardiac arrest survival rates from 10% to 41%, East Pierce Fire & Rescue in Bonney Lake, Wash., saw significant community support and the benefit it brought. The department notes that cardiac arrest survivors routinely ask to address the organization's Board of Commissioners about their experiences. "The personal stories told by these CPR survivors, who usually bring their families to the meetings, are a powerful reminder to our elected officials, much more so than statistics, about the positive impact of their continued support for the resuscitation program," notes Assistant Chief Russ McCallion.⁵ "We build support, and introduce the survivors and their families to our elected officials and fire chiefs, to demonstrate that investing in this program—when funds and resources are tight—provides an actual 'pay-off' in lives saved."

Read on to find out how your organization can get started.

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Step One: Build the Case

Before an organization can begin any significant change program, it must build a case for the need to change. This is necessary not only to win over doubters, those who don't see a need for the change, but also because it's an important part of defining exactly what the change will look like.

When it comes to CPR quality improvement, the first step for most agencies in building a case is admitting that your providers are probably not meeting the AHA Guidelines for CPR. This can be difficult to face, but it's important to remember that failing to meet CPR quality standards isn't the result of a lack of dedication or effort on the part of providers. The simple reality is that CPR is not as easy as it looks, especially when providers are expected to perform it for long periods under extremely stressful conditions. When the Pittsburgh Bureau of Fire was beginning to focus on CPR quality, the bureau asked company officers of the first-responding crews to observe firefighters delivering CPR and indicate how long it took before they saw signs of fatigue. "Despite being 'big strong firefighters,' they were getting tired after about 3 minutes," says Ron Roth, MD, medical director for the City of Pittsburgh Department of Public Safety.

Stressing factors like fatigue and how often poor-quality CPR is performed will be important to building a case for change. A landmark study published in *JAMA* sought to describe the performance of CPR in the out-of-hospital setting in three major European cities. Despite the fact that providers had just been retrained in standard resuscitation practices and knew that their CPR was being measured, the net result was that patients received adequate chest compressions at a rate of not even 18 per minute.¹

Each agency is different, however. In 2008, following a lengthy implementation of new CPR process to meet the AHA's 2005 Guidelines, the Henderson (Nev.) Fire Department started using real-time CPR feedback to measure chest compression quality and consistency. "Unlike the studies from 2005 that showed that many prehospital per-

sonnel did not push fast enough or deep enough, we observed through the use of real-time chest compression and ventilation monitoring and feedback that our crews tended to push too fast (at an average of 140 compressions per minute) and that we did not routinely allow for adequate chest recoil," writes Scott Vivier, EMT-P, AGS, EMS division chief for the department.²

Chest recoil was also an issue for East Pierce Fire & Rescue in Bonney Lake, Wash. "Most of our crews did great on the rate, and the depth wasn't a problem, especially when we were cycling people out every 2 minutes," says Battalion Chief/Medical Services Officer Jeff Moore. "The problem was the recoil. People just didn't realize how much they were pressing on the chest. And as little as 5 lbs. of pressure on the chest can make a difference. It was a huge thing we had to address, and we still do. Now when our battalion chiefs and lieutenants perform their clinical oversight of cardiac arrest calls, one of the first things they're looking for is incomplete release."

Another issue for East Pierce: flow time. Using CPR feedback devices, they were able to document pauses in CPR that were affecting the quality. "When we first started, people were surprised how often the hands are off the chest," Moore says. "Without that data, we would have no way of knowing. Data gives you the report card, it tells you that there were 15 seconds where you didn't compress the chest." East Pierce combines feedback data with voice recordings of calls to better determine why such pauses occur.

Whether too fast, too slow or inaccurate, it's common for even highly trained providers to fail to consistently meet CPR guidelines, a problem that becomes worse as the call drags on. A literature review published in the *Australasian Journal of Paramedicine* noted, "It has been demonstrated by several investigators that physical fatigue in the rescuer occurs as soon as one minute after starting compressions on mannequins. Furthermore, it was also reported that the rescuer is unaware that fatigue has reduced their performance of compression effectiveness."³

Assistant Chief Russ McCallion with East Pierce Fire & Rescue in Bonney Lake, Wash., observed this in his personnel as well. "Based upon Q-CPR feedback, and reports from crews, it was clear that the new 2010 AHA Guidelines for CPR were exhausting the crews sent to a cardiac arrest call," he notes. The department had been sending a two-person medic unit and an engine with two or three firefighters or paramedics. Based on consultations and lessons learned from the Resuscitation Academy, East Pierce now sends three units to every cardiac arrest call, plus a battalion chief. The result: "Improved CPR performance and better scene management," McCallion says.⁴

However, EMS leaders need to be prepared to meet resistance from line providers. Imagine if someone all of a sudden demanded to observe and measure your productivity at the job you'd been doing for many years. Providers who consider themselves skilled resuscitators may feel the same.

Roth says Pittsburgh medics were initially worried about real-time CPR feedback from a family member standpoint. "They're doing CPR, and the device is giving them feedback, telling them to push harder, push faster," he says. Providers worried that the family members would conclude that the crew was doing a poor job. Interestingly, Pittsburgh EMS allowed providers the option to turn off the real-time prompts. However, Roth doesn't recall a single issue arising as a result of audible real-time feedback.

Another key step is highlighting how much improvement your community could achieve. When witnessed v fib OHCA survival rates are around 10% nationally, it's easy to be satisfied with a 10% rate, and even pleased with one in the range of 12–15%. But in fact, the experience of several communities has demonstrated that it is possible to do much better.

East Pierce Fire & Rescue experienced this first hand. Located near Seattle and King County, Wash., it was well aware that these communities were boasting 45–48% witnessed v fib survival rates. Some East Pierce CQI Committee members doubted these numbers, but a detailed data review bore them out. "After critically reviewing the data, our East Pierce members accepted that ... these survival rates were possible," McCallion writes.⁴

Messaging was important in winning support. After calculating that East Pierce Fire & Rescue could achieve a rate of around 40%, McCallion noted that this would mean

saving the lives of three to four citizens each year. He seized on this point in meetings with department leaders: "We would tear our department apart and rebuild it step by step if we thought we were losing three to four citizens per year who should have been rescued from fires. So, when we know we can save three to four additional people every year from cardiac arrest, are we, as an agency, going to step up and put the same energy into saving these CPR patients? To the family, 'dead is dead,' and each is equally tragic. So why would we spend any less effort saving these patients?"⁴

The experience of Mecklenburg (N.C.) EMS Agency points to the fact that even agencies that currently have above-average resuscitation rates can strive to do better. Although the community was seeing rates around 35%, the agency implemented a process to dig deeper into what was working and what wasn't, applying the concept that "if you standardize work and reduce variation in an EMS system, you will see improvements in your processes and systems, and those improvements will benefit your patients." After retraining providers and further defining the needed actions during a resuscitation attempt, the agency experienced seven consecutive months of OHCA survival rates above 50%.⁵

Finally, central to the efforts to build a case for improving CPR quality is to stress that the point of doing so is, and never will be, punitive. Yes, providers will be monitored, but it is important that everyone—individual providers, supervisors and administrators alike—understand that such data isn't being collected in order to point fingers. In some agencies, this step is perhaps the most difficult; if you have low levels of organizational trust, it won't be easy to convince anyone that "we're all in this CPR quality improvement thing together."

"Our providers were resistant at first," Moore says. "They had a really strong belief that we were going to use this in a disciplinary fashion." To overcome resistance, Moore recommends clearly outlining the process by which all providers will receive training, being transparent about which data is being collected and how it's being used, and stressing that calls will be monitored for quality assurance/quality improvement only.

In addition, East Pierce had success by bringing in a King County paramedic who runs his department's CQI program. "He addressed our CQI committee, our firefighter lieutenants, para-

medics, union personnel, and told them that in all the years it had been used in their agency, it's never once been used for discipline. That got us the buy-in we needed at that time at least to try it," Moore says. "And since we've been doing it, our organization wouldn't know what to do without it. The providers expect the debrief now, and they self-evaluate. They're harder on themselves than I would ever be. But by letting them be part of the solution, they came to embrace it."

The Henderson (Nev.) Fire Department has experienced similar reaction. "Because we've been doing QI for so many years, it's not a scary thing for our providers," Vivier says. "When they get a CPR scorecard that's not great, they know that it's not about punishment; it's about improvement."

Vivier says that the organization trains all crews to understand that some calls are outliers. "Not every call will go perfectly," he notes. "When they review their feedback, they know if it was because it was a 500-lb. patient and they had an extended extrication to move them down three flights of stairs. And they know there's not going to be punitive results. So the feedback drives them to think, how can we do this better?"

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AEDs: Failed Promise?

The sooner you defibrillate a patient in v fib, the better the chance for them to survive. Every provider knows that. As a result, the development of low-cost AEDs suitable for layperson use was predicted to be a game-changer in out-of-hospital cardiac arrest survival rates. Some even predicted AEDs would render CPR obsolete.

Unfortunately, the AED revolution failed to dramatically impact survival rates. After AEDs became available, defibrillation was one of the reasons behind the merger of the FDNY and New York City EMS—the thought was that it would reduce response times and double the number of defibrillators on the streets. "Response time was reduced, from 9.3 minutes to 4.7 minutes," says John Freese, MD, director of prehospital research for FDNY. "That, combined with essentially doubling the number of defibrillators on the street, should have meant a dramatic increase in cardiac arrest survival. And yet, when you looked at it, the City saw only a small increase in cardiac arrest survival—2.2% to 2.9%." And when you dig deeper into the statistics, you can see that when defined as return of spontaneous circulation (ROSC), survival actually decreased in the short term, from about 30% to 20%.

Importantly, Freese notes, this trend wasn't unique to New York City. "Seattle seemed to experience a similar decrease in survival, from around 35% to 20%," he says. "The problem seems to be the technological imperative—if you only give people a hammer, and endorse the amazing properties of the hammer, the world is going to be a nail. So what probably happened is that we forgot the other key components."

Step Two: Measure Where You Are Right Now

Improving anything requires understanding your current performance. This is why, in addition to stressing clinical protocols, the American Heart Association (AHA) also recommends that EMS agencies gather data on the quality of CPR delivery and patient response at the scene, conduct debriefings and participate in CPR data registries.¹

The Resuscitation Academy also stresses the importance of agencies belonging to a cardiac arrest registry, listing it as one of the “low-hanging fruit” steps that agencies can take to start to improve OHCA survival rates.²

What exactly is a cardiac arrest registry? Put simply, it's a database that collects EMS performance measures on cardiac calls and links them to patient outcomes data. Data that are collected include:

- Critical variables, such as witnessed collapse, collapse before EMS arrival, first rhythm obtained, shockable rhythm, bystander CPR, telephone CPR, time of call to dispatch center, time of EMS CPR, estimated time of bystander CPR, time of first compression for dispatch-assisted CPR, and time of first defibrillation.
- Measurement of outcomes, such as death at scene, death in hospital, and discharge alive (ideally with a determination of neurological outcome).²

Over time, as more and more data is collected, agencies can begin to identify trends and make comparisons with similar services. This reveals areas where their agency is successful and areas where it is less successful—information which, in turn, points to the steps needed for improvement.

Although an EMS agency can establish its own registry, it's more common for registries to be established at the county or regional level, easing the burden of resources required to maintain the registry. In addition, one national registry is open to EMS systems throughout the United States: the Cardiac Arrest Registry to Enhance Survival (CARES). As of 2013, there were 50 communities from 17 states participating, plus six statewide EMS programs.²

Mecklenburg (N.C.) EMS Agency joined CARES in 2010 and has since used its common data definitions to accurately track outcomes and survival from OHCA, and draw comparisons to other EMS agencies.³ East Pierce Fire & Rescue participates in the Washington Cardiac Arrest Registry for Enhanced Survival (WACARES). “Entering the data for each cardiac arrest patient takes less than 10 minutes, and patient outcomes are generally updated within two weeks,” notes Assistant Chief Russ McCallion. “The WACARES data output uses the internationally recognized ‘Utstein’ format, in which the primary focus is on witnessed v fib patient survival to ensure consistency between systems reporting data.”⁴

A sort of bare bones, free-standing registry also exists: Cardiac Arrest Tracking System (CATS). This registry includes 14 event variables and three outcome variables. Although it's not linked to a national registry, participation in CATS requires minimal time and resources for any EMS agency, and allows the agency to monitor its own performance and track changes over time.²

There are also ways to take advantage of registry data even if your organization doesn't belong to one. “We didn't belong to a registry when we started [CPR quality improvement] and we're still not a CARES site, but we always used the Utstein criteria for data collection. We're just not a reporting site,” says Henderson (Nev.) Fire Department EMS Division Chief Scott Vivier. However, Henderson took advantage of the registry data published by King County, and used that to benchmark against. “We know the gold standard is King County, and we can find their information, they do a great job of publishing it. If we meet or exceed that, we know we're doing well.”

Participation in a registry is a long-term way of measuring where your organization is with regard to CPR quality. In the shorter term, you must also measure how well your providers are performing CPR.

For Pittsburgh EMS, the key to tracking CPR performance came through its participation in the Resuscitation Outcomes Consortium (ROC), a network of 11 regional clinical centers and a data coordinating center. The ROC conducts experimental and observational studies of out-of-hospital treatments of cardiac arrest and trauma.

“Prior to working with the ROC, our survivals were anecdotal; we’d hear about someone surviving, or they would contact us to thank us,” says Ron Roth, MD, medical director for the City of Pittsburgh Department of Public Safety. “We simply recorded whether we delivered the patient to the ED with or without a pulse. As the medical director, I pulled every cardiac arrest strip sheet, looking at the procedures that were done and the success rate. But there was no way to gauge CPR quality.” Complicating matters: Research at the time seemed to point to medication administration as more important in survival than CPR. And that in turn influenced what Roth looked for when reviewing calls, and what information was relayed back to the crew. “Obviously now we know the exact opposite is true; CPR is more important, medication is not as important,” he says. “But back then the feedback we gave to the crew was more centered around medication administration.”

Then in 2005, Pittsburgh started working with the ROC, which assisted with the purchase of monitors that provided CPR feedback. “ROC provided someone to look at CPR quality uniformly across the organization—fire first responders as well as ALS paramedics—and interpret the data for us,” Roth says. Rather than relying on the medical director to assess each cardiac arrest, the organization was now receiving detailed reports about crews’ CPR success, including when and how long they paused during CPR, expressed as a CPR percentage. “Now that the research suggests that the quality of CPR really matters, we’re able to provide feedback to the crews: Your CPR percentage was good or bad,” Roth says. “We can also determine why it was bad—because after the shock it took too long to start CPR again, etc. That was how we started.”

Although not everyone can participate in the ROC, many agencies have found CPR feedback devices to be valuable for measuring provider CPR performance. A research review by the University of York sought to assess use of CPR real-time feedback/prompt devices during training and actual resuscitation attempts. It looked at compressions depth, rate and error rates (or percentage performed correctly); and ventilation rate, volume and error rates. Looking at 32 different studies, the authors concluded that “good evidence existed to support use of CPR feedback/prompt devices during CPR training to improve CPR skill acquisition and retention.”⁵

Certainly, skilled trainers can catch and correct many errors during CPR certification and recertification. But one of the areas many providers struggle with is achieving

correct compression depth—something that can be very difficult to measure simply by observing. CPR feedback devices can not only record whether the provider is pressing too shallow or too deep, but can also provide that feedback as the provider is practicing, allowing for instant correction. “Human error in CPR is the number one thing we can control, so you have to be able to real-time correct your CPR performance,” Vivier says. “That alone will improve success rates.”

Such devices can also be immensely valuable when trying to correct the technique of seasoned rescuers, who are less likely to make changes based on observational feedback. Faced with objective data showing the problems with their technique, however, they will be hard pressed to deny it.

Of course, the idea is not to create a combative environment, but to introduce providers to CPR feedback as an exciting new resource to help them save more lives. EMS leaders will do well to emphasize how providers from some of the biggest, most well-resourced departments are using such feedback and have had to make changes in their CPR technique as a result.

Applying CPR feedback in system-wide training can reveal overall trends: Compared with the AHA Guidelines, are you providers pushing too fast? Not hard enough? Are they providing too many ventilations? Could your “hands-off” time be reduced? Knowing such metrics—where you are now—will help you understand better how to structure the training that will necessarily follow.

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Step Three: Set a Plan for Improvement

Once you know where you are, you can define where you want to be. Step three of the CPR quality improvement process involves defining a vision of CPR quality for your agency.

The most obvious goal is survival rate for witnessed v fib OHCA. The rate your organization can achieve will depend on resources, timeframe and where you're at right now. Communities at the lower end of survival rates—5 to 15%—have more room for improvement than those that are hovering in the 30% range.

But this begs the question: Should you even set a specific percentage to work toward? East Pierce Fire & Rescue in Bonney Lake, Wash., found a goal rate to be beneficial. The department reviewed existing system components and considered geography and population to determine an “achievable” performance goal for witnessed v fib patient survival: 30%.¹ “It seemed fair to expect 30% was an achievable goal from the current 12% at the time, considering that we were spending a significant amount of effort and time up front to improve the process,” says East Pierce Battalion Chief/Medical Services Officer Jeff Moore. “The only other consideration at the time regarding this number was that King County Medic One to the north of us was achieving 45% save rates at the time.”

Moore emphasizes that a survival rate goal gives the agency something to strive for. “You need a goal, something to shoot for,” he says. “If you don't meet it, you come up with solutions, do a gap analysis to determine how to meet that goal. If you meet it, you set it higher.” Moore stresses that the goal must be specific to your agency and the particular challenges facing it. “The goal is unique to every department, as are the roadblocks each department will face,” he says. “For us it was response time; we're a huge district, so our efforts had to include public CPR training and equipping police officers with AEDs in addition to retraining providers.”

The department also took it step by step, moving to about 22% in the first year after implementing a CPR quality program and to about 30% the next. “Just last year we

crossed the 40% barrier,” Moore says. Key to the success of the efforts: training and Q-CPR. “We understood that monitoring the quality and performance of CPR has to happen not only in after-action review, but right there on the scene so providers can improve rate, depth, recoil in real time,” he says.

When it came to goal-setting, Henderson (Nev.) Fire Department set its sights high—and it worked. “We wanted to meet or best that of King County; we felt that was our goal,” EMS Division Chief Scott Vivier says. “We've made great progress with our outcomes. Our overall cardiac arrest survivability—all patients, nothing excluded—is between 17% and 19%. Nationally, that figure is 1–6%. For witnessed v fib cardiac arrest, our survival runs from 46–50%. We have been there the past four years.”

But there are other numbers to target beyond survival rate. Mecklenburg (N.C.) EMS Agency isolated four key performance metrics:

1. Average compression rate
2. Frequency of adequate compression depth
3. Time to defibrillation
4. Flow time

It then set performance goals for each of these metrics. In a recent article detailing their agency's CPR quality improvement process, Mecklenburg leaders note, “Armed with obtainable metrics and set goals for each metric, the quality improvement (QI) department began to track and report performance to Medic's leadership team and field providers. Cases not meeting these goals were reviewed by a QI staff member to identify barriers to the process. System-wide areas for improvement were

also identified by tracking this data over time. Using historical data, Medic was able to track the effect of each change on both performance metrics and survival. Each time Medic refined the process, officials observed a corresponding improvement in overall performance and survival.”²

For Pittsburgh EMS, the key metric was CPR percentage—the percentage of time during the call that CPR is performed. “If your CPR percentage is 96%, great,” says Ron Roth, MD, medical director for the City of Pittsburgh Department of Public Safety. Because the organization is currently participating in a ROC study, some of its calls use continuous CPR and some use 30:2 (30 compressions, 2 ventilations). For continuous CPR, Pittsburgh targets a CPR percentage of around 80–90%. The 30:2 CPR percentage, simply by its nature, is a little lower.

“For calls where the percentages are low, we look to see why,” Roth notes. “Sometimes it’s because of patient positioning—maybe the patient was under a table or in a small room—so then we do training under those conditions and we modify our protocols, tell them to move the patient to another room before starting CPR.”

One important factor when setting performance metrics: resources. The amount of resources your organization will be able to dedicate to CPR improvement can affect how quickly you see results. If resources are fewer, more conservative goals may be in order.

A CPR quality improvement effort doesn’t have to be expensive, but it does require some level of investment. Assistant Chief Russ McCallion notes that when East Pierce Fire & Rescue began its program, it knew “that implementation of new resuscitation program components was going to cost money, including overtime for training, technology to improve CPR quality and provide cardiac arrest debriefs, and the staging of a long-vacant Medical Services Officer position, who would coordinate the program.”¹ As with most change initiatives, the key lay in securing the support of the entire administration. When leadership is all on the same page, money and resources can often be found.

Following are some of the resources to consider:

- **Equipment.** We have already discussed the benefits of CPR feedback devices. Deploying them across all medic units will require a significant investment. Depending on the age of your current monitors, it may make sense to upgrade them as well, which will clearly require a greater monetary commitment—but new monitors and new technology such as 12-lead ECG transmission can offer additional benefits that can further improve survival rates. In addition to feedback devices, EMS agencies will likely need to invest in software that can analyze and report on all of the new data being collected.

Selecting a CPR Feedback Device

Following are a few factors to consider when you’re considering outfitting your crew with CPR feedback devices.

- **Ease of use.** As with any device, providers will have preferences on the features of feedback devices. You may not be able to please everyone, but you can ask a select group of providers within your agency to test several devices and report on what they like and don’t like. Things to consider include, does the device display feedback in a way that’s easy for the provider to see when delivering compressions? Is use intuitive or will it require a lot of training? What maintenance will be required? How easy the device is to use will have a direct impact on whether it is embraced and properly deployed in the field.
- **Durability.** EMS occurs in the field, not a controlled laboratory. Equipment must be able to take some hits and still keep going. Again, field-testing some devices will give you a feel for whether they are going to hold up to different providers using them repeatedly under high-pressure situations.
- **Ability to measure ventilation.** Hyperventilation is relatively common and harmful during CPR, and yet it can directly impact the victim’s chances for survival. CPR feedback devices that measure ventilations and provide hyperventilation protection are available.
- **Audio prompts and feedback.** Although some providers resist the notion of having a device audibly announce their performance, fearing it could make them “look bad” to bystanders, don’t underestimate the power of audio feedback. When reviewing CPR performance data recently, the FDNY noticed a dip in quality; digging deeper, they discovered that the devices’ audio features had been disabled for a short time. A device that provides audible feedback (that can also be turned off, of course) is best.

- **Training.** Agencies must be prepared to train and retrain providers. This includes training on the latest AHA Guidelines. If your CPR improvement program includes a “pit crew” approach, you’ll need to spend time getting providers adjusted to the new roles and helping them understand what actions those new roles translate to on scene. Finally, EMS agencies should consider sending select personnel to attend the Resuscitation Academy. Although the program is offered at no cost, it will require travel and associated expenses. More information about training and the Resuscitation Academy is provided in Step Four.
- **Staffing.** As McCallion notes, a CPR quality improvement program can result in new positions within EMS agencies or the need to create an EMS Division within the fire department. Agencies may need to increase overall staffing as well to address the fact that more providers are needed to respond to cardiac arrest calls to prevent rescuer fatigue and to improve overall management of the call. Fortunately, today’s fire and EMS leaders have access to GIS and other scheduling and deployment programs that can help ensure the most effective deployment of resources.
- **Overtime.** Pulling providers out of the field for training necessarily leads to overtime costs. These may be further exacerbated if the agency elects to send providers to off-site training, such as the Resuscitation Academy—but the results will pay dividends.

Finally, the most important—and yet elusive—resource of all is not dependent on funding at all. Even unlimited new equipment and training will fail to achieve the organization’s full potential unless leadership at all levels is on board. “Equally important as the commitment of resources is the need for organizational support and leadership—at all levels in a department—to successfully implement new, comprehensive programs,” McCallion notes. “Without such support—which often includes changing the culture of an organization—efforts at program implementation frequently stall, or fail.”¹

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Step Four: Retrain and Re-Educate Providers

As noted in Step Three, EMS agencies hoping to see significant improvement in cardiac arrest survival rates must be prepared to invest a significant amount of time in training and educating providers.

When the 2010 AHA Guidelines were released, many agencies had to make adjustments in their CPR protocols and as a result, provided comprehensive CPR retraining. A similar effort may be needed as you roll out your improvement program.

Begin training with a focus on the science of CPR. Although you don't want to present so many studies that your providers' eyes glaze over, it's important that they understand the *why* in order to embrace the *what*. *Example:* You can tell providers that ventilations should be less than 10 per minute. Or, you can explain that increasing ventilation increases intrathoracic pressure, which in turn impedes venous return to the heart, thereby decreasing forward blood flow to the myocardium and brain during CPR.¹ With the latter, you're effectively showing how even a few extra ventilations could jeopardize the other work they're doing on scene to revive the patient.

Another approach many agencies have found valuable is to implement some form of the "pit crew" approach. Designed by Robert Boyd Tober, MD, FACEP, the pit crew approach to CPR designates a specific task or role to each person on an EMS team when responding to a patient in cardiac arrest, similar to how each member of a pit crew at a NASCAR event has a specific job.²

Each agency implements the pit crew approach a little differently. The Henderson (Nev.) Fire Department identified four critical positions:

- **Compression technician:** The most important position, which is filled first on scene. This position ensures the application of high-quality chest compressions.
- **Monitor technician:** The second position filled, this position oversees the entire cardiac arrest, applying appropriate shocks and determining correct pharmacological interventions, as well as documenting the code.

- **Ventilation technician:** This is the third position filled and is responsible for setting up the department's autoventilator. The ventilation technician rotates with the compression technician every two minutes to minimize rescuer fatigue.
- **Medication technician:** The last position to be filled, this person establishes IV or IO access, and draws up and delivers medications.³

Scott Sullivan, EMS officer with Tualatin Valley Fire & Rescue in Oregon says his organization hasn't done any formal pit crew training, although they have discussed the concepts. Instead, he notes, "Our agency implemented high-performance CPR based off the King County Resuscitation Academy model in 2012, and have integrated this into our code management."

Pittsburgh also took a modified approach to the pit crew concept. Ron Roth, MD, medical director for the City of Pittsburgh Department of Public Safety, notes that it refined the pit crew approach even further, designating where providers should position themselves during the call. "We refined it to be more like a NASCAR pit crew rather than a tire-changing on the side the road," he says.

Whatever you call the specific roles, it's important that providers be given time to practice them and provide feedback about how they are working. East Pierce Fire & Rescue employs scenario-based training to help providers practice their roles during resuscitation, using CPR feedback to supplement the training. "In quarterly drills, they're given a scenario and have to apply the skills, and they get a report card that comes from the Q-CPR," Moore says. "It shows us flow times, recoil, rate, depth—immedi-

ate numbers on how they're performing.”

One caveat: A pit crew approach must go beyond simply assigning new roles to providers. Leaders at Mecklenburg (N.C.) EMS Agency believe that at first, the pit crew approach impeded their efforts to improve OHCA survival rates. In a recent article, they note, “Assigning roles reduced distraction but didn’t yield the great improvement Medic had envisioned. The ‘pit crew’ approach to resuscitation is a great method to standardize work on an OHCA scene by lessening distractions and improving focus. Although this approach may provide direction to providers and give them a job duty, it doesn’t innately tell them the performance expectations of their job. Medic officials came to realize that the efficiency of the care provided is paramount; it was essential to determine what each provider should be doing and define the performance of each role. Being assigned a role was not a sufficient-enough change to see improvement.”⁴

Although it did not abandon the pit crew approach, Mecklenburg achieved more success when it educated providers on a standard approach for how each task was to be performed on scene. Most recently, Mecklenburg’s leadership chose to focus training on CPR depth and time to defibrillation. They note: “In July 2012, Medic’s first responders were retrained in performing high-quality CPR at adequate depth and reducing rotation time between compression cycles, while paramedics were trained on reducing time to defibrillation and pre-charging the defibrillator at the 180th compression. Following this intervention, Medic achieved seven consecutive months of Utstein cardiac arrest survival rates above 50%, and a 12-month average of 51.1%.”⁴

Tualatin Valley Fire & Rescue, which, like Pittsburgh, is an ROC EMS agency, had to provide performance data as part of its participation in the consortium. “Initially we had issues with crews forgetting to use the accelerometer, which meant no data and no feedback,” Sullivan says. “We worked on some logistical issues to make this easier (pre-attached accelerometer, etc.) and also provided feedback when possible to remind the crews. Once crews got used to the new device and saw the value of the real-time feedback we have had nearly 100% compliance.” Now, the organization provides focused CPR training every January, in which all personnel must complete at least two minutes of CPR while using the accelerometer. “Most of our crews are used to using the monitor screen for feedback on rate, depth and complete release,” Sullivan says. “We also have hands-on training two or three times a year that is station based.”

Pittsburgh’s approach also evolved over time. The organization first rolled out high-quality CPR during a quarterly paramedic/firefighter training. “We were switching from radically different monitor/defibrillators, so we had an initial 8-hour classroom training, but

found that we needed to supplement that,” Roth says. “We would go out, take a monitor and mannequin to the station, call the unit out of service, run through a couple of things.”

Recently, Pittsburgh has begun more focused training. “We know which fire companies are doing the most cardiac arrests, and we know their quality of CPR,” Roth says. “So for the crews who have lower CPR percentages, we’re calling them down to the training bureau to get additional CPR training. We present this as positive as opposed to punitive—more training as opposed to “you’re not doing so good.” We put a very positive spin on it, and it’s been well-received.”

Regardless of the training approach your agency takes, there’s an important lesson here: Training providers once is rarely enough. Rather, you must evaluate the effectiveness of the training, identify what’s not working and develop training that addresses the deficiencies. Rarely will you succeed on the first try—and even if you do, periodic refreshers are needed.



What Is Quality CPR?

Delivering high-quality CPR lies in understanding what high-quality CPR looks like. The six key factors are:

1. Compression depth of at least 2 inches.
2. Compression rate of at least 100 compressions per minute.
3. Allowing the chest wall to recoil fully between every compression.
4. Spending about 50% of the “duty cycle” of CPR actively compressing.
5. Limiting interruptions in CPR.
6. Ventilations of less than 10 per minute.

Unfortunately, knowing we need to perform CPR in this manner and actually doing it are two different things. “A JAMA study showed that the average compression rate is great, but with no feedback, the average patient ends up receiving just 18 effective compressions per minute,” due to some compressions not being deep enough and due to pauses in CPR, says John Freese, MD, director of prehospital research for FDNY. “That may help to explain the overall 3% survival rate to discharge for these patients.”

Another important training resource to consider is the Resuscitation Academy, sponsored by Seattle King County Medic One and the University of Washington. This program is offered free of charge; it provides evidence-based information and tools to improve cardiac arrest survival and opportunities for attendees to share the real-life challenges they face.⁵ Topics include high-quality CPR, the role of dispatch agencies, quality improvement analysis, and why a systems approach is needed to improve overall CPR patient survival rates.⁶

Both East Pierce Fire & Rescue and Mecklenburg EMS sent staff to the Academy. East Pierce sent 15 paramedics and officers (14% of the total workforce). “Sending a large number of members through the training helped develop a core group of resuscitation team ‘advocates,’ which has helped maintain organizational focus on improving cardiac arrest survival,” notes Assistant Chief Russ McCallion. “These advocates, most of whom were identified peer leaders in the organization, have helped spread the word about cardiac arrest resuscitation techniques. Overtime was spent putting members through the training program. Without a large group of informed, well-trained advocates, however, the department’s ability to make program improvements would have been slowed dramatically.”⁶

Resuscitation Academy tool kits are also available free of charge online for those agencies that can’t send personnel to the on-site academy. This is the approach Henderson (Nev.) Fire Department took. “The Resuscitation Academy really does provide a whole systems approach, and if you begin to implement what they’re recommending, you will see results,” Vivier says. “We’re the testament to that.”

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Step Five: Track, Refine, Repeat

Once you've trained providers and rolled out your CPR quality improvement program, the final step is to monitor progress. "We have registry data that goes back to 1998 in our community. We are in the process of looking back at this data to get a better sense of trends over time," says Dr. Mohamud Daya, Medical Director with Tualatin Valley Fire & Rescue in Oregon. "We have shown better CPR fraction over time as well as less interruption in CPR for intubation. Our overall survival percentage has improved from 4–5% in the late 1990s to 19% this past year. Using raw counts, we had 7 survivors in 2001 and 29 survivors in 2012."

Although part of your monitoring will focus on long-term metrics such as survival rates, it's also essential to employ a rigorous quality improvement/quality assurance (QI/QA) process to determine on a more specific scale what's working and what's not.

Fortunately, technology has made it much easier to perform QI on every arrest call. Software programs quickly capture and report out data in easy-to-read formats. The Henderson (Nev.) Fire Department uses Event Review Pro to review each cardiac arrest call. "The software provides something called the CPR scorecard, which measures fraction time, flow time, percent of compressions done correctly, average rate—all the parameters we need, and also gives us the ability to review the whole call," says EMS Division Chief Scott Vivier.

Mecklenburg (N.C.) EMS Agency also uses CPR feedback. "Data from this device is stored in the cardiac monitor and is available for post-arrest performance review," note several Mecklenburg leaders in a recent article. "Collecting this data system-wide was paramount for Medic to determine overall CPR performance and identify areas in need of improvement. A process was developed for all cardiac arrest data to be imported into a central database so individual and system-wide analysis could be performed."¹

QI is just one part of the equation. To be truly effective, the information needs to be shared with the crew. There are different ways to do this—providing them with a scorecard or a detailed report, or meeting in an "after-action" format. Your agency will need to find what works best for you.

"Recently we have expanded our QI feedback and began providing crews with a CPR Performance Report following each arrest, based on the data that is downloaded from the heart monitor," Daya says. "The report provides specific feedback on rate, depth and release as well as pre- and post-shock pause times. The goal is to get this back to the crews by their next duty shift so the call is still fresh in their minds. With time, we hope that some crews will also debrief themselves after a call by directly downloading the file."

East Pierce Fire & Rescue in Bonney Lake, Wash., provides detailed "case debriefs" for each witnessed v fib cardiac arrest call, allowing the crews who responded to a CPR call an opportunity to review and critique their own CPR performance. "These reviews, similar to After-Action Reviews for fire incidents, are an incredibly powerful training tool and invoke the competitive spirit of participants, to compare their performance statistics to other crews," writes Assistant Chief Russ McCallion.²

McCallion says case debriefs usually last about 45 minutes. Crews receive a scorecard and review the audio recording of the call while "watching" their CPR performance, which was cap-

tured by the Q-CPR device. “Crews have improved their performance dramatically as a result,” McCallion says. “Hands-off intervals for defibrillation are now in the 3–5-second range and flow time rates, which measure the percentage of time chest compressions were being delivered, routinely exceed 95%.”²

Depending on the size of your agency and how many cardiac arrests it responds to, performing a detailed case debrief for every arrest call can prove challenging. Leaders at Mecklenburg EMS note, “Providing retrospective feedback on more than 500 OHCA cases per year proved difficult due to the sheer number of providers performing CPR across different agencies during a variety of shifts in various locations. Initial attempts at feedback began with case debriefings by an education and quality specialist; however, this method was time consuming and inefficient.”¹

The agency is testing other approaches to giving feedback, including selective debriefing of calls. Perhaps more importantly, however, Mecklenburg’s providers showed increased interest in debriefing OCHA calls. “Employees wanted to know if the patient survived, how they performed and what they could do to improve next time ... administrators were starting to see a willingness to improve among the agency’s providers.”¹ This underscores the need to provide feedback in some way to the crews in the field.

CPR quality improvement is not something you do for a couple of years, achieve and move on to something else. It requires a sustained, focused commitment.

Vivier agrees. “The feedback loop is important; we feel it’s what helped solidify our results,” he says. “The medicine of CPR hasn’t changed, but what has changed is what good CPR is, and sharing that information with the crew so they can make changes.” He adds that precisely because cardiac arrests are a small portion of most EMS agencies’ call volume, it is possible to review each one. “You have to focus on reviewing every call and giving the feedback to the crews,” he says. East Pierce Fire & Rescue hopes to expand the number of cardiac arrest debriefs to include all witnessed cardiac arrest calls, rather than limiting debriefs to only v fib cases.²

Built into the feedback loop is the need for constant improvement. Evidence that your CPR improvement program is working should lead to new goals and initiatives. Tualatin Valley Fire & Rescue, for example, is now targeting the pre- and post-shock

pause and the impact of airway measures on CPR interruption. “To improve performance we are considering using mechanical CPR during transport and in prolonged cardiac resuscitation situations,” Sullivan adds. “We currently use audio and video feedback for training purposes and feel both may be just as valuable in reviewing actual incidents in the near future.” East Pierce Fire & Rescue is targeting some of these same metrics, and is striving for continuous CPR during intubation through the use of video laryngoscopes. Pittsburgh EMS is participating in a study to determine the effectiveness of continuous CPR vs. 30:2 CPR (30 compressions followed by two ventilations).

The bottom line: CPR quality improvement is not something you do for a couple of years, achieve and move on to something else. It requires a sustained, focused commitment. “You can have great change when you first implement training, but the important part is to keep up an intensity and passion for improvement,” Moore says. “When you get good numbers, it’s easy to start focusing on something else, other operations, logistics, etc. So we have to stay vigilant on our goal, which ultimately is having an increase in cardiac arrest survival.”

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Summary of Key Takeaways

1. **Improving survival rates requires a systems approach; improving CPR quality is one part of that.** Ron Roth, MD, medical director for the City of Pittsburgh Department of Public Safety, identifies many additional elements to improving OHCA survival than just CPR: pre-arrival CPR instructions, short response times, firefighters who can initiate BLS measures quickly, ALS response with transport capabilities, 12-lead EKG, therapeutic hypothermia, identifying receiving hospitals as STEMI centers. Strategic deployment of AEDs and robust public education is also key. “We know that it starts before the call,” says Henderson (Nev.) Fire Department EMS Division Chief Scott Vivier.

2. **Participating in a registry can help you track progress and benchmark against other organizations.** Joining a registry is a relatively simple step that can provide you with valuable data. It also helps advance the science of cardiac arrest response and EMS medicine.

3. **Be prepared to make an investment.** “Implementation of these comprehensive programs has required a commitment of resources, including the staffing of an EMS Division, whose personnel focus on improving EMS systems for patient care, as well as funding to provide high-quality training and to purchase appropriate technology, including 12-lead ECG transmission, Q-CPR feedback units and software to review cardiac arrest performance that is shared with crews,” notes Assistant Chief Russ McCallion of East Pierce Fire & Rescue.

4. **If you aren’t already using CPR feedback devices, your providers probably have significant room to improve their CPR technique.** It’s a tough pill to swallow, especially for veteran providers, but even highly trained professionals often under-perform in key areas, including allowing the chest to completely recoil, achieving correct compression depth, and applying the recommended number of ventilations.

5. **Technology is an essential part.** Ultimately, improving CPR quality is a data-driven task. Without employing technology—devices and software—to assist you, you will not be able to achieve much. “Even if it’s not the Q-CPR, technology to make sure that you’re doing good compressions is essential,” Vivier says. “And it’s extremely beneficial for real-time feedback.”

6. **Feedback is necessary but must be nonpunitive.** CPR quality improvement can’t happen in an agency where the providers don’t trust administration not to use data against them. To build trust, be clear about how data will be used and cite examples of how it’s currently used in other agencies. “It’s always about improvement, it’s never punitive,” Vivier says.

7. **Success requires commitment at all levels in the organization.** Scott Sullivan, EMS officer with Tualatin Valley (Ore.) Fire & Rescue notes the need for “support for the tools and the personnel required to collect, interpret and provide the feedback. You must make OHCA a priority in terms of the organizational mission.”

Further Reading



Driving the Course of Care

This three-part supplement series, sponsored by Philips Healthcare, was developed to give you a look into some of the many ways EMS is leading the pack in offering advanced monitoring and medical care in the field and driving additional advancements to receiving emergency departments.

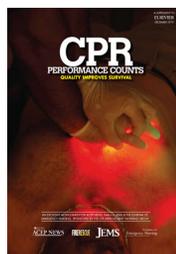
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Evolution in Resuscitation

This supplement walks step-by-step through the 2010 AHA Guidelines for CPR and the significant changes they involve in prehospital cardiac care with regard to compressions, ventilation, intubation and confirmation of a patient airway. Sponsored by the American Heart Association, Laerdal, Michigan Instruments, Philips, Physio-Control, Vidacare and ZOLL.

www.jems.com/special/evolution-resuscitation



CPR Performance Counts

This monograph alerts health care professionals to the disparity between how they perceive their performance and their actual CPR performance; and the role that retraining, monitoring and feedback play in the delivery of quality CPR. Sponsored by the CPR Improvement Working

www.jems.com/special/cpr-december-2010



Webcast: The Weakest Link: Using CPR Feedback to Improve Quality

John Freese, MD, presents the advantages of CPR feedback devices that capture data for quality control post-event review. You will also learn: 1) How to integrate CPR feedback devices into an EMS agency, including training and implementation. 2) Real-world examples of what code reports look like and how they were used for quality improvement. 3) Clinical studies that show how CPR feedback has improved patient outcomes.

www.jems.com/webinar/patient-care/weakest-link-using-cpr-feedback-improve