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Editor’s Note:

Cardiac arrest is one of the most common EMS calls for service in the United States. The American Heart Association estimates that there are 350,000 out-of-hospital cardiac arrest events each year.

This life-threatening condition requires quick intervention, including CPR, for the patient’s best chance of survival. It’s important to invest in continuing education to stay abreast of the latest protocols, techniques, tools and best practices for out-of-hospital CPR.

In this eBook, you’ll learn how new research provides criteria for higher-quality compressions, how to avoid hyperventilation and how one EMS agency transformed its CPR approach to gain a significant improvement in ROSC rates and patient outcomes.

– Kerri Hatt, EMS1.com Editor

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How to improve patient outcomes

By Shawna Renga

Each year, more than 350,000 out-of-hospital cardiac arrests occur in the United States [1]. About 90 percent of people who experience cardiac arrest outside of a hospital will die.

While the No. 1 predictive factor for surviving an out-of-hospital cardiac arrest is immediate bystander CPR, the actions of EMS providers once on scene also significantly affects the likelihood of a positive outcome for the patient.

By implementing a coordinated set of CPR protocols designed to reflect current best practices, agencies can dramatically improve survival for the patients in their care.

Several critical factors affect survival of out-of-hospital cardiac arrest, most of which can be influenced by EMS providers. Higher-quality compressions, effective ventilations and appropriate training and feedback are all areas of possible improvement for EMS agencies looking to influence cardiac arrest survival rates.

**Deliver higher-quality compressions**

For most EMS providers, the concept of high-quality compressions is not new. We are likely all familiar with the idea that CPR should be a...
coordinated effort, with good compressions and minimal interruptions. Current AHA guidelines of compressions at a rate of 100-120 beats per minute remain best practice, and most successful EMS systems utilize a coordinated, “pit-crew” approach to CPR to achieve higher survival rates for out-of-hospital cardiac arrest.

However, newer research provides additional criteria for higher-quality compressions that will improve chances of survival for patients in cardiac arrest. Active compression-decompression (ACD) CPR plus the use of an impedance threshold device (ITD) is considered a superior alternative to traditional CPR.

With ACD CPR, additional tools are used to dramatically increase blood flow through the heart and to the brain. ACD+ITD CPR uses a suction cup device to raise and lower the chest, along with an impedance threshold device to limit a rush of air into the patient on the upstroke of compressions.

This combination dramatically lowers both intrathoracic and intracranial pressure, allowing for increased venous blood flow from the brain back to the heart, and easier forward blood flow from the heart to the body [2].

Compared to standard CPR techniques, ACD+ITD CPR caused 50% more out-of-hospital cardiac arrest patients to survive with good neurologic function a year after hospital discharge [3].

Another interesting factor in achieving higher-quality chest compressions is a focus on not just the depth and recoil of compressions, but the speed at which the chest recoils. A slower “upstroke” on compressions, causing a slower recoil of the chest, was associated with decreased survival, even if the chest was allowed to fully recoil [3].

Faster chest recoil, whether achieved by manual compression or the use of ACD devices, is associated with improved cardiac output and an increased chance of achieving a return of spontaneous circulation [4].

Ensure appropriate ventilations

Despite receiving significant training on providing positive pressure ventilations, prehospital providers routinely hyperventilate patients in cardiac arrest [4]. The recommended ventilation rate of 10-12 breaths per minute is often exceeded, reaching up to over 30 breaths per minute in some studies [5]. This is problematic,

By implementing a coordinated set of CPR protocols designed to reflect current best practices, agencies can dramatically improve survival for the patients in their care.

as excessive ventilation rates are associated with significantly decreased survival rates from cardiac arrest.

Overventilation increases pressure inside the thoracic cavity, decreasing venous return to the heart and lowering cardiac output during CPR, thereby decreasing the chances that a return of spontaneous circulation will be achieved [6].

Agencies interested in improving out-of-hospital survival rates for cardiac arrest should consider investing consistent time and resources to provide continuing education to providers on proper ventilation techniques, as well as the dangers of hyperventilation. Use of an impedance threshold device, along with other monitoring tools such as capnography, can also aid providers in avoiding hyperventilation during resuscitative efforts.
Train for end-tidal carbon dioxide monitoring

The use of end-tidal carbon dioxide monitoring during CPR has long been considered best practice. End-tidal CO2 measurements during resuscitation are predictive of survival – low values reflect poor outcomes.

Continuous ETCO2 monitoring allows for a continuous evaluation of chest compression depth and efficacy, as quality chest compressions will typically produce an ETCO2 reading of 10-20 mm Hg during CPR. However, it may be beneficial to set a higher goal for ETCO2 measurements during resuscitation, as an average ETCO2 reading of 25 mm Hg is associated with a likely return of circulation [7].

This higher level of ETCO2 may be largely dependent upon factors outside of EMS personnel’s control, such as bystander CPR quality and total down time. However, avoiding hyperventilation, allowing for rapid chest wall recoil, and the use of ACD+ITD CPR may allow for improved blood flow and therefore higher ETCO2 readings during resuscitation.

Using continuous ETCO2 monitoring also allows for quick detection of return of spontaneous circulation, as an abrupt rise in end-tidal carbon dioxide is a specific marker of ROSC [8]. Continuous ETCO2 monitoring allows for the continuation of chest compressions and minimal interruptions for rhythm and pulse analysis, which yield more effective resuscitative efforts.

Improve outcomes through training and feedback

The most fundamentally effective strategy for improving cardiac arrest survival rates is a calculated and thoughtful training program and immediate feedback for responders caring for patients in cardiac arrest.

Lawrence-Douglas County Fire Medical revamped its cardiac arrest protocols in 2018 in an effort to improve patient survival and long-term outcomes. They launched the Cardiac Arrest Protocol for Excellence in May 2018. (image courtesy of LDCFМ)
The skills involved in cardiopulmonary resuscitation are perishable and require consistent practice to maintain effectiveness. The common two-year cycle of recertification in CPR training is woefully inadequate to maintain a proficiency in these skills, particularly as new equipment and research is released regularly that should inform training and practice [9].

Monthly or even bi-weekly training focused on the factors that influence survival – higher-quality compressions, ventilations, monitoring devices and a team approach – provides a critical opportunity to hone these skills before they are needed.

Real-time audiovisual feedback is also predictive of increased survival rates. Cardiac monitors that provide rate and depth measurements, chest recoil, ventilation rates and interruption timers provide valuable feedback to responders and allow them to make in-the-moment adjustments to their care. This feedback is critical to providing the consistent and targeted care required to achieve a positive outcome in cardiac arrests.

Investing time and resources into training and feedback creates an environment where caring providers have the ability to succeed, and patients are given the best chance for surviving an out-of-hospital cardiac arrest.

References


HOW TO IMPROVE CARDIAC ARREST OUTCOMES BY TAKING A ‘PIT CREW’ APPROACH

Pit crew CPR means that every responder has an individual assignment, but all work as a team to resuscitate the patient.

By Sarah Calams

Last year, a retired Lawrence-Douglas County (Kansas) Fire Medical Department firefighter suffered a cardiac arrest while at home. A fellow firefighter-paramedic responded to the call and found his former colleague in asystole. Crews worked the retired firefighter for about 13 minutes before terminating the resuscitation. Up until May 2018, this type of response was normal for the department because of the low frequency of achieving ROSC in asystolic patients.
Now, the department’s revamped cardiac arrest protocol requires crews to be on scene for at least 30 minutes, giving responders more time to work on patients – and, in turn, giving those patients a better chance to live.

**Taking a ‘pit crew’ approach**

Pit crew CPR is mirrored after the NASCAR crews who help get racecars back on the track quickly and efficiently. It’s not a new technique in EMS, but the approach is helping save countless cardiac arrest victims.

In EMS, pit crew CPR means responders have individual assignments but work as a team to improve cardiac arrest outcomes.

“Every person has a place, and every place has a purpose,” said Kevin Joles, division chief of EMS at Lawrence-Douglas County Fire Medical Department.

As a result, the department has implemented a checklist and a member of the team is assigned as a scribe during calls, making sure the appropriate steps are completed while on scene. “Everyone has a job, but sometimes their job is to just stand there and be ready for the next procedure,” Joles said.

For example, if crews are using a mechanical CPR device, one person may be an assigned battery changer. Manual compressions are performed when the mechanical CPR device is not in operation, and compressors rotate to minimize fatigue and the potential for inadequate chest compressions.

“It’s hard to stand there, but that’s the time where I encourage people to be more clinical than just task-based,” Joles said. “We don’t need to always be doing something. We can evaluate the patient clinically and anticipate what the next step might be.”

Standing there and watching, Joles said, is sometimes the best answer.

**Revamping a cardiac arrest protocol**

Joles, a 23-year fire service veteran, became the department’s division chief of EMS in November 2017. When he first arrived, Joles said crews were hyper-focused on putting patients on mechanical CPR devices.

“We weren’t doing high-quality manual CPR,” he said. “We had to change that mindset.”

Now, crews go hard and fast for at least two minutes of manual CPR before placing a mechanical CPR device on a patient.

“That has improved focus greatly,” said Joles.

Implementing high-quality CPR – whether it comes from manual or mechanical compressions – was the department’s first hurdle. Then, Joles said, it came down to re-educating responders on lifesaving equipment:

“In training, we went over keeping a seal on the bag-valve mask. We also went over using the ResQPOD impedance threshold device that ZOLL offers.”

The ResQPOD impedance threshold device delivers intrathoracic pressure regulation therapy during BLS or ALS CPR to help improve perfusion. Prior to his arrival, Joles said, crews either didn’t use the device at all or used it incorrectly.
Moreover, when the department originally implemented the ResQPOD device, Joles said providers did not receive adequate recurring training, and the device fell out of favor.

“We had that on the shelf for years,” he said, “but crews didn’t understand the science behind it.”

Crews were also reeducated on how to properly use ZOLL’s AutoPulse device, which helps compress a patient’s chest to improve blood flow.

“We reeducated on that during training and answered a lot of questions, mainly from people who had joined the organization after the initial implementation of the AutoPulse,” said Joles. “It was a real hurdle we didn’t know we had to jump over.”

Then, crews were reminded about the importance of seemingly small, but important, tasks.

“We talked about making sure you can still see the ZOLL monitor so that a rhythm can be seen,” Joles said. “You also want to make sure the compressor is doing quality CPR, whether that’s manually or mechanically, by using the CPR feedback device on the monitor.”

“We had four extra saves in just one week.”

– Kevin Joles, division chief of EMS at Lawrence-Douglas County Fire Medical Department
Finally, crews were trained on using equipment they hadn’t in the past – like the SpO2 probe and blood pressure cuff – to catch or capture return of spontaneous circulation. The importance of monitoring ETCO2 was also emphasized in the new protocol.

**Putting the protocol into service**

Although the department only runs about 70 codes a year, Joles said they are encouraged by the numbers and by crews’ willingness to implement a protocol that goes against everything they were previously taught.

“When we introduced it, crews were practicing every day in the firehouse,” Joles said. “You’d walk in the living room and they were on the floor practicing this new protocol, champing at the bit to put it into service.”

Some crewmembers were so eager that they put the protocol into service prematurely, he added:

“But we had four extra saves in just one week when it was put into service early.”

As part of the protocol, crews now stay on scene for at least 30 minutes.

“We’ve been known to stay on scene for 40 to 45 minutes, because we are giving these people a chance to live,” Joles said.

Additionally, crews are placing patients on a cot, allowing providers to intubate while standing up instead of crouching or lying on the ground. Because of this change, the department’s intubation success rates have gone up over the past year.

Crews are also raising patients’ heads by 30 degrees in order to decrease intracranial pressure.

“If they don’t have a ResQPOD impedance threshold device in place, the circulation loop isn’t closed, which equates to the patient receiving mini-concussions with every compression,” Joles said. “For example, with a compression rate of 80 per minute, it’s like giving a patient 80 mini-concussions a minute.”

And, thanks to the revamped cardiac arrest protocol, the department is seeing positive patient outcomes. Most notably, they have nearly doubled their ROSC rates, and patients have seen more positive neurological outcomes.

“Asystolic patients are getting their pulses back between 26 and 29 minutes,” Joles said. “We don’t want to give up on these people just because we’ve known in the past that asystole wasn’t commonly producing a perfusing rhythm. We’re not writing people off.”
Thanks to a revamped approach, Lawrence-Douglas County Fire Medical Department boosted its ROSC rates from 36 percent to 62 percent in less than a year

By Sarah Calams

When Kevin Joles became division chief of EMS at Lawrence-Douglas County Fire Medical Department just west of Kansas City, he accepted the position knowing that changes would need to be made in order to maximize the department’s present and future success.

Within the first couple of weeks, Joles had a page full of handwritten notes outlining outstanding tasks – both large and small – that either needed to be changed or implemented. After learning that the department’s ROSC rates were hovering around 36 percent, revamping a cardiac arrest protocol moved to the top of his list.

Creating a new cardiac arrest protocol

Joles, along with medical director Dr. Caleb Trent, sat down and ran the department’s ROSC numbers back to 2015.

“They weren’t crazy bad, but they also weren’t where I was expecting them to be,” Joles said. “I came from a pretty successful EMS system where the ROSC percentage was in the mid-50’s.”
On average, Lawrence-Douglas County Fire Medical’s ROSC rate was in the mid-30s, and they weren’t happy with that. While contemplating their next step, Joles and Trent attended an EMS conference and met with ZOLL representatives.

“We’re a ZOLL user here,” Joles said. “We sat there and talked about ideas, about what we could be doing better.”

Ultimately, the ZOLL representatives recommended that Joles and Trent connect with members of the Rialto Fire Department in California, which boasts a 71 percent sudden cardiac arrest survival rate.

After getting in contact with Rialto Fire, Joles invited their crews, who made the trip to Lawrence-Douglas County in March 2018 to share how they had improved ROSC and survival rates.

The first four hours of training, which was mandatory, focused on the science and background of improving cardiac arrest outcomes. In just that short time, Joles said, you could see a change in mindset and that it was quickly making sense to the providers.

An additional four hours of training put it all together, allowing providers to get hands-on practice by running scenarios.

In order to encourage buy-in from their crews, Joles and Trent worked to come up with a name for the program. Eventually, they came up with CAPE – Cardiac Arrest Protocol for Excellence – and the protocol was implemented in May 2018.

Implementing the protocol
According to Joles, the department’s biggest achievement was not implementing the protocol. Instead, it was changing the department’s mindset and culture.

“Everyone implements protocols. It’s not a big deal,” he said. “But getting people to do...
what you’re saying, especially when it’s totally opposite of what they have been taught – that’s huge.”

During training with Rialto Fire, Joles encouraged providers to question everything.

“We encouraged people to talk,” he said, “and they talked a lot.”

Another difference-maker was distinguishing certain members as CAPE champions.

“During training, we placed a CAPE champion at every table,” Joles said, “so, when crews sat down, they had someone who knew a little more about the program than they did. If someone had a question, they could answer it at the table. Or, if it was asked publicly, we could minimize repetition of the questions.”

Members of the department were also reeducated on how to use existing ZOLL equipment, including the ResQPOD impedance threshold device and AutoPulse.

Joles also stressed the importance of capturing a patient’s blood pressure while they’re on AutoPulse so crews have a blood pressure reading if they achieve ROSC.

Most importantly, Joles said, crews needed to be reminded about using ETCO2 to evaluate the patient’s status and recognize the next step in the protocol.

**Striking success**

As a result of the revamped cardiac arrest protocol, the department has gone from 36 percent to 62 percent ROSC – nearly doubling their rate from May 2018 to January 2019. But because their department is a small sample size – running about 70 codes a year – one code can change their percentage significantly.

“We are down in the middle 50s right now,” Joles said. He attributes this to the crews working longer to resuscitate people. “That counts against us when we’re not getting ROSC.”

The fluctuating numbers don’t discourage Joles, though. If anything, it’s having the opposite effect.

“I’m proud of the fact that we’re not giving up,” he said.

Currently, the department is in the process of reviewing and revamping all of their protocols – hoping to strike similar success to the CAPE program.

“We want to start by putting our protocols on an app,” Joles said. “That way, crews have the ability to look up the protocol on their phones.”

The department is also looking into cerebral perfusion analytics to broaden their knowledge for their cardiac arrest protocol.

“That way, we can measure brain activity during cardiac arrests while also being non-invasive,” he said.

But, at the end of the day, Joles said the department’s main goal is to just be better.

“We want to give our patients the very best care,” he said.
Resources

American Heart Association CPR Resources

ZOLL Medical CPR Overview

Lawrence-Douglas County Fire Medical

EMS1 on Cardiac Care

EMS1 on CPR

EMS1 on Capnography