Establishing a System of Cardiac Care

The Improvement

Thirty-eight percent of people stricken by sudden cardiac arrest (SCA) in Howard County, MD, survive to hospital discharge with no neurological impairments. That’s double the survival rate from before 2010, when the county’s Fire & Rescue Services teamed with other emergency healthcare teams to improve survival for cardiac patients.

In addition, door-to-balloon (D2B) times are under 72 minutes for STEMI patients treated and transported by EMS responders. That’s well within the 90-minute recommendation set by the American Heart Association (AHA) for percutaneous intervention (PCI), the definitive care for patients whose ECGs show ST-segment elevation. Furthermore, the current EMS arrival to balloon time is 99 minutes.

The region achieved these results by taking a team approach that partnered Howard County Department of Fire & Rescue Services (HCDFRS) responders with hospital providers to speed and choreograph patient care. The system measures performance and feeds data back so all members of the cardiac care team see how they make a difference.

Here’s how they did it.

Foundations of Care

HCDFRS serves a population of 290,000 in the Baltimore/Washington DC region, covering 262 square miles of suburban and rural communities. Cardiac emergencies are treated at Howard County General Hospital (HCGH), the county’s only hospital. It is a member of Johns Hopkins Medicine.

Success can be attributed primarily to three areas of focus:

- **Partnering** with HCGH to streamline care for STEMI patients from first EMS contact through reperfusion.

- Training all basic life support (BLS) and advanced life support (ALS) responders in **high-performance CPR**, with tightly choreographed response to cardiac arrest that maximizes uninterrupted chest compressions.

- Creating data-driven feedback loops by measuring performance and sharing the data—including patient outcomes—with all members of the care team. (Fig. 1) This shows responders the importance of their actions, such as capturing 12-lead ECGs in the field to identify STEMI and performing high-quality CPR as a well-tuned team.

Fig. 1 Letter from the HCDFRS Medical Director

Improvements in SCA survival and reduced D2B times for STEMI came out of recognizing and seizing opportunities rather than laying out a master plan in advance, explains Dr. Kevin Seaman, medical director of the county’s Fire & Rescue Services.

“Don’t put up walls,” advises Seaman, who holds board certification in emergency medicine. “Ask how can you partner with other organizations to get quantum improvements in care. Don’t be limited by thinking only about what you control directly.”

The Implementation

STEMI patient care provided the first opportunity for a significant leap in performance.
Early identification of STEMI and protocols to speed reperfusion

For Howard County, a turning point came in 2006 when a team from the hospital asked the EMS service for help in reducing D2B times for STEMI patients, in order to meet state benchmarks and allow the community hospital to continue performing PCI. “HC/Johns Hopkins said ‘We can’t do this without your help,’” remembers Seaman, who saw it as a chance to make a real difference in patient outcomes.

With two-hour D2B times common, “We knew we were going to have to streamline a process that allows us to identify in the field people with ST-elevation MIs,” recalls cardiologist George Groman, MD, FACC and co-director of the STEMI program at HCGH. It required a partnership with EMS so paramedics are trained, equipped and authorized to identify STEMI and activate the PCI interventional team from the field.

To speed care for patients who need balloon angioplasty, paramedics acquire 12-lead ECGs in the field, call a STEMI alert and activate the cardiac cath lab if the ECG shows ST elevation in a patient with a suspected MI. Howard County’s EMS providers have an 85-percent accuracy rate in identifying STEMI. Because hospital physicians have such trust in EMS staff, Groman says, the cath lab is mobilized even before the ECG is transmitted to the hospital for over-read by the interventional cardiologist.

ALS responders get training on STEMI physiology and identification as part of their annual recertification training, when selected educational STEMI cases are presented by a team that includes Groman, the hospital’s STEMI coordinator, and often the ED nurse manager and an interventional cardiologist.

Performing many actions simultaneously instead of sequentially is key. The paramedics’ STEMI Alert activates the hospital’s catheterization lab so the team can be ready when the patient arrives. HCFDRS frontline responders are equipped with Lifepak 12 or Lifepak 15 monitor/defibrillators, which can capture and transmit 12-lead ECGs to HCGH over the Lifenet System cloud-based data transmission network. Other support vehicles carry Physio-Control AEDs, either Lifepak CR Plus or Lifepak 1000 devices.

And with the Lifenet Consult iPhone application, remote HCGH physicians are able to securely view emergent patient data on their smart phone to speed critical decision making.

Provided the cath lab is fully-staffed, STEMI patients bypass the ED and go straight to the lab on arrival, accompanied by the EMS team. When possible, both BLS and ALS providers observe the catheterization and angioplasty procedure, an important part of the feedback loop.

“By activating the cath lab from the field, we’ve taken two sequential processes and made them simultaneous,” says Seaman. “Results have been phenomenal,” with D2B average time of 72 minutes.

“Were fortunate to have extremely well-trained interventional cardiologists motivated to come in at short notice, hospital administrators who realize that level of effort requires funding and make the funds available, a high level of trust between EMS, physicians and hospital administrators, and very dedicated EMS squad providers,” sums up Groman. “We take as careful a systems approach as we possibly can to meet the needs of patients in the community.”

Success with STEMI and post-cardiac arrest patients has prompted efforts to expand STEMI protocols to cardiac arrest patients with ROSC. Seaman explained, that the published literature shows that 50% or more of post-cardiac arrest patients have coronary narrowings or occlusions and may benefit from catheterization and intervention to relieve blockage. The 2013 American College of Cardiology/AHA guidelines for STEMI management recommend immediate angiography and PCI, when indicated, in resuscitated out-of-hospital cardiac arrest patients whose initial ECG shows STEMI.

STEMI feedback loop

The best protocols in the world don’t work without buy-in from all members of the care team. That’s why the feedback loop is key.

When EMS care is finished and the team returns to service, a provider fills out a STEMI form on the Fire Department’s intranet. That action pages key people in the Fire Department, who link the 12-lead and pre-hospital care report and feed it to the hospital.

A nurse designated as STEMI coordinator at the hospital consolidates EMS data with ED records (if any), cath lab report and hospital discharge summary. The STEMI coordinator also creates a time-tracking sheet with the time of diagnosis, D2B time and other key benchmarks and sends the succinct packet to HCFDRS EMS supervisors. Fig. 2 They meet with the EMS providers and go over the entire outcome for the patient.

Fig. 2 STEMI confidential feedback sheet
“It used to be that our providers felt 12-leads in the field didn’t make a difference,” Seaman says. “Now everyone from EMT to paramedic to the cardiology team feels they make a difference in what they do. There’s much better provider buy in, much better door-to-balloon times and it’s much better for patients.”

Tight choreography for each cardiac call

To significantly improve cardiac arrest survival, Howard County started by “learning from the best” and sent a three-person team in 2010 to the Resuscitation Academy run by Seattle’s nationally recognized Medic One and King County EMS.

Upon return, the team committed to action: adopt high-performance CPR, review and annotate every sudden cardiac arrest call, analyze data and give prompt feedback to EMS teams on their performance.

EMS Captain Dale Becker brought the High Performance CPR training to the crew of Station 8B, who practiced the techniques and made them their own. The “CPR Dance,” as the Howard County team learned at the Resuscitation Academy, emphasizes a team approach with pre-assigned roles based on level of training. Positions are rotated every 2 minutes to avoid rescuer fatigue and maximize uninterrupted quality chest compressions for the duration of the resuscitation.

On four of the next five cardiac arrest calls attended by rescuers trained in the “CPR dance,” the patient experienced return of spontaneous circulation (ROSC).

This provided great incentive to extend the training throughout the department, and Fire Chief Bill Goddard approved sending nine additional people to the Resuscitation Academy. “If you do something and get success, everyone is buoyed, and that small success helps you get to the next step,” Seaman notes. More than 90% of career personnel and 70% of active volunteers have been trained in high-performance CPR, with plans to extend training to the entire force.

To further reduce CPR interruptions, in 2011 HCDFRS piloted the use of video-guided intubation using the Glidescope, which improved endotracheal tube placement to 91% compared to 64% when traditional laryngoscopy was used and allows EMS to intubate a patient during ongoing chest compressions. Intubation while compressions are continuing helps to maximize the CPR fraction and survival from SCA.

Once ROSC is achieved, therapeutic hypothermia is initiated in the field, contributing to improved patient survival.

The new programs allowed Howard County to more than double SCA survival rates. The latest figures show 38% of patients with witnessed cardiac arrest and a shockable rhythm survive and are discharged from the hospital with no neurological impairments. For the decade before 2011 incomplete data is available on hospital discharge outcomes, but only 18% of patients arrived at the hospital with a pulse and blood pressure.

Review and rapid feedback on each SCA case

Anecdotes about saves are morale-boosting, but to know definitively that efforts are paying off takes consistent measurement, review and feedback.

The department hired an EMS data analyst who works with Seaman to perform detailed analysis of cases and track patient outcomes to hospital discharge. To capture and consolidate cardiac cases, Howard County uses Physio-Control CODE-STAT™ Data Review Software with Advanced CPR Analytics.

At the end of each cardiac call, medics transmit the code data on the LIFEPAK monitor/defibrillator via the LIFENET System to the EMS service’s CODE-STAT database. The LIFENET System then sends an alert to the data analyst to let her know a case is ready for review.

The analyst works with Seaman to annotate the record, such as noting the start and end of the cardiac arrest call, verify that the record is correct (such as looking for waveform artifact that is falsely recorded as compressions, and crediting compressions that are not recognized by the program) and noting ROSC (if any).

![Fig. 3 Actual HCDFRS CPR report generated from CODE-STAT software, which is part of the QI feedback sent to the EMS provider](image)

The CODE-STAT software creates a progress report (Fig. 3) showing CPR fraction ratio (percentage of time that CPR is performed during the total time on call) and compressions per minute.

As soon as patient outcome results from the hospital are available, they are combined with the annotated record and the quality improvement feedback is sent to the EMS provider.

Statistics on hands-on chest compressions are currently available for each call. Fire & Rescue is working to analyze data for the entire system to measure, for example, system averages for CPR fraction.

Plans call for posting completed cases (including patient data) more quickly to the database so EMS providers could access the report back at the station within a couple of hours of the call. “That would get the crew talking,” Seaman says. “That’s where we want to be.
“With department averages and a quicker feedback loop it becomes almost self-study. As an EMS provider, you’d see here’s where you are, here’s the department average, here’s the target performance, and ask yourself what do you think you can do to improve?” Seaman adds. “The crews are in the best position to evaluate their own performance and decide what to change to continue to improve the care they provide, with the result of improved outcomes for patients.”

Keys to Success

- Implement the “CPR dance” so BLS and ALS teams are tightly choreographed and CPR interruptions are minimized.
- Equip EMS responders with monitor/defibrillators capable of transmitting 12-lead ECGs and helping them identify STEMI in the field.
- Share data securely ASAP so instead of next steps, you’re performing simultaneous steps.
- Analyze and annotate the data from cardiac calls so you can measure performance and provide meaningful information to team members.
- Consolidate and centralize your data, so patient records combine diagnosis, treatment and patient outcomes from first EMS contact through hospital discharge.
- Give feedback as quickly as possible so team members see how their own performance makes a difference. That’s how you’ll win buy-in and spur improvements.
- Put timesaving protocols in place, so once STEMI is identified in the field, the cath lab team is activated and EMS delivers the patient straight to the cath lab. LIFENET sends simultaneous alerts to multiple team members (cardiologist smart phone and ED computer).

Parting words of advice

“Patients want good care and they don’t care what uniform you’re wearing as long as you give it,” says Seaman. “That care doesn’t stop when we deliver them to the hospital door. We have to focus on the care that bridges out-of-hospital and hospital.”

The Tools

LIFEPAK® 15 and LIFEPAK 12 monitors/defibrillators, which can capture and transmit 12-lead ECGs, are carried by Howard County Fire & Rescue Services front-line responders. In addition to transmitting 12-lead ECGs, the devices automatically capture continuous ECG waveforms and impedance data that can be sent from the LIFEPAK device through the LIFENET System wirelessly.

LIFEPAK CR® Plus AEDs and LIFEPAK 1000 defibrillators are carried by Fire & Rescue support vehicles. In addition, 60 Physio-Control AEDs are carried by police and 82 of the devices are placed in community venues as part of Howard County’s public access defibrillation (PAD) program.

LIFENET® System, Physio-Control’s cloud-based data management network, automatically sends alerts to team members and routes data (from LIFEPAK monitors/defibrillator and other sources) to the appropriate CODE-STAT database.

CODE-STAT Data Review Software with Advanced CPR Analytics receives the data from the LIFENET System, allowing the data analyst to review and analyze the code data. The software generates a succinct report of a cardiac arrest call, with chest compressions superimposed onto the patient’s continuous ECG report. The report also shows CPR fraction time and compressions per minute. The software can also provide summary reports for specific time periods (i.e., monthly or yearly) to quickly identify statistics for a given period.

Howard County Department of Fire and Rescue Services (HCDFRS) serves a population of 290,000 over 262 square miles of suburban and rural communities in the Baltimore, MD/Washington DC region. The career fire department is comprised of nearly 400 dual-role, cross-trained providers at both the BLS and ALS levels. An additional 600 (approximately 200 operationally active) volunteers supplement the career responders. Dr. Kevin Seaman is the department’s full-time medical director.

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