The Improvement

One of the busiest emergency medical response systems in the world, the London Ambulance Service (the Service) has doubled survival rates for sudden cardiac arrest patients in just four years, in partnership with London hospitals.

In 2011-12, the Utstein survival rate—for patients with a witnessed cardiac arrest due to presumed cardiac cause where the initial rhythm is ventricular fibrillation (VF) – was 32%, the highest in the UK and among the best in Europe. Over the past five years, Utstein survival rates for out-of-hospital cardiac arrest have increased from 12% to 32% (Fig. 1).

Foundations of Care

To achieve such impressive gains in survival, the Service focused across the chain of survival to:

- Quickly identify patients suffering the most lethal type of heart attack, ST-segment elevation myocardial infarction (STEMI), identified by ST-segment elevation on a 12-lead ECG, which indicates a blocked coronary artery.
- Take STEMI patients directly to a designated Heart Attack Centre (HAC), even if it means bypassing closer hospitals. HACs are staffed 24/7 by cardiologists and equipped to provide advanced cardiovascular treatment, including balloon angioplasty to open a blocked artery.
- Provide high-quality CPR and defibrillation without delay for patients suffering a cardiac arrest.
- Robustly manage patients with return of spontaneous circulation (ROSC), including staying on scene to stabilize patients and capturing 12-lead ECGs to identify STEMI patients who need direct transport to a HAC.
- Turn bystanders into the first line of defense by placing public access defibrillators in the community and training people to recognize a cardiac emergency, perform CPR and use a defibrillator.
- Use data to drive improvements and share patient outcomes with responders so they see how their actions make a difference.

“Years ago we assumed that every patient who suffered a cardiac arrest died,” says Mark Whitbread, Consultant Paramedic, who oversees major clinical strategies for acute cardiac care at the Service. “In the last three or four years it has all come together and we now have 32% survival. The question now is, where do we go next?” asks Whitbread, who has a Master’s degree in cardiology and reports directly to the Service’s Medical Director.
The Implementation

Base protocols on clinical evidence

In setting protocols, the Service is guided by the European Resuscitation Council (ERC) guidelines and UK Department of Health standards. In addition, the Medical Director's office independently evaluates clinical research and adopts practices that work best in the densely populated area it serves.

Identify STEMI and speed access to angioplasty

When Whitbread was asked to help the Service improve its cardiac arrest survival in 2000, he advocated practices based on clinical evidence: direct access to a cardiac catheterization lab for heart attack patients with STEMI, rather than administering clot-busting drugs at the closest Accident and Emergency (A&E) Department.

That practice was not yet an official guideline of the ERC in 2006, when the Service adopted the protocol.

“In the UK that was considered a radical move,” he says. “But clinically it was a proven therapy. We got two hospitals on board and quickly the others followed.”

Ambulance crews—both Emergency Medical Technicians (EMTs) and paramedics—acquire and interpret 12-lead ECGs in the field (Fig. 2). If they identify STEMI, they activate the cath lab while transporting the patient directly to one of eight designated HACs in the capital. There’s no physician over-read or consultation.

“The ambulance world was very worried, but we proved them wrong,” he says. “Bypassing A&Es with time-critical patients makes people nervous. But there’s no need to be nervous if you’re taking patients to the right place.”

Treat cardiac arrest with high-quality CPR and early shocks

More recently, the Service has focused on improving on-scene treatment of cardiac arrest, with an emphasis on fast, deep chest compressions. The Service is working on more tightly choreographed on-scene response, with checklists to be sure all steps are covered. Crews are now encouraged to remain on scene until ROSC is achieved.

Procedures also have changed to speed defibrillation, such as using defibrillators in manual mode to enable shocks to be delivered without delay, in recognition of ERC 2010 guidelines.

The Service recently adopted a new protocol to use 360 joules for the initial shock, says Whitbread, because “It’s better to go in with a big dose the first time.” He is guided by research showing that even at higher energy levels biphasic shocks won’t harm the myocardium.

Robustly manage patients after ROSC

In 2008, the Service strengthened its post-resuscitation practices. Before conveying resuscitated patients to the hospital, crews stabilize the patient’s condition.

Once ROSC is achieved, 12-lead ECGs are acquired and patients with STEMI are taken directly to a HAC. In September 2010, the Service became the first to implement a protocol to transport patients directly to a HAC if they experienced ROSC following an out-of-hospital cardiac arrest and had an initial rhythm of VF.

Expanding the STEMI protocol in 2011 to include resuscitated patients with any initial rhythm triggered a marked increase in the number of patients taken directly to these specialty cardiac care centres have an overall survival rate of 63%.

The Service is undertaking a trial of prehospital therapeutic hypothermia, administering cold saline to patients who have been resuscitated but remain unconscious. The Service also is evaluating the LUCAS® 2 mechanical chest compression system.

Train, equip and support EMS responders

To identify STEMI in the field, ambulance crews—all 1,700 paramedics and 800 EMTs—are trained and equipped to acquire and interpret 12-lead ECGs. Crews get ECG refresher training annually.
EMS activates the cath lab from the field and heads to the nearest HAC, without transmitting the ECG or getting a clinical consult.

“'I want technicians and paramedics to have ownership of care," Whitbread says. "I don’t want it to be done by pressing buttons’ (to transmit an ECG for over-read by a physician).

Ambulances are equipped with LIFEPAK® 15 monitor/defibrillators, while smaller vehicles (including bicycles) carry LIFEPAK 1000 AEDs. The Service operates roughly 740 LIFEPAK 15 devices and an equal number of AEDs.

As practices are updated to reflect new guidelines or clinical evidence, crews train on the new initiatives. The Service is introducing training to more tightly choreograph on-scene response to cardiac arrest calls and is beginning to incorporate checklists for responding crews. Training is reinforced by clinical bulletins that incorporate current ERC guidelines.

A linchpin of the programme is the trust in EMTs and paramedics on the scene, and the support provided to them. Field crews can consult a clinical hub at the emergency operations centre that is staffed by experienced paramedics and a flight paramedic, accessible by radio or telephone 24/7.

Crews strive for excellence; perfection is not expected.

“When we do training," explains Whitbread, “to instill confidence we say ‘You will get it wrong. We’re expecting you to get it wrong’ (some of the time). Each HAC knows that 10 to 15% of the time activation will be incorrect. That’s not an issue provided it’s on the side of safety. It’s a safety net—not a fault in the system.”

If the STEMI call is a false positive, the patient taken to a HAC gets defibrillators, says Whitbread. “We're expecting you to get it wrong” (some of the time). Each HAC knows that 10 to 15% of the time activation will be incorrect. That’s not an issue provided it’s on the side of safety. It’s a safety net—not a fault in the system.”

The Service oversees 30 community responder and co-responder programs, where volunteers are trained to provide the first care in a medical emergency.

“Because we have a big databank of cardiac arrest information, we know where cardiac arrests occur, so we know where to place the defibrillators.”

— Mark Whitbread

More than 1,000 defibrillators are positioned in public places, including underground stations. These community-based devices were used 31 times in 2011/12. Some of the defibrillators are provided by the Service with funding from the British Heart Foundation. Businesses and community organizations pay for the others.

“Because we have a big databank of cardiac arrest information, we know where cardiac arrests occur, so we know where to place the defibrillators,” says Whitbread.

Some 8,000 community responders have been trained to use the defibrillators and provide CPR and first aid.

Bystanders provided CPR in more than 64% of cardiac arrest calls in 2011-2012. Emergency Medical Dispatchers (EMDs) instruct 999 callers to deliver 600 initial non-interrupted chest compressions. To improve the effectiveness of compressions, EMDs count aloud to 100 beats per minute in time to a metronome.

Set goals and measure performance

The Service maintains an extensive registry of cardiac arrests, with data going back to 1998. The databank includes patient demographics, bystander interventions, cause, initial rhythm, response times and survival to hospital discharge.

Like ambulance services throughout the UK, the Service is required to report to the Department of Health each month on cardiac arrests, including data related to ROSC, STEMI and system performance. The Service also verifies patient outcome data with area hospitals to ensure accuracy.

The metrics that are tracked include 999 call-to-arrival time (6 minutes on average in 2011-12); arrival on scene to defibrillation (4 minute average), and call-to-balloon time (the Service met the 150-minute standard 93% of the time, with an average call-to-balloon time of 107 minutes). The Service also tracks whether patients are conveyed to the correct type of facility, HAC compared to hospital A&E. In 2011-12, 99% were taken to the appropriate destination.

To date, crews have not routinely downloaded data from the defibrillators, so the Service currently has not been able to assess CPR quality or give responders feedback on the quality of resuscitation efforts. The Service is experimenting with using moderns on the LIFEPAK 15 defibrillators to automatically transmit device data. “We have to aim to download at least 75% of the cases so we can provide crews with feedback and look at the quality of CPR,” Whitbread says.

Cooperation from hospitals on reporting patient outcomes helps the Service monitor resuscitation efforts and let staff know how clinical practice is positively impacting patient outcomes, through bulletins and presentations at meetings.

Parting advice

“Everything we do regardless of money, regardless of politics, has to be in the patient’s interest,” says Whitbread. “Otherwise there’s no point in doing it.”

Keys to Success

Whitbread identifies these elements as crucial to creating the model system:

• Take a system approach, with initiatives across the Chain of Survival.

• Create lifesaving protocols based on solid clinical evidence, particularly direct access to angioplasty for those who need it.

• Train and equip ambulance crews to deliver best practices—such as performing high-quality CPR, identifying STEMI and activating the cath lab from the field.
- Teach the public to recognize and provide initial care in cardiac emergencies—including a lifesaving shock.
- Set goals, measure performance against them and always look for ways to improve.

Video interviews with Whitbread, paramedics and EMTs from the Service, NHS clinicians, as well as survivors themselves, can be seen at: www.codestemi.tv

The Tools

The LIFEPAK® 15 monitor/defibrillator continuously monitors all 12-leads and alerts responders to changes in the patient’s condition with ST-segment trend monitoring. The entire LAS ambulance fleet is equipped with LIFEPAK 15 devices. In paddles mode, the devices automatically capture continuous ECG waveforms and impedance data showing chest compressions and ventilations. Its capnography monitoring gives real-time feedback on chest compressions and ROSC.

LIFEPAK 1000 defibrillators are carried by responders in response cars, motorbikes and bicycles. More than 900 of the devices are deployed throughout the capital city. The large screen displays graphics and ECG readings that are clear and easy to read.

CODE-STAT™ Data Review Software with Advanced CPR Analytics is a powerful tool for collecting and accessing information on critical measures, strengthening the feedback loop with EMS teams. The Service is working to improve data download from LIFEPAK devices to a central database to better assess CPR quality and determine areas for improvement. The software can generate a succinct report of a cardiac arrest call, with chest compressions superimposed onto the patient’s continuous ECG report. The software can also provide summary reports for specific time periods.

About London Ambulance Service NHS Trust

One of the busiest ambulance services in the world, the London Ambulance Service covers the 620 square miles of Greater London and serves a population of 8.2 million people (Fig. 3). Last year its control room received 1.7 million emergency calls. Frontline staff in ambulances and cars, on motorbikes and bicycles attended 1.2 million incidents. More than 5,000 staff work for the Service, based in 70 ambulance stations around the capital.