When quality counts – Lessons from New York

This year marks the 55th anniversary of Resusci Anne, the world's most famous life-sized resuscitation manikin, who was created by Asmund Laerdal to help teach people CPR. Since the 1960s, how we practice CPR has changed very little but advances in technology used in conjunction with a manikin shows that improving the quality of CPR can increase survival rates.

Jon Laerdal

Jon Laerdal is the Managing Director of Laerdal Medical UK. Laerdal Medical is a global corporation dedicated to helping save lives through the advancement of the cause of resuscitation and emergency care.

To help us deliver quality CPR, Jon Laerdal, Managing Director of Laerdal Medical UK, talks through the evolution of CPR and how firefighters in New York have helped improve out of hospital Sudden Cardiac Arrests (SCAs) survival rates.

CPR through the years

It may be surprising to learn that CPR is a young science. It was only in 1956 that US Chiefs of Anesthesiology, Dr. Peter Safar and Dr. James Elam conducted research studies, which confirmed that life-saving resuscitation could be performed with expired air by mouth-to-mouth ventilations. The problem that lay in its application was how to train people in this skill.

In 1958, Dr. Peter Safar presented his findings at a conference of Scandinavian anaesthesiologists in Gausdal, Norway, also attended by Bjorn Lind from Stavanger Hospital (Laerdal's home town). Aware of the difficulties of training this mouth-to-mouth skill, it struck Lind that Stavanger's own publisher and toymaker should go to the US to meet with Dr Safar to discuss the making of a manikin. Following the 1958 conference, the resuscitation debate quickly gathered momentum and the next significant milestone came from Dr. James Jude, Dr. Guy Knickerbox and Dr. William Kouwenhoven in the US, who discovered that external chest compressions could provide circulation of blood to the brain when the heart stopped beating, and increase greatly the possibility of revival.

My grandfather, Asmund Laerdal applied all his efforts to making a complete CPR training manikin for use to practice artificial ventilation and external chest compressions. The result was Resusci Anne. To date, it is estimated that 400 million people worldwide have been trained in CPR on this iconic manikin.

As time has progressed, CPR delivery has fundamentally remained the same but the resuscitation community has developed technology that now gives us a deeper insight into how the quality of CPR can be better and save more lives.

What is Quality CPR?

Going back to basics, CPR is a first aid technique that can be used if someone is not breathing properly or if their heart has stopped. The American Heart Association (AHA) describes quality CPR as a way of providing healthcare providers and healthcare systems with a tangible framework to maximise the delivering of the technique. The AHA has developed four practical metrics to support the implementation of the 2010 AHA Guidelines for CPR and ECC. The metrics used for quality CPR are:

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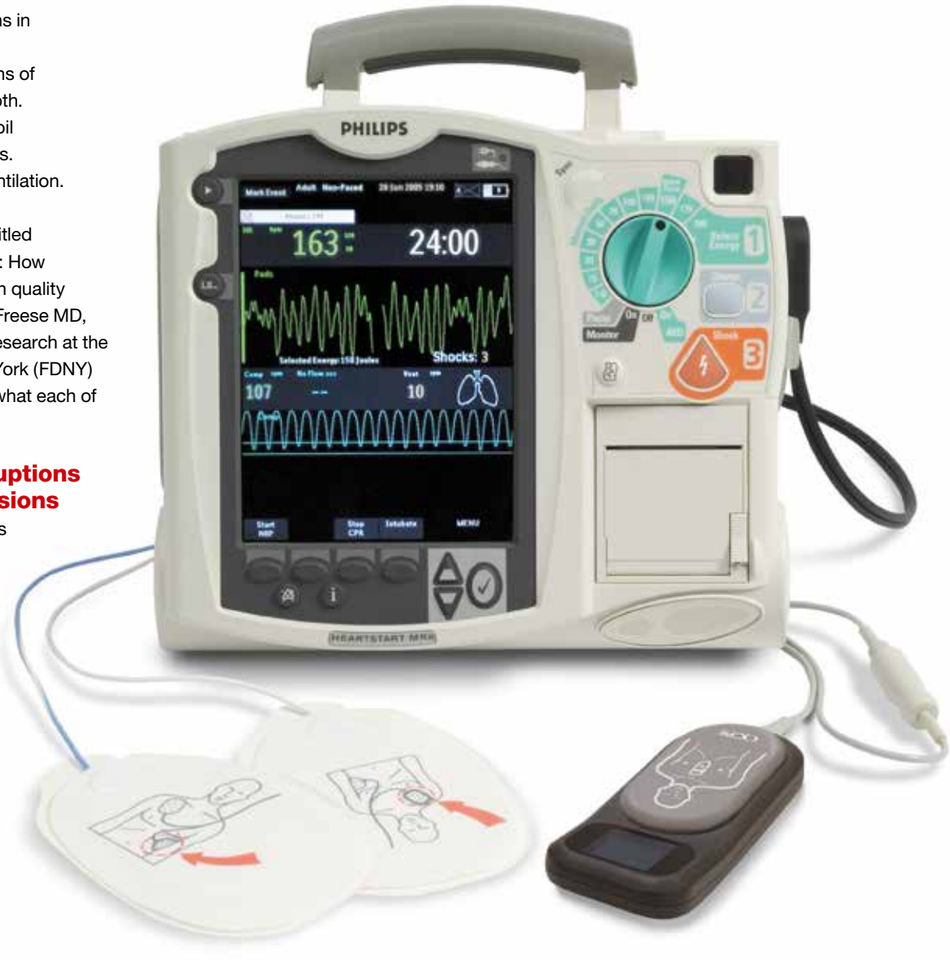
- Minimizing interruptions in chest compressions.
- Providing compressions of adequate rate and depth.
- Allowing full chest recoil between compressions.
- Avoiding excessive ventilation.

In his excellent article entitled "Resuscitation in the City: How technology helps maintain quality CPR in New York." John Freese MD, Director of Prehospital Research at the Fire Department of New York (FDNY) describes in clear terms what each of these metrics mean.



Minimizing interruptions in chest compressions

Don't stop: Compressions are frequently "held" for airway management, pulse checks, rhythm interpretation and patient movement, as well as to change provider roles, charge the defibrillator and defibrillate. But the interruption of chest compressions reduces perfusion and survival. This means limiting the interruption of chest compressions, ideally to no more than 10 seconds.

Providing compressions of adequate rate and depth

Not too fast, not too slow, but just right: Just right seems easy enough to define. Too fast and the heart won't fill sufficiently, and there will be no blood to move forward. Too slow and the heart will fill but won't move that blood sufficiently to maintain effective circulation. The 2010 AHA Guidelines support the recommendation that compressions be delivered at a rate of "at least 100/minute."3 But they also support the concept that compressions can be too fast and probably shouldn't exceed 120 per minute. And so our "just right" rate falls within that range of 100–120 compressions per minute.

Just deep enough: The 2010 AHA Guidelines recommend that compressions be delivered at a depth of "at least 2 inches." And reviewing the aforementioned worksheets, it's clear that the depth should probably not exceed 2.5 inches.

Allowing full chest recoil between compressions

Don't lean on the chest, just press on it: Even the slightest bit of leaning on the chest between compressions can result in positive pressures that eliminate this natural "pull" and can prevent blood returning to the chest. The chest wall needs to fully recoil after each compression for CPR to be effective.

Avoiding excessive ventilation

One and two and … : The use of a cadence like this isn't coincidental. It accomplishes an important final goal of delivering chest compressions with the appropriate rhythm, maintaining the appropriate duty cycle, which is the percentage of time spent pressing downward during each compression. Said another way, it's the percentage of time you spend applying pressure to the chest in order to deliver the compressions. Ideally that percentage will fall between 40–50% of the compression time, and the use of a cadence (out loud or in your head) will help achieve that percentage. However, many providers might not need the cadence because delivering 100–120 compressions per minute actually produces a natural duty cycle of ~50%. So attention to one aspect of compressions (rate) may actually help to define quality in this area as well.

Is Quality CPR being delivered?

There are numerous studies showing that quality CPR is not being delivered as extensively as it should. In a ROC study

published in 2012 which examined the CPR delivered by rescue personnel 90% of them did not comply with the guidelines compression depth.

How do you know you are delivering quality CPR?

In order to know you are delivering quality CPR, it is critical to measure the different elements of the technique as the old adage goes “if you don’t measure it, you can’t improve it”.

The 2010 AHA Guidelines not only developed the five metrics for delivering quality CPR but also examined the potential benefits of real-time CPR prompting and feedback. In fact the guidelines specifically stated “This process of quality improvement consists of … (1) systematic evaluation of resuscitation care and outcome, (2) benchmarking with stakeholder feedback, and (3) strategic efforts to address identified deficiencies.” This is where technology begins to play its part in delivering quality CPR.

The FDNY Experience

In New York City, cardiac arrest patients are transported only to cardiac arrest centres, which are hospitals that have partnered with the FDNY to provide therapeutic hypothermia and are required to provide outcomes and other data points for all cardiac arrest patients. This data is added to prehospital data and is combined with the CPR performance data derived from an Advanced life Support (ALS) monitor—the Philips HeartStart MRx and its Q-CPR technology. This master data allows the department to analyse the various aspects of CPR performance to establish benchmarks that reflect “quality CPR” and that are defined by their likelihood to improve cardiac arrest outcomes.

In a paper presented at the Resuscitation Science Symposium (ReSS)[1] in 2014 John Freese described the results of adding real-time CPR feedback to advanced life support defibrillator/monitors. The paper concluded that adding real-time CPR feedback to a large urban EMS system’s resuscitation care resulted in significant improvements in immediate survival.

In conclusion

The core components of CPR are still as relevant today as they were when first practiced in the early 1960s. The depth, rate and frequency of our compressions have changed as we have learned to perfect our skills and deliver quality CPR. Combined with advances in technology numerous research papers have shown that immediate survival rates from out of hospital cardiac arrests can be improved to the ultimate benefit of patients.

For further information, go to www.laerdal.com

Reference

1. Abstract 72: Addition of Real-Time CPR Feedback Improves Immediate Outcomes for Out-of-Hospital Cardiac Arrest. www.circ.ahajournals.org/content/130/Suppl_2/A72