

CPR REVIVED

NEW RESEARCH DEMONSTRATES
THE IMPORTANCE OF CPR QUALITY



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program delivers the right message
to the right people

COVER PHOTO COURTNEY MCCAIN

The Guardian Angel of CPR

By A.J. HEIGHTMAN, MPA, EMT-P

Recently, while watching *Grey's Anatomy*, ABC's show about surgical residents in a fictional Seattle hospital, I witnessed two horrific examples of CPR: In the first case, a paramedic "riding-the-rail" of the cot performed one-handed CPR. In the next scene, a young surgical resident attempted to resuscitate the victim while standing next to a hospital gurney and compressing the victim's chest at a 45° angle, much like a short cook stuffing a turkey on a tall kitchen counter (demonstrated in the photo on p. 5). While the poor-quality CPR disturbed me, the fact that ABC's technical advisor allowed these scenes to pass muster disturbed me even more.

Research shows that poor quality CPR is performed every day on the street, in hallways, on stairways and in ambulances. Much of it goes unnoticed, but some systems now study their crews' performance. The results confirm what many of us have known for years: Poor CPR yields poor resuscitation results.

Often, when we think we're compressing correctly, we hold back a bit, perhaps out of a subconscious fear of breaking ribs. And although we pass our CPR exams on a stationary manikin, when moving awkwardly down a narrow hallway, we don't compress at the proper rate and depth, and we fail to ventilate our patients acceptably. Add fatigue to the mix, and it's no wonder resuscitation rates are stagnant.

Research shows that poor quality CPR is performed every day on the street, in hallways, on stairs & in ambulances.

I recently had my CPR performance tested on a stationary manikin. I thought I performed perfect CPR, but in fact failed to allow the chest to rise completely after each compression. How am I so sure? Because an invisible assistant (manifested by electronic voice and visual coaching) guided my performance like a guardian angel sitting on my shoulder.

Q-CPR™ measurement and feedback technology, developed jointly by Laerdal Medical and Philips Medical Systems and built into the Philips HeartStart MRx ALS Monitor, electronically evaluated my performance in real time and provided instant feedback, allowing

me to correct my technique and deliver care within clinically acceptable parameters. The small, figure-eight shaped Q-CPR™ sensor, placed on the sternum and connected to a HeartStart MRx, performed like a field instructor along for the ride.

The "Q" in Q-CPR™ stands for "quality," and, true to its name, the device instructed me to deliver quality CPR. If I compressed too slowly or quickly, an electronic voice message told me to "compress faster" or "compress slower." When I purposely compressed in a shallow manner, it promptly told me to "compress deeper."

In addition to the audible reminder (which can be turned off if desired), representations of each compression and ventilation appeared on the large monitor screen, helping me perform within AHA parameters. The Q-CPR™ technology, like cardiac monitoring, works best in a stationary environment, and as always the medic's own experience and judgment come into play when relying on tools in a moving ambulance. Of course, there's currently a debate about whether we should be performing CPR in a moving ambulance at all (see December Tricks of the Trade), but that's a subject for future discussion.

Paramedics and nurse anesthetists in Sweden, England and Norway tested Q-CPR™ before its introduction in the United States. Early results show a dramatic improvement in CPR quality.

JEMS is pleased to bring you this editorial supplement, *CPR Revived*, presenting the current research on effective CPR and introducing you to a new technology that can help you perform optimal CPR in the field. Most importantly, we hope the articles drive home the importance of getting "back to the basics" and taking steps to ensure quality CPR delivery.

A.J. Heightman is the editor-in-chief of *JEMS*.

Where We Fail

Research reveals our weaknesses
in CPR delivery

By ELIZABETH A. CRISS, RN, MED

Since Biblical times people have looked for ways to revive the dead. It is told in 2 Kings, Chap. 4, v. 34, that Elijah "... went up, and lay upon the child, and put his mouth upon his mouth, and his eye upon his eyes, and his hands upon his hands; and he stretched himself upon the child; and the flesh of the child waxed warm."¹ But despite Elijah's positive outcome in this story, not much progress had

been made in the way of survival from cardiac arrest for more than 1,900 years until, in 1891, Dr. Friedeich Maass successfully performed external chest compression on a human, to be followed by the first successful resuscitation using external chest massage in 1903 by Dr. George Crile.² It wasn't until the early 1950s when the research team of Drs. Peter Safar and James Elam made the biggest leaps forward by

demonstrating that expired air could provide adequate oxygenation, to be followed in 1954 by the delivery of mouth-to-mouth resuscitation with predictable results.^{3,4} Then, in 1960, when Dr. Kouwenhoven et al perfected the technique for closed-chest massage, the last piece of the puzzle was put into place. Modern cardiopulmonary resuscitation (CPR) was born, and consistent results were finally achievable.⁵



PHOTO MARK C. IDE

Before changes are made to the CPR guidelines, more emphasis should be placed on simplifying the way CPR is performed.

than 300 cardiac arrests, evaluating the quality of the CPR that bystanders provided.⁹ They classified CPR as “good” if a femoral or carotid pulse was palpable during compression and if chest rise could be seen with ventilation. This group found that survival to discharge was about 25% when good bystander CPR was performed prior to hospitalization. If the CPR was classified as “bad,” the rate of survival dropped to 1%, and for those patients who received no bystander CPR the rate of survival was 6%.

In 1995, Gallagher et al replicated Wik’s work in an effort to determine if CPR quality was an independent indicator of survival to discharge.¹⁰ The criteria for determining effective vs. ineffective CPR was the same as that used by Wik et al.⁹ In this study, 662 of 2,071 cardiac arrest patients received bystander CPR, with an overall survival rate of 2.9%. In the group that received bystander CPR, 4.6% had CPR performed effectively and were found to have a survival rate of 4.9%. The survival rate for those who received ineffective CPR was found to be 1.4%. Evaluated in Sweden in 2000, Holmberg et al found that bystander CPR increases the

So how consistently are individuals able to resuscitate unconscious/unresponsive victims outside the hospital with CPR? Since these techniques have been around for more than 45 years and most people are aware of the need for early CPR, the numbers of survivors should be increasing with each generation. Unfortunately, that hasn’t been the case; in fact the frequency of bystander CPR has steadily declined.⁶ Despite significant research on CPR, the rate of survival from out-of-hospital cardiac arrest has not significantly improved in the past 30 years.⁷ There are probably several reasons for the static or even declining nature of CPR statistics; one of the biggest is the ability to retain and effectively implement CPR in an unresponsive victim.

QUALITY VS. QUANTITY IN DELIVERY OF CPR

One of the first things researchers did to try to quantify the effect of bystander CPR on patient survival

was to look at who initiated CPR and when it was initiated. In 1989, Bossaert et al analyzed 998 cardiac arrests in which bystander CPR was initiated.⁸ In this study, health-care workers were the most common

If health-care providers are finding it difficult to maintain their CPR skills, the rate of skill degradation in the lay provider must be tremendous.

group to initiate CPR outside the hospital, with family members being least likely. The authors concluded that bystander CPR was most effective in cases where advanced life support was not going to be available for more than eight minutes.

Beginning in the early 1990s, researchers began looking at the quality of CPR vs. patient survival in cases of out-of-hospital cardiac arrest. Wik et al analyzed more

chance of survival by two to three times over victims who do not receive bystander CPR.¹¹

The quality of bystander CPR has not been the only focus for researchers; in the past few years the emphasis has shifted to looking at the quality of CPR provided by health-care professionals. In 2000, Aufderheide et al evaluated the effect of an artificial ventilation rate of 30 breaths per minute (bpm)

on coronary perfusion pressure (CPP) and survival in lab animals.¹² The ventilation rate used in the study was taken directly from actual resuscitation cases. The authors found that at 30 bpm the CPP was approximately half of that in animals ventilated at 12 bpm. The

CPR SKILL RETENTION

Over the years, numerous studies have looked at the rate of skill retention in both lay rescuers as well as professional health-care providers.^{15,16} Some authors suggest that CPR skills begin to deteriorate in as little as one month after training, while others

More emphasis must be put on the delivery of chest compressions, both at the correct depth & at the correct rate, minimizing the amount of time without chest compressions.

researchers also found that the hyperventilation reduced the venous return to the right heart, further impacting the possibility of survival.

In 2005, Wik et al analyzed the adherence of professional EMS personnel to international CPR guidelines during field resuscitations.¹³ The authors found that during the first five minutes of resuscitation the patients received compressions at a rate of 60/minute, and nearly 60% of those compressions were too shallow to result in effective CPR. The authors concluded that more emphasis must be put on the delivery of chest compressions, both at the correct depth and at the correct rate, minimizing the amount of time without chest compressions.

Hospital personnel were also analyzed during patient resuscitation.¹⁴ During the first five minutes of in-hospital resuscitation the chest compression rate was found to be 80/minute for 13% of the cases and 90/minute for another 28%, and chest compressions were too shallow to be effective in about one-third of the resuscitations. Ventilation rates exceeded 20 bpm in 60% of the resuscitations. Similar to the conclusions in the out-of-hospital resuscitation articles, the authors call for researching ways to improve compliance with current guidelines as a way to improve patient survival.

suggest that skills are retained for a minimum of six months. The length of skill retention is clearly debatable.¹³

HANDS-OFF TIME

Research has shown that in addition to the quality of compressions and ventilations being suboptimal during CPR, compressions are interrupted too frequently, and too much time passes during which no compression activity takes place. Several studies have addressed the problems caused by inadequate perfusion of the patient during cardiac arrest and highlight the need to reduce hands-off time during resuscitation.²¹⁻²⁵

IMPROVING CPR SKILLS WITH FEEDBACK

It only makes sense that if it's difficult to remember how to effectively perform CPR, rescuers need ongoing instruction during an event. This concept of real-time feedback has been used very effectively in automated external defibrillators (AEDs). Law enforcement personnel and trained and untrained lay responders have been extremely successful in initiating defibrillation due to the prompts the AED equipment provides.

So how about feedback during CPR training? In an evaluation in 2001, a group of 24 paramedic students were randomized to receive either three minutes of CPR practice on a manikin without feedback or three minutes with continuous feed-

back.¹⁷ The students who initially received no feedback during practice were found to improve significantly after receiving the continuous feedback practice. The students that started with the feedback practice maintained the quality of their skills throughout the practice session.

Similar findings were reported for the lay responder during training with continuous CPR feedback.¹⁸ A group of office employees were given initial CPR training; the participants were then evaluated at four different intervals after completing the training. The first evaluation occurred immediately after training completed, once without feedback and once with feedback. Despite significant improvement noted even without feedback, once feedback was utilized the ventilation rate improved by seven percentage points; correct compression depth improved by nearly 15 percentage points. At six months, one week after initial training with the feedback system in place, the employees were able to regain their initial performance levels.

As several of the previous studies have noted, reinforcement is an important component to providing quality CPR. Although no evidence has directly linked the quality of CPR to survival, several of the studies have demonstrated that a relationship is very probable. If health-care providers are finding it difficult to maintain their CPR skills, the rate of skill degradation in the lay provider must be tremendous. Before more changes are made in the international CPR guidelines, perhaps more emphasis should be placed on simplifying the way CPR is performed, and adding feedback to the equipment.²⁰ Finally, survival rates might reach the projections made at the outset of the adoption of CPR.

Elizabeth Criss is a frequent *JEMS* contributor and editorial board member.

REFERENCES

1. *Holy Bible*. King James Version, 2 Kings, Chapter 4, verse 24.
2. Kazi RA: "The life and times of George Washington Crile." *Journal of Postgraduate Medicine*. 49:289-290, 2003.
3. Safar P, Escarrage L, Elam J: "A comparison of the mouth-to-mouth and



PHOTO JULIE MACIE

Despite significant research on CPR, the rate of survival from out-of-hospital cardiac arrest has not improved in the past 30 years.

Medicine. 49:289–290, 2003.

3. Safar P, Escarrage L, Elam J: "A comparison of the mouth-to-mouth and mouth-to-airway methods of artificial respiration with the chest pressure arm life methods." *New England Journal of Medicine*. 258:671–677, 1958.
4. Berman RA, Safar P: "Mouth-to-mouth resuscitation." *Anesthesiology*. 19(5):685–687, 1958.
5. Kouwenhoven WB, Jude JR, Knickerbocker GG: "Closed-chest cardiac massage." *JAMA*. 173(Jul 9):1064–1067, 1960.
6. Stratton S, Niemann JT: "Effects of adding links to 'The Chain of Survival' for pre-hospital cardiac arrest: A contrast in outcomes in 1975 and 1995 at a single institution." *Annals of Emergency Medicine*. 31:471–477, 1998.
7. Becker LB, Ostrander MP, Barrett J, et al: "Outcome of CPR in a large metropolitan area: Where are the survivors?" *Annals of Emergency Medicine*. 20:355–361, 1991.
8. Bossaert L, Van Hoeyweghen R, et al: "Bystander cardiopulmonary resuscitation (CPR) in out-of-hospital cardiac arrest." *Resuscitation*. 17(Suppl):S99–109, 1989.
9. Wik L, Steen PA, Bircher NG: "Quality of bystander cardiopulmonary resuscitation influences outcome after prehospital cardiac arrest." *Resuscitation*. 28:195–203, 1994.
10. Gallagher JE, Lombardi G, Gennis P: "Effectiveness of bystander cardiopulmonary resuscitation and survival following out-of-hospital cardiac arrest." *JAMA*. 274(24):1922–1925, 1995.
11. Holmberg M, Holmberg S, Herlitz J: "Effect of bystander cardiopulmonary resuscitation in out-of-hospital cardiac arrest patients in Sweden." *Resuscitation*. 47:59–70, 2000.
12. Aufderheide TP, Sigurdsson G, Pirrallo RG, et al: "Hyperventilation-induced hypotension during cardiopulmonary resuscitation." *Circulation*. 109:1960–1965, 2004.
13. Wik L, Kramer-Johansen J, Myklebust H, et al: "Quality of cardiopulmonary resuscitation during out-of-hospital cardiac arrest." *JAMA*. 293(3):299–304, 2005.
14. Abella BS, Alvarado JP, Myklebust H, et al: "Quality of cardiopulmonary resuscitation during in-hospital cardiac arrest." *JAMA*. 293(3):305–310, 2005.
15. Handley AJ, Handley SA: "Improving CPR performance using an audible feedback system suitable for incorporation into an automated external defibrillator." *Resuscitation*. 57(1):57–62, 2003.
16. Brennan RT, Braslow A: "Skill mastery in cardiopulmonary resuscitation training classes." *American Journal of Emergency Medicine*. 13:505–508, 1995.
17. Wik L, Thowsen J, Steen PA: "An automated voice advisory manikin system for training in basic life support without an instructor. A novel approach to CPR training." *Resuscitation*. 50(2):167–172, 2001.
18. Wik L, Myklebust H, Auestad BH: "Retention of basic life support skills 6 months after training with an automated voice advisory manikin system without instructor involvement." *Resuscitation*. 52:273–279, 2002.
19. Q-CPR™ Measurement and Feedback System.
20. Sanders AB, Ewy GA: "Cardiopulmonary resuscitation in the real world: When will the guidelines get the message?" *JAMA*. 293(3):363–365, 2005.
21. Eftestøl T, Sundt K, Steen PA: "Effects of interrupting precordial compressions on the calculated probability of defibrillation success during out-of-hospital cardiac arrest." *Circulation*. 105:2270–2273, 2002.
22. Steen S, Liao Q, Pierre L, et al: "The critical importance of minimal delay between chest compressions and subsequent defibrillation: A haemodynamic explanation." *Resuscitation*. 58:249–258, 2003.
23. Van Alem AP, Sanou BT, Koster RW: "Interruption of cardiopulmonary resuscitation with the use of the automated external defibrillator in out-of-hospital cardiac arrest." *Annals of Emergency Medicine*. 42(4): 449–457, 2003.
24. Rea TD, Shah S, Kudenchuk PJ, et al: "Automated external defibrillator: To what extent does the algorithm delay CPR." *Annals of Emergency Medicine*. 46(2):132–141, 2005.
25. Venezuela DT, Kern KB, Clark LL, et al: "Interruptions of chest compressions during emergency medical systems resuscitation." *Circulation*. 112:1259–1265, 2005.

EMS Leaders Weigh In

Drs. Ornato & Pepe on CPR quality & improving compression performance

By TERESA MCCALLION

A quiet premise—do the basics better—is gaining attention amid the highly public medical and technological advancements designed to save lives following a cardiac arrest. A number of recent studies seem to indicate what most already know: The better the CPR, the better the patient's chances of survival.

New devices to assist emergency responders are filtering into the field, and new American Heart Association (AHA) Cardiopulmonary Resuscitation and Emergency Cardiovascular Care guidelines are imminent. But experts say there are steps that can be taken immediately to improve survival rates for those who suffer a cardiac arrest.

"It's really a hot topic," Joseph P. Ornato, MD, FACC, FACEP, says. "There is a tremendous amount of progress in beginning to understand the mechanics of CPR."

Dr. Ornato, professor and chair of the Department of Emergency Medicine at Virginia Commonwealth University/Medical College of Virginia, in Richmond, is also the medical director for the Richmond Ambulance Authority and an active researcher in the field of CPR.

Until recently, improvements in cardiac arrest resuscitation have been off the radar screen, bypassed by flashy bells-and-whistle-type technology. It has only been within the past five years, Ornato says, that the medical community has come to recognize the potential opportunity for improving a patient's odds of survival.

"It's an exciting time," he says.

"We are seeing some startling, previously unrealized, ways of improving blood flow and heart activity."

Internationally recognized resuscitation researcher Paul E. Pepe, MD, MPH, acknowledges that a common thread in successful EMS systems is an extreme focus on the

received a definitive airway, such as endotracheal intubation."

Pepe is a professor of medicine, surgery and public health and chairman of Emergency Medicine at the University of Texas Southwestern Medical Center in the Parkland Health and Hospital System in



Dr. Joseph Ornato (left) & Dr. Paul Pepe (right)

basics. Stronger compressions delivered with fewer interruptions and minimal time between compressions and defibrillation appears to be the key to successful outcomes.

"Exacerbating the problem [have] been the rote training concepts that patients in cardiac arrest should receive a higher frequency of ventilation in order to 'deliver more oxygen and counteract metabolic acidosis,'" Dr. Pepe says. "Such practices not only inhibit forward flow of blood, but they will also lead to frequent interruptions of chest compressions in patients who have not

Dallas, and director of EMS for the City of Dallas.

ILLUMINATING STUDIES

Recent studies of CPR quality validate the greater need to focus on the basics, including a European study that found paramedics and nurse anesthetists performed chest compressions only half of the available time. The study, by Lars Wik, MD, PhD, of Ulleval University Hospital in Oslo, Norway, also reports that only 28% of the compressions conformed to the recommended depth. That study set into motion a series

of investigations into what has become known as the “hands off interval.” Using animal studies, Max Harry Weil, MD, PhD, of the Institute of Critical Care Medicine, in Palm Springs, Calif., documented the importance of minimizing the time between the last chest compression and the first shock. In his study of pigs, he found that decreasing the number of seconds between compression and defibrillation increased the likelihood that the shock would return the heart to a normal rhythm.

off interval” will eventually become a household phrase. “Four to five years from now, we will be very fluent in these types of discussions,” he says. “This is a cutting-edge topic.” “Ventilation itself is an exciting area of development,” Ornato says. Again, animal studies found that ventilation rates of 30 times per minute were not only unhelpful, but were actually dangerous. “That seems totally counterintuitive,” Ornato says. However, rapid ventilation does not allow the lungs time to move oxygenated blood into the

Aufferheide, MD, of the Medical College of Wisconsin, in Milwaukee, found that the average number of ventilations per minute conducted by prehospital providers exceeded the current AHA guidelines. Although there are no definitive field studies yet, it appears that survival rates for humans would increase by slowing ventilation. “Certainly based on what we are seeing in an animal model, there is a concern,” Ornato says.

The importance of the combination of early CPR and defibrillation has been substantiated in several recent clinical trials. The studies suggest that while many of the new technologies have increased the rate of hospital admission for patients who suffered cardiac arrest, the rate of survival to hospital discharge has not been substantially improved. The seminal Ontario Prehospital Advanced Life Support (OPALS) study published last year determined that in an emergency services system of rapid defibrillation, advanced life support (ALS) interventions did not improve the rate of survival following an out-of-hospital cardiac arrest. The study concludes that the key to survival appears to be early CPR and defibrillation.

FEEDBACK IN THE FIELD

Reinforcing proper CPR skills observed in the field is crucial to successful outcomes, Pepe says. According to an article he co-wrote in *Critical Care Medicine Magazine*, intensive oversight and immediate feedback by an “expert resuscitologist/medical director” has demonstrated an extremely positive effect on survival rates. New technologies are being developed to serve as an adjunct for medical directors who cannot be present at every cardiac arrest in their system. “One of the interesting aspects of these new automatic monitoring devices is that they may be capable in some circumstances to give immediate feedback to the rescuers,” Pepe says. Q-CPR™, a measurement and feedback tool built into the Philips HeartStart monitor/defibrillator, is an example of such a

It’s an exciting time. We are seeing some startling, previously unrealized, ways of improving blood flow & heart activity.

Studies by Trygve Eftestol, PhD, an associate professor at Stavanger University College, in Stavanger, Norway, further illustrated the importance of the “hands off interval.” His investigation of AED recordings from the field determined that patients with a “hands off interval” of less than six seconds were more likely to return to an organized rhythm and stable blood pressure.

Ornato expects the term “hands

blood stream. Hyperventilation increases intrathoracic pressure, decreasing the flow of blood through the chest. Pepe agrees. “While many experts have understood these concepts for many years, it may have been technology, such as end-tidal CO₂ monitors, that began to convince practitioners that overzealous ventilation was counterproductive,” he notes.

Preliminary field studies by Tom

ELEMENTS OF QUALITY CPR

According to Joseph P. Ornato, MD, the results of a number of recent studies indicate that paying attention to the details of CPR is more important than originally thought. “A lot of these things are pretty easy and straight forward,” he says. Of note:

- Track the number of actual chest compressions per minute and the percent of time during resuscitation that chest compressions are being given.
- Deliver quality chest compressions. Make sure appropriate force is used and that the chest is allowed to recoil fully between compressions.
- Monitor ventilations per minute. Do not hyperventilate the patient.
- Minimize the “hands off interval”—the period of time between the last chest compression and the defibrillation shock.

device (see Q-CPR™ Eliminates Guesswork, p. 14). It uses a small sensor attached to the patient's chest to evaluate the quality of CPR being delivered.

The impact of the feedback is felt well beyond the incident. "In fact, users have often found that their general performance improves over time after the initial use of these devices because they are re-learning their rhythm and syncopation," Pepe says.

He warns that this new technology should be viewed as a tool; however, better controls are still needed. "Such devices are adjuncts for quality patient care, but are no substitute for intensive, street-wise expert medical direction," he says.

Although it's early in the development, some emergency responders view devices that incorporate audible feedback with skepticism. They worry that bystanders, especially the patient's family members, will misinterpret a device that appears to be critical of the CPR being performed.

While Ornato views the concerns as important considerations, he also recognizes the survival advantage to helping rescuers provide optimal CPR in real time. Ornato suggests that engineering solutions, such as wireless headsets, or the special indicator lights and signals already incorporated into the Philips monitor, could address those concerns.

"Clearly the industry is moving in the direction of providing more capabilities to monitor CPR," Ornato says. "We are still at a very early stage of seeing how this shakes out," he says. "Nevertheless, I am excited about the prospect."

TRACKING CPR VARIABLES

The National Institute of Health Resuscitation Outcomes Consortium (ROC) is working on several studies that should shed light on current CPR delivery, including monitoring. Along with field-testing various devices and drugs, ROC will track CPR variables and examine the relationship between the variables and their effect on overall survival rates,

says Ornato, ROC co-chair.

"This will give us a better idea of what we are actually doing in the field," he says. "Our effort will provide a very large database and a better understanding of the optimal procedure." In fact, Ornato says, the result will be the largest CPR database ever gathered. He estimates the data set will include an unprecedented 12,000 cardiac arrest cases per year. Most cardiac arrest trials include a data set of a couple of hundred patients, he notes.

The large database should help identify other possible variables in the delivery of quality CPR. "We

should be able to tease some of that information out," Ornato says.

It should also help identify how many cases of cardiac arrest occur annually in the United States. With no national registry, it's difficult to determine exactly how many patients collapse into cardiac arrest each year. The latest estimates from the Centers for Disease Control and Prevention are three or four years old, Ornato says. They indicate between 400,000 and 450,000 victims per year in the United States. AHA estimates are lower. They believe more than 300,000 Americans die each year of cardiac arrest. (For more information on ROC, visit <https://roc.uwctc.org>.)

"This [will be] an interesting period of discovery over the next few years," Ornato says. Never have this many resources been focused on CPR resuscitation. The result could mean the difference between life and death for a huge number of patients suffering from cardiac arrest.

"From the information we have at hand, there appears to be that

hope," he says. "The pieces of the puzzle are just starting to come into play."

Teresa McCallion is a contributing writer to JEMS.

RECOMMENDED READING

Wik L, et al: "Quality of cardiopulmonary resuscitation during out-of-hospital cardiac arrest." *Journal of the American Medical Association*. 293(3):305-310, 2005.

Aufderheide TP, Sigurdsson G, Pirralo RG, et al: "Hyperventilation-induced hypotension during cardiopulmonary resuscitation." *Circulation*. 109(16):1960-196, 2004.

Becker LB, Ostranders MP, Barrett J, et al: "Outcome of CPR in a large metropolitan area: Where are the survivors?" *Annals of Emergency Medicine*. 20(4):355-361, 1991.

Users have often found that their general performance improves over time after the initial use of these [feedback] devices because they are re-learning their rhythm & syncopation.

Ko PC, Chen WJ, Lin CH, et al: "Evaluating the quality of prehospital cardiopulmonary resuscitation by reviewing automated external defibrillator records and survival from out-of-hospital cardiac arrest." *Resuscitation*. 64(2):163-169, 2005.

Pepe PE, Mattox KL, Duke JH, et al: "The effect of full-time specialized physician supervision on the success of a large urban emergency medical services system." *Critical Care Medicine*. 21:1279-1286, 1993.

Pepe PE, Roppolo LA, Cobb LA: "Successful systems for out-of-hospital resuscitation." *Cardiopulmonary Arrest*. 649-681, 2004.

Stiell I, Wells G, Field B, et al: "Advanced cardiac life support in out-of-hospital cardiac arrest." *The New England Journal of Medicine*. 351(7):647-656, 2004.

Sunde K, Eftestol T, Askenberg C, et al: "Quality assessment of defibrillation and advanced life support using data from the medical control module of the defibrillator." *Resuscitation*. 41(3):237-247, 1999.

Yu T, Weil MH, Tang W, et al: "Adverse outcomes of interrupted precordial compression during automated defibrillation." *Circulation*. 106:368-372, 2002.

Real-World Findings

Dr. Petter Steen discusses the *JAMA* research on CPR quality

By JENNIFER DOYLE



In January, the *Journal of the American Medical Association (JAMA)* published two studies, as well as an editorial, on the current quality of CPR, both in and out of the hospital setting.¹⁻³ In the hospital setting, researchers found that the quality of “multiple parameters of CPR was inconsistent and often did not meet published guideline recommendations, even when performed by well-trained hospital staff.” With regard to out-of-hospital CPR attempts, researchers found that “chest compressions were not delivered half of the time, and most compressions were too shallow.”

<< Emergency medicine researcher and study author Petter Steen, MD, PhD, sat down to shed some light on the real-world implications of the studies’ findings. Dr. Steen is chair of the anesthesia department at the University of Oslo (Norway), a member of the Laerdal Board of Directors and past chair of the European Resuscitation Council. He received the AHA Resuscitation Giants Award in January and the AHA Lifetime Achievement Award in November. His interest in CPR dates back to the 1970s and ‘80s, when he found that a patient’s chance of survival changed by a factor of four to five after receiving good vs. poor quality CPR.⁴

WHERE WERE THE JAMA STUDIES PERFORMED, AND WHY WERE THOSE AREAS SELECTED?

They were performed in Akershus, a county outside of Oslo, Stockholm and London, while a parallel in-hospital study was done at the University of Chicago.^{1,2} It’s nice to perform studies with people in other countries; we learn from each other and avoid getting patients with the same cultural background.

WHAT MAKES THE JAMA CPR STUDIES SO UNIQUE?

There have been hardly any studies looking at the *quality* of CPR in ACLS providers. Before we had defibrillators that could measure it for us, you had to have a researcher at the site, and it still was impossible to see if someone presses three or four or five centimeters on the chest. Before the present studies, nobody really looked at the timing of chest compressions and the depth of them.

BASED ON THE FINDINGS, WHAT IS THE CURRENT QUALITY OF CPR BY PROFESSIONALS AND LAY BYSTANDERS?

It’s fascinating and discouraging. We found that almost half the time there was no compression activity, and when rescuers were doing compressions, they reached the mini-

mum compression depth less than 30% of the time. Furthermore, in the recent Arizona and Amsterdam studies, professionals compressed less than half the time.^{6,7} One hypothesis for that is that there are so many other things that we tell them to do—put in IVs, administer drugs, check for a pulse, etc. These have a tendency to draw awareness away from the basics: chest compressions and ventilations.

WHAT OTHER FACTORS CONTRIBUTE TO POOR CPR PERFORMANCE IN THE FIELD?

If you don’t get enough time and resources for training [then performance suffers]. In our system, the number of cardiac arrests isn’t high—we’re probably doing 250 or 300 CPR attempts a year—and with 150 paramedics, that means the average paramedic might only be involved in three or four, maybe even two, cardiac arrests a year. In Paris, where they had good results with active decompression CPR, they train people twice a month.⁸

CAN YOU ADDRESS HOW NEW TECHNOLOGY COULD AID IN CPR SKILL RETENTION?

The idea was to get a feedback system into defibrillators. We started doing studies where manikins gave

direct verbal feedback to the students on CPR quality, and found that people who had never trained with feedback before took three minutes [of training with voice feedback], and the quality of what they were doing was absolutely phenomenal.⁹ If they then were brought back after a year with no feedback in the meantime, and we turned on the feedback, they were right back on again, which we never see without feedback.¹⁰

WHY IS THE QUALITY OF CHEST COMPRESSIONS PERHAPS MORE CRITICAL THAN VENTILATING A PATIENT?

If you do very good chest compressions without any pause whatsoever, you only have maybe 25–35% blood flow to the brain and heart. If you then stop to ventilate, let’s say for 10 seconds, that’s 10 seconds without any blood flow to the brain or the heart. Even when you start your chest compressions again, it takes two, three or four compressions to build up the pressure that will again give good blood flow. So every break in chest compressions is fairly dramatic. If you give oxygen, which most of us do during advanced CPR, you don’t need that much ventilation. Possibly, if you’re able to keep the airways open, you don’t need much ventilation at all. The problem is if

nobody pays attention to the airway of a cardiac arrest patient it will be closed off by the tongue. So you still need somebody to handle the airway.

We know in animals there's a dramatic difference between compressing three or four or five centimeters in a 20-kilo pig. Three centimeters gives poor blood flow, compared to pressing four or five centimeters. So it's not only that you have to compress all the time, but you really have to push down fairly hard.

DID YOU FIND THAT HYPERVENTILATION IS A PROBLEM?

It seems to be more of a U.S. problem than a European one. There's one good study in the States reporting on hyperventilation.¹¹ It's also important to remember in the Aufderheide study, they only looked at the 16-second period with the highest ventilation rate.¹¹ During a 15-minute CPR, a 16-second hyperventilation period wouldn't necessarily be problematic.

WHAT TYPE OF IMPROVEMENT IN SURVIVAL IS SEEN WHEN QUALITY CPR IS DELIVERED BEFORE DEFIBRILLATION?

There are three studies on the quality of bystander CPR, and all of them show four to five times higher survival rate if the quality of the CPR is good.^{4,12,13} In one study we also found an improved outcome when the paramedics did three minutes of CPR before attempting to defibrillate if the ambulance took more than five minutes to get to the patient.¹⁴ A closer look at the data showed that the condition of the heart improved with three minutes of CPR and made it more ready for defibrillation.¹⁵

WHY DOES FEEDBACK TO CPR PROVIDERS IMPROVE QUALITY?

There are at least four or five publications on voice feedback during training that show voice feedback dramatically improved CPR quality.^{9,10,16,17} So the interesting thing was to see if it also improved quality when you were doing CPR on patients. We have completed those studies and found that with the use of feedback, the median percentage of chest compressions within CPR guidelines more than doubled.

DID USERS LIKE THE VOICE FEEDBACK?

HOW DID BYSTANDERS PERCEIVE IT?

The great majority said it's helpful. Some [providers] said it disturbs them, [but] some of the disturbances I like. For instance, some will say, "It disturbs me when I try to put in an IV needle." I'd say it's the other way around. When it disturbs you when you put in an IV needle, it means you're not doing CPR. Stop getting that needle in and do CPR instead! Most of the time there's so much going on that feedback from the defibrillator doesn't concern [bystanders]. In those instances where it was noted, the feedback was positive.

HOW SHOULD THESE FINDINGS AFFECT AHA'S CPR GUIDELINES AND TRAINING?

The guidelines process is changing with more emphasis on quality, especially chest compressions. Guidelines and training need to focus on chest compressions. We need manikins that have different chests; all patients are not alike. Instructors need to look more at the total scene—how people are interacting, working together—with more realistic scenarios with difficult IV needles, difficult intubations, and maybe noise around. Our training is very sterile compared to what's really going on out there.

WHAT KEY MESSAGE WOULD YOU LIKE READERS TO TAKE AWAY?

Improving CPR quality is the key factor for improving outcomes after cardiac arrest. There is mounting evidence that supports this. We should focus on doing the basics well and delivering quality CPR.

Jennifer Doyle is a contributing writer and editor to *JEMS*.

REFERENCES

1. Wik L, Kramer-Johansen J, Myklebust H, et al: "Quality of cardiopulmonary resuscitation during out-of-hospital cardiac arrest." *Journal of the American Medical Association*. 293:299–304, 2005.
2. Abella BS, Alvarado JP, Myklebust H, et al: "Quality of cardiopulmonary resuscitation during in-hospital cardiac arrest." *JAMA*. 293:305–310, 2005.
3. Sanders AB, Ewy GA: "Cardiopulmonary resuscitation in the real world: When will the guidelines get the message?" *JAMA*. 293:363–365, 2005.

4. Wik L, Steen PA, Bircher NG: "Quality of bystander cardiopulmonary resuscitation influences outcome after prehospital cardiac arrest." *Resuscitation*. 28:195–203, 1994.
5. Sunde K, Eftestøl T, Askenberg C, et al: "Quality assessment of defibrillation and advanced life support using data from medical control module of the defibrillator." *Resuscitation*. 41:237–47, 1999.
6. Valenzuela TD, Kern KB, Clark LL, et al: "Interruption of chest compressions during emergency medical systems resuscitation." *Circulation*. 112:1259–65, 2005.
7. van Alem AP, Sanou BT, Koster RW: "Interruption of cardiopulmonary resuscitation with the use of the automated external defibrillator in out-of-hospital cardiac arrest." *Annals of Emergency Medicine*. 42:449–57, 2003.
8. Plaisance P, Lurie KG, Vicaut E: "A comparison of standard cardiopulmonary resuscitation and active compression—Decompression resuscitation for out-of-hospital cardiac arrest." *New England Journal of Medicine*. 341:569–575, 1999.
9. Wik L, Thowsen J, Steen PA: "An automated voice advisory manikin system for training in basic life support without an instructor: A novel approach to CPR training." *Resuscitation*. 50(2):167–172, 2001.
10. Wik L, Myklebust H, Auestad BH, et al: "Twelve-month retention of CPR skills with automated correcting verbal feedback." *Resuscitation*. 66:27–30, 2005.
11. Aufderheide TP, Sigurdsson G, Pirrallo RG: "Hyperventilation-induced hypotension During Cardiopulmonary Resuscitation." *Circulation*. 109:1960–5, 2004.
12. Van Hoeyweghen RJ, Bossaert LL, Mullie A, et al: "Quality and efficiency of bystander CPR. Belgian cerebral resuscitation study group." *Resuscitation*. 26:47–52, 1993.
13. Gallagher EJ, Lombardi G, Gennis P: "Effectiveness of bystander cardiopulmonary resuscitation and survival following out-of-hospital cardiac arrest. *JAMA*. 274:1922–1925, 1995.
14. Wik L, Hansen TB, Fylling F, et al: "Delaying defibrillation to give basic cardiopulmonary resuscitation to patients with out-of-hospital ventricular fibrillation: A randomized trial." *JAMA*. 289:1389–1395, 2003.
15. Eftestøl T, Wik L, Sunde K, et al: "Effects of cardiopulmonary resuscitation on predictors of ventricular fibrillation success during out-of-hospital cardiac arrest." *Circulation*. 110:10–15, 2004.
16. Handley AJ, Handley SA: "Improving CPR performance using an audible feedback system suitable for incorporation into an automated external defibrillator." *Resuscitation*. 57:57–62, 2003.
17. Hostler D, Wang H, Parrish K, et al: "The effect of a voice assist manikin (VAM) system on CPR quality among prehospital providers." *Prehospital Emergency Care*. 9:53–60, 2005.

Q-CPR™ Eliminates Guesswork

Measurement & feedback
keep rescuers on target

What if there were a simple solution to the pervasive problem of inconsistent CPR performance? What if medical personnel could employ a simple tool to guide their delivery of CPR in accordance with American Heart Association (AHA) guidelines? And what if it were available today on a piece of lifesaving equipment you already use? Your answer to all three questions would likely be, “I want to know more about it.”

What exactly is this tool? It's continuous, real-time CPR monitoring, and it could potentially help us save more lives from cardiac arrest. Each year, in the United States alone, sudden cardiac arrest strikes approximately 340,000 victims, and, despite our best efforts, still less than 5% survive.

This new technology—Q-CPR™ Measurement and Feedback—was developed by Laerdal and is now available in the Philips HeartStart MRx Monitor/Defibrillator. Laerdal, with 40 years of leadership in CPR training and clinical products, and Philips Medical Systems, the world leader in automated external defibrillation, collaborated during the past five years to develop and incorporate CPR measurement and feedback capabilities into an ALS monitor, realizing the connection between quality CPR and the effectiveness of electrical defibrillation. The Q-CPR™

Measurement and Feedback tool provides objective measurement and real-time corrective feedback in both manual defibrillation and AED modes for compression depth and rate, as well as ventilation frequency and inspiration volume, to guide rescuers' CPR performance in accordance with AHA guidelines.

From the viewpoint of the user, Q-CPR™ is very easy to set up and to use, and it's easily integrated into the care process of both paramedics and hospital clinicians. For the first time, the rescuer can monitor his or her performance in the moment, while gathering data that was never before available and may ultimately contribute to a systemic improvement in sudden cardiac arrest survival rates.

SEEDS OF INVENTION

In 1998, motivated by a strongly held belief that resuscitation survival rates remain unacceptably low, both in and out of the hospital, Laerdal initiated research to shed new light on three questions: Is it possible to accurately measure the quality of CPR? If so, might this reveal a hidden problem with CPR delivery? And, would verbal feedback improve CPR quality? Research has shown the answer to all three questions is *yes*.

Laerdal researchers, with years of experience in AEDs and interac-



tive skills-training technologies, already knew the powerful effect of voice prompts on caregivers. With voice prompts, minimally trained and even untrained rescuers can use an AED. So it seemed plausible that voice prompts could also help rescuers deliver better CPR.

Laerdal built a series of research tools to investigate the effect of CPR verbal feedback. Researchers developed algorithms for verbal feedback that worked with lay people, as well as with trained healthcare professionals. This technology, called VAM (voice activated manikin), improved CPR when used as a feedback system and proved feasible as a training instrument.

The VAM had built-in sensors for detecting chest compressions and ventilations. Laerdal then developed sensors for use on actual



patients during cardiac arrest and tested prototypes in collaboration with the universities of Stavanger and Oslo (Norway).

Initial testing proved promising, so Laerdal and Philips developed a prototype device to deliver visual and verbal feedback, using a commercial ALS defibrillator as the base. The device, a modified Philips HeartStart defibrillator, was deployed for use by EMS systems in Stockholm, London and Akershus (Oslo), and in hospitals in Vienna and in Chicago for use in two studies. These studies first measured baseline (feedback was not used) CPR performance during both in-hospital and out-of-hospital instances of cardiac arrest. This enabled researchers to record the current state of CPR quality. The results, which showed that the quality of CPR delivered both in and out

With each compression, the Q-CPR™ sensor measures force and motion from which the HeartStart MRx produces a visual depiction of depth and rate in the form of a wave.

of the hospital was consistently sub-optimal relative to AHA guidelines, were published in the January 2005 issue of *JAMA*.^{1,2}

Based on findings from this preliminary work, additional algorithms for signal analysis and feedback were developed, with support from researchers at the University Hospital in Vienna and the University of Stavanger.

In the second stage of the research, verbal feedback was activated in the prototype HeartStart device and introduced to users as part of their annual retraining. The results of these studies, presented at the AHA's Scientific Sessions 2005, show improved CPR perform-

ance for CPR measurement and feedback users, in and out of the hospital. Dr. Jo Kramer-Johansen from Oslo reported on cardiac arrests in three ambulance services in Europe, where the automatic verbal and visual feedback features of Q-CPR™ improved the quality of CPR delivered by the paramedics and EMTs, doubling the percentage of compressions within guidelines and increasing the mean depth of compressions. There was a trend toward increased survival with regards to both the percentage of patients admitted to hospital and those discharged alive with good neurological status.

Dr. Ben Abella from Chicago

announced that real-time CPR monitoring and feedback also improved multiple parameters of CPR quality for cardiac arrest patients treated in hospital. And his colleague, Dr. Dana Edelson, received the ReSS Young Investigator of the Year award for a study on cardiac arrest patients showing that the quality of CPR affects the success rate of defibrillation, which is also associated with more patients leaving hospitals alive. In particular, she reported that a modest increase in the depth of chest compressions could double the chance of defibrillation success.

HOW Q-CPR™ WORKS

Q-CPR™ consists of an 8-oz. reusable compression sensor and a set of standard multifunction defibrillation electrode pads, integrated with the HeartStart MRx monitor/defibrillator. Set-up is simple. The Q-CPR™ sensor and pads cables are attached to the defibrillator. The defibrillation pads are applied to the patient's chest as they typically are, in the anterior/anterior positions. The Q-CPR™ sensor is applied over the patient's sternum in the normal CPR hand position. After selecting the therapy mode, either manual or automated defibrillation, CPR measurement and feedback begins.

During use, the multifunction pads measure chest impedance related to ventilation volume, analyzed by a ventilation algorithm. The algorithm interprets change in impedance on the basis of the apex/sternum placement. The Q-CPR™ compression sensor measures compression force and acceleration, which are analyzed by a depth algorithm. Q-CPR™ interprets ventilations and compressions, and produces visual measurements and the appropriate verbal/textual feedback through a feedback algorithm.

Users receive visual feedback of the delivered compression depth on the monitor's display, via a compression wave derived from signals from the compression sensor. As the user compresses the chest, the motion is represented as a downward stroke of the wave, rebounding up to a baseline as they release. Two parallel lines, extending horizontally across

the wave sector, drawn at -1.5" and -2", define a target zone to help the user identify the optimal compression depth.

A calculated compressions-per-minute (cpm) rate, also derived from the compression sensor's signal, is displayed in the screen's upper left corner. If compression depth or rate falls outside AHA guidelines, the monitor/defibrillator provides on-screen signals and delivers corrective



In manual mode, a single ECG wave displays in the top half of the screen, while the compression and ventilation numerics, the lung-shaped ventilation icon and the compression wave appear in the middle.

verbal feedback to the rescuer, e.g., "compress deeper." If there's no detectable compression after 1.2 seconds, a "No Flow" value is displayed and updated on screen, and the voice prompt "15 seconds without compressions" is delivered as warranted.

The ventilation volume is indicated by an icon resembling a set of lungs displayed in the upper right-hand corner of the screen. As breaths are delivered, the icon registers one-third, two-thirds or completely full. The defibrillation pads collect ventilation data by detecting changes in chest impedance, which correlate to inspiration volume. The ventilation rate is presented as ventilations-per-minute (vpm), with a target range from six to 16 vpm. A ventilation rate above or below this range results in corrective audio feedback, helping the user better manage the patient's blood oxygenation.

Q-CPR™'s verbal feedback sounds only as needed. And in instances when more than one prompt is required, they're prioritized and delivered in the

order of clinical importance. The voice prompts can also be volume-adjusted or muted, if desired.

With the HeartStart MRx in AED mode, the screen presentation is very simple; text messages and scrolling time bar indicators replace the numerics and wave seen in manual mode, and verbal feedback directly mirrors on-screen text.

Working in either mode, Q-CPR™ measurements can be recorded, using the strip chart printer on HeartStart MRx. Printing all active monitoring parameters in real-time or with a 10-second delay, MRx documents ventilation rate, compression rate and "no-CPR" time every 25 seconds.

Laerdal and Philips are jointly expanding the collection and management capability of Q-CPR™ to produce detailed post-event summary reports. The objective and accurate data collected by MRx can also be used for case review, training and process improvement. Aggregate data can help track system performance and improvements, reveal patterns and support resuscitation research.

Philips plans to offer Laerdal's Q-CPR™ technology as an option in its new defibrillators, featuring a user interface appropriate to the skill level of the intended user (which varies by device).

GREAT THINGS TO COME

Given this important focus on CPR, Philips and Laerdal will continue to work together to develop technologies to help improve the quality of CPR in conjunction with early defibrillation. Together they've mapped out a portfolio of innovations designed to support caregivers at every level. For more information on Q-CPR™ measurement and feedback visit www.laerdal.com and www.medical.philips.com.

REFERENCES

1. Wik, L, Kramer-Johansen J, Myklebust H, et al: "Quality of cardiopulmonary resuscitation during out-of-hospital cardiac arrest." *JAMA*. 293:299-304, 2005.
2. Abella BS, Alvarado JP, Myklebust H, et al: "Quality of cardiopulmonary resuscitation during in-hospital cardiac arrest." *JAMA*. 293:305-310, 2005.

Bystander CPR

A new video-based training program delivers the right message to the right people

Bystander CPR is critical to the Chain of Survival, but, thus far, it has been difficult to accomplish. Bystander CPR is only performed in about 33% of witnessed arrests.¹ This is not a surprise, given that 80% of cardiac arrests occur in the home in people who are older than 50 years. In contrast, the average age of a typical CPR course student is 25–30 years, and they are unlikely to be at the home of an arrest victim when an event occurs.²

Improving the incidence of bystander CPR and boosting survival rates by buying time is not just about training more people, but training the right people. The American Heart Association (AHA) is determined to see 20 million people per year trained in CPR by the year 2010. Achieving this goal means that educators must reach new groups not currently touched by CPR training.

There are many reasons why older people may not wish to attend a traditional course, including the time commitment, embarrassment at going to a class and being watched, and fear of failure or inability to perform the skills. *The question is: How can we reach these people?*

BRIDGING THE GAP

A number of years ago the idea of video self-instruction provided a gateway to this older population, with clear proof that video self-learning worked.³ Although the concept didn't catch hold, the times have changed. The DVD player has become a part of everyday life, and the idea of "watch while you do" is no longer foreign. What's more, this training method works in large facilitated groups, reducing the need to have highly



The DVD-based training program can be used any time to reach people who would not otherwise take a traditional CPR course.

trained instructors on hand to help these older beginners.

With this in mind, the AHA and Laerdal Medical Corp. joined forces to develop a new 22-minute learning system that can be used either at home or in groups. The resulting program involves DVD-based learning and an innovative new training manikin.



CPR Anytime employs a dynamic video-coaching, "watch-and-do" method to teach users core CPR skills in only 22 minutes.

EVIDENCED-BASED CPR EDUCATION

To ensure they developed an effective training program, the AHA and

Laerdal researchers embarked on a product development and research cycle that led to multiple iterations of both the educational DVD and the training manikin. Developers based the process on the need to prove whether the program would really work, and that the tools used

would suit the users' needs, i.e., could older people learn how to use them?

RMC Research Corp., based in Portland, Ore., performed detailed research that involved testing people older than 45 years of age who had not taken a traditional CPR course in recent years. Although the kits used were prototypes, the results proved better than expected.

Researchers compared those who trained using the kits to those who trained on their own (with the help of others and at a traditional AHA Heartsaver CPR class). The researchers found that those using the experimental kit were:

- better than the Heartsaver CPR group in the performance of adequate ventilations; and
- as good as Heartsaver CPR group with regard to mean percentage of all compressions performed with proper hand placement and with adequate depth.

In addition, the learners using the kit performed equally well when using it on their own or with facilitation from a peer or an AHA-certified BLS instructor.⁴

When they were evaluated by instructors/assessors, they performed just as well as a traditional Heartsaver group in overall performance (see chart).

Further studies using the kit were undertaken in different environments and with a variety of groups, but are not ready for publication. This research helped to refine the learning kit.

CPR ANYTIME

After watching hundreds of hours of video and studying the research results, developers fine-tuned the kit's contents. As a result, AHA, in conjunction with Laerdal Medical Corp., recently released *CPR Anytime for Family and Friends*, a self- or group-learning program based on the original idea of DVD instruction.

CPR Anytime uses a dynamic video-coaching, "watch-and-do" method that teaches users the core skills of CPR in just 22 minutes. The DVD host guides the participant through the inflation of a new inflatable "Mini Anne" manikin, use of the kit and performance of the key steps of CPR. Here's how it works:

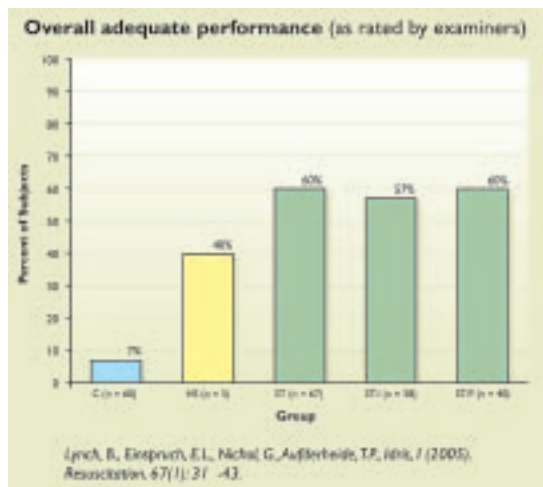
- The DVD host shows the learner how to provide compressions and rescue breaths.
- It stresses the importance of calling 9-1-1 and checking the victim for "signs of circulation"—breathing, coughing or movement.
- The host then walks users through putting it all together, from recognizing the emergency to giving cycles of compressions

and ventilations.

- The kit can also be used to train family members and to refresh the participant's skills.

MAKING A DIFFERENCE

In building the kit for individual use, it became apparent that it was also appropriate for group instruction. The idea of people learning without the support of local facilitators was thought to be less effective—not in



C = Control group, no training
 HS = Traditional Heartsaver Group
 ST = Kit Learners, without any help
 ST-I = Kit Learners, with the help of an instructor
 ST-P = Kit Learners, with the help of a peer

learning, but in getting people at home to use the program.⁵ It may prove most effective to teach the program at a short facilitated session, and then send it home with participants. Researchers tested the effectiveness of this educational process using people in the workplace, and found it to be very effective.⁶

The program's success in widespread reach to the community will depend on its delivery. Potential uses for *CPR Anytime* include:

- Community-based CPR programs: Municipalities, fire departments, hospitals or businesses organize a community CPR outreach program for their employees, families and friends.
- Community CPR day: Members of the healthcare community collaborate with local organizations on an event and encourage them to promote it to their members, students or employees.
- *CPR Anytime* in schools:

Students receive awards for the most number of family members and friends they train. The key is to get students to become program champions.

- Faith-based or community organizations: Encourage members to take a kit home and complete the training at their own convenience.
- Company training programs: Include *CPR Anytime* training as part of the company's new employee training process.

CPR Anytime for Family and Friends provides a unique training opportunity. One thing is certain: Bystander CPR rates remain dismally low. This new training approach just may boost those numbers and save lives.

American Heart Association®

Learn and Live™

The American Heart Association has a full-time *CPR Anytime* program team to help organizations coordinate their programs. For assistance, call 888/242-2665. For more information on the kit, call 888/LMC-4AHA or visit www.cpranytime.org.

REFERENCES

1. Stiell IG, Wells GA, Field B, et al: "Advanced cardiac life support in out-of-hospital cardiac arrest." *New England Journal of Medicine*. 351:647-56, 2004.
2. Swor R, Compton S: "Estimating cost-effectiveness of mass cardiopulmonary resuscitation training strategies to improve survival from cardiac arrest in private locations." *Prehospital Emergency Care Journal*. 8(4):420-423, 2004.
3. Braslow A, Brennan RT, Newman MM, et al: "CPR training without an instructor: Development and evaluation of a video self-instructional system for effective performance of cardiopulmonary resuscitation." *Resuscitation*. 34:207-20, 1997.
4. Lynch B, Einspruch EL, Nichol G, et al: "Effectiveness of a 30-minute CPR self-instruction program for lay responders: A controlled randomized study." *Resuscitation*. 67(1):31-43, 2005.
5. Eisenberg M, Damon S, Mandel L, et al: "CPR instruction by videotape: Results of a community project." *Annals of Emergency Medicine*. 25:198-202, 1995.
6. Roppolo LP, Ohman K, Pepe PP: "The effectiveness of a short cardiopulmonary resuscitation course for laypersons." *Circulation*.