# Editorial

## CPR—The Vanishing Competency

### CPR—Investments

For the better part of the past 40 or 50 years, healthcare professionals of all stripes have been learning, certifying, and annually recertifying in that most fundamental of lifesaving skills, cardiopulmonary resuscitation (CPR). Countless hours have been devoted to palpating, looking-listening-feeling, ventilating, thumping, compressing, counting cadences, and attempting to coordinate all of the procedural components of CPR over and over again until we finally get it right—that is, execute the procedure as specified in the American Heart Association (AHA) guidelines. Every few years, when revised guidelines are issued, we struggle to break and unlearn the previously used behavioral sequences and embed new neuronal imprinting that coincides with the latest research evidence and best practices.

During more than 10 of those 40-plus years, that pristine moment of "getting it right" required a CPR instructor to observe our efforts and subjectively determine whether they collectively qualified us to be certified (or recertified) in CPR. We weren't required to repeat a perfect behavioral sequence numerous times; a single correct demonstration could suffice (though that feat may have required hours to achieve). Some years later, CPR performance expectations were made more objective and quantitative when they were explicitly detailed with timing elements on a printed checklist. As CPR instructional technology continued to advance, we encountered mannequins with increasingly more sophisticated recording devices designed to objectively measure performance parameters related to timing, volume, and pressure and print out a strip for documentation. In addition to a passing score on the customary written test, CPR skill certification now required explicit, detailed, quantitative, objective evidence (ie, "a perfect strip") rather than a generic, summary, qualitative, subjective judgment. Now, these mannequins are remotely controlled for a range of clinical data and clinical response and can record discrete and detailed measurements of whether performance meets the litmus test accorded by the AHA guidelines.

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### CPR—Returns

So what do we have to show for all of this invested effort? Keep in mind that the number of CPR certifications and recertifications need to be multiplied for each healthcare worker on an annual basis and then multiplied over 40 to 50 years. Do we see finely honed and flawlessly executed CPR skills, refined over decades of instruction? Can we point with pride to steadily rising CPR survival rates gleaned from these exquisitely sharpened resuscitative skills?

### Skills Evaporate Quickly Following CPR Instruction

A substantial body of research and related literature[1-27] attests to the fact that basic CPR skills decay at a rapid rate following CPR instruction. Within weeks of training classes, repeated measurements of CPR performance in simulated settings demonstrate that substantial numbers of healthcare staff no longer meet established standards. These findings hold true for all categories and levels of medical, nursing, and other healthcare personnel, as well as for lay persons, throughout the United States and internationally, and have held true for nearly 30 years, that is, since CPR performance has been examined.

## Skills Often Lacking in Actual Provision of CPR

Until quite recently, little was known regarding the quality of CPR actually provided to real victims of cardiopulmonary arrest. Two studies published earlier this year, however, offer evidence that deficient CPR performance is not only endemic in the classroom, but is generously distributed both within and outside hospitals here in the United States and abroad.

Quality of cardiopulmonary resuscitation (CPR) provided in hospital and prehospital settings

| Parameter (mean/average) | CPR guideline target values | In-hospital CPR[29] (n = 37) | Prehospital CPR[28] (n = 176) |
|---|---|---|---|
| Chest compression rate (per minute) | 100-120/min | < 90/min in 28% | 121/min during 52% of arrest time<br>Not provided for 48% of arrest time |
| Chest compression depth (per minute) | 38-51 mm | < 38 mm in 37% | 34 mm |
| Ventilation rate (per minute) | 12-16/min | > 20/min in 61% | 11/min |
| No-flow fraction | < 0.17* | 0.24 | 0.48 |

*Maximum of approximately 10 seconds out of each minute.

The 2 studies were roughly parallel in design. Wik et al[28] measured the quality of CPR performed for cardiac arrest victims in prehospital settings by paramedics and nurse anesthetists in 3 European cities (Stockholm, London, Akershus [Norway]). Abella and colleagues[29] measured the quality of CPR performed in a hospital setting (University of Chicago Hospitals) by that facility's cardiac arrest response team. Both studies employed the same instrument to measure CPR quality: a prototype monitor and defibrillator designed by Laerdal Medical (Stavanger, Norway) that was capable of sensing the rate and depth of chest compressions, the rate of ventilations, and the fraction of time during the arrest that chest compressions were not provided ("no-flow fraction"). The 2 studies also shared the same outcome measure: adherence to established CPR guidelines.

A summary of the results from the Chicago hospital-based CPR study are provided quantitatively in the Table. A synopsis of these results can also be provided qualitatively, as follows:

- Chest compression rate: too slow to be effective in many cases
- Chest compression depth: too shallow to be effective in many cases
- Ventilation rate: too fast for optimal ventilation in most cases
- No-flow fraction: too long a period without chest compressions

Results from the European prehospital CPR study were even more deficient whether viewed with quantitative (Table) or qualitative lenses:

- Chest compressions were not provided at all during 48% of cardiac arrest time. During the remaining 52% of the arrest time, chest compressions were provided at a rate faster than recommended. Combined (to account for 100% of the arrest time), the average rate of chest compressions would be 64/min, considerably slower than the recommended rate.
- Chest compression depth: too shallow to be effective
- Ventilation rate: slower than optimal
- No-flow fraction: too long a period without chest compressions

The conclusions gleaned from combining the findings of these 2 studies are disappointing at best and deadly at worst. I suppose that the silver lining is that they help explain the persistently dismal (10%) survival rate after CPR that hasn't budged significantly since CPR was first widely instituted. The study authors acknowledged this point and suggested that CPR quality might be enhanced by a greater focus on areas of deficiency during training courses[1] and through development of mechanical devices that could deliver the desired rate and depth of chest compressions and improved patient monitoring with real-time feedback to rescuers when corrections to any of these parameters is warranted.[2]

It is tempting to ascribe many CPR performance pitfalls to its emergency circumstances, its pressure-charged, often confusing, disorderly, typically unanticipated nature as well as its demand for therapeutic coordination amidst circumstantial chaos. Despite all these realities, there remains something especially elusive about performing CPR skills so that they conform to established standards. Although we often seem to seek answers to problems such as these by generating more and more detailed quantitative and technological "data," somehow I'm not convinced that even more practice, more complex technology, more measurements, and/or more data will effect better CPR. My instincts as a BCLS, ACLS, and regional ACLS instructor trainer for many years suggest that the opposite may be true.

## Rethinking CPR

What is it about this set of behaviors that so often defies attainment? If other lifesaving emergency measures can be learned, executed, and performed "the right way," such as extinguishing fires, the Heimlich maneuver, intubation, or defibrillation, why is CPR so often performed incorrectly? If practice makes perfect, shouldn't we expect that 40 or 50 years of practice should suffice to perfect CPR prowess? Perhaps it is an opportune time to reconsider how we learn and retain such activities.

When we learn a group of related behaviors that are components of a more inclusive task or activity, we depend on a form of long-term memory called procedural memory, which enables us to gradually learn how to do things by repeatedly performing them. After sufficient repetition, we no longer need to recall the discrete sequential steps involved with performing that activity; we are able to execute the entire procedure without thinking about it at all. After we have acquired a procedural memory, 2 other effects become apparent: the first is an extended (sometimes lifetime) retention of how to perform that procedure. Thus, even if it has been years since we have ridden a bicycle or skied a mogul, once those activities have been thoroughly learned, we can quickly jump on a bicycle and pedal away or lock on our skis and head down a slope. In so doing, our so-called muscle memory enables us to quickly recognize and make any corrections necessary until our performance "feels right" to us. The second effect is that once memory of the procedure is formed, it becomes very difficult and disruptive to go back and refocus on the serial behaviors that comprise the activity we are accustomed to performing automatically. For example, any parent who has taught a child how to drive a car with a manual transmission knows how awkward and slow that teaching process can be when we haven't concentrated on those serial details for 18 or 20 years. We repeat the phrase, "Wait, let me think about how to do this," innumerable times because we struggle to return to thinking in those separate, sequential terms.

Once we have mastered the "correct performance" of the maneuvers that comprise CPR, does the persistent need for rescuers to focus on moment-to-moment details (eg, rates/minute and mm/compression, seconds without compression) not represent the same type of regressive serial thinking that would make us fall off a bicycle, wipe out on a ski slope, or stall a car with manual transmission? Once we have learned how to perform CPR (ie, have developed procedural memory for that activity), isn't it just as unnatural and contrary to procedural learning to focus on those details? It may be that the current form of CPR performance prevents the formation of procedural memory or that the necessity of focusing on its constituent behaviors unravels whatever procedural memory existed.

Rather than searching for greater volumes or details in CPR performance data, perhaps a search for simplicity in these procedures would be a more promising approach. Consider the automated external defibrillator (AED). Not so long ago, only physicians could perform the complex and potentially dangerous defibrillation procedure. Today, with the help of user-friendly, ultra-simplified AED technology, anyone who can hear, read, or just follow pictorial directions can successfully defibrillate a victim of cardiac arrest. Perhaps there is a lesson there for CPR procedures. This month, the 2005 International Consensus on CPR and ECC [Emergency Cardiovascular Care] Science with Treatment Recommendations Conference publishes its latest guidelines. Let's hope that they offer CPR guidelines that can actually be learned, retained, and provided to victims of cardiac arrest.

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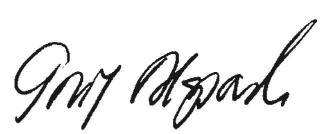

Grif Alspach, RN, MSN, EdD
Editor