Appropriate CPR techniques for carers of infants outside of hospital

Corresponding Author:

Rachael K Gregson PhD, Respiratory, Critical Care and Anaesthesia (RCCA) section in Infection, Immunity and Inflammation (III) Programme[1] & Paediatric and Neonatal Intensive Care[2] r.gregson@ucl.ac.uk

Telephone: 020 7905 2382

Professor Mark J Peters, **PhD**, RCCA in III[1] & Paediatric and Neonatal Intensive Care[2]

[1]UCL Great Ormond Street Institute of Child Health, London WC1N 1EH, UK
[2]Great Ormond Street Hospital NHS Foundation Trust, London, WC1N 3JH. UK

(UCL, University College London)

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1 Figure

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Sudden out-of-hospital cardiac arrest with unsuccessful cardiopulmonary resuscitation (CPR) is the third leading cause of death in industrialised nations. Up to 70% of out-of-hospital cardiac arrests are witnessed by family members, friends and other bystanders. A greater percentage of cardiac arrests in infants are likely to involve first responders who are the child's family members or other close care-givers. There is considerable rescuer variation in compression treatment styles, as shown in Figure 1.[1] When compared with adults, relatively few CPR data exist regarding treatment of children during cardiac arrest. As a result, internationally-agreed CPR guidelines have been developed with data often extrapolated from adults or animal studies.[2]

Evidence suggests people feel unprepared for resuscitation of young children, babies and infants. Outcomes of infant CPR remain poor. This is partially due to the aetiology of the arrest with hypoxia being much more common than primary arrhythmia. However, poor quality chest compressions probably contribute to low return of spontaneous circulation rates. Training in CPR is believed to enhance real-life performance. Much effort is being expended to 'upskill' the general public in CPR, facilitating both competence and confidence. These include global initiatives such as the 'World Restart a Heart Day' and 'Kids Save Lives', this latter statement being endorsed by the World Health Organisation. When treating older children and adults, internationally accepted wisdom promotes the delivery of chest compression force using two interlocked and plantar-facing heels of the hand. However, in infants, there is some evidence to support the claim that encircling the infant's chest with the hands and applying compressions to the sternum through the two thumbs may be preferable to two-fingered compressions. Traditionally, two-thumb and two-finger infant chest compression techniques rarely comply with compression targets.[3] Recently, a variety of additional infant CPR techniques have been proposed using fingers or thumbs with varying accompanying styles of fist-clenching, torso-encircling and 'finger-knocking'.[4-6] It is proposed that the latter technique, involving the combined use of a finger and thumb, both

improves compression performance and allows delivery of ventilatory support by a lone rescuer.

In this issue, *Pellegrino et al.* present the results from their randomised crossover study of chest compression treatments for a 3-month-old-sized manikin, comparing two-finger with two-thumb-encircling techniques by lay infant care-givers. The 42 care-givers were predominantly young females, with a median age of 17 years. They were enrolled from a Midwestern city in the USA, via schools and community health services. None had received infant CPR training in the previous five years. Following randomisation, they received instruction in infant ventilation and in their first chest compression technique, practising on the manikin while receiving visual feedback and coaching. After eight minutes of monitoring there was a thirty minute washout period followed by the second set of CPR instruction and performance of their second treatment technique. The researchers found that the two-thumb-encircling technique was preferred by lay rescuers and resulted in a 2mm deeper compression of the chest. They highlighted the high prevalence of long fingernails amongst the rescuers as being a significant contributory factor for the unpopularity of the two-finger technique – an important physical constraint to consider. However, neither of the techniques studied here 'worked ideally' in the single-responder scenario, in terms of: maintaining the desired 40mm compression depth over the full 8 minutes, the compression fractions achieved or producing full release with two-thumb-encircling. The researchers' findings lend support to the Guidelines' recommendation to change every two minutes the rescuer who is delivering chest compressions. Improved Guidelines-compliant performance compared with other groups studied[3] was attributed to the use of visual feedback during the practice sessions. Real-time feedback during chest compressions often re-aligns inappropriate treatments to comply with internationally-prescribed targets.[3,7] Use of an infant manikin which allowed compression depths exceeding 40mm was also cited as a reason for the improved performance recorded in this study.

Interestingly, the infant manikin was placed on a 'standard height table' (71cm). Where infant chest compressions are delivered has implications both in terms of the springiness of the supporting surface (which may significantly dissipate the force applied at the sternum) and the posture required of the rescuer. One might expect that many infants would be placed on the floor to receive CPR at home – or at least that this should be promoted where possible. Whether rescuers kneel to administer treatment on a hard floor, or adopt a more upright stance for treatment of an infant in a cot merits investigation in lay populations. For the treatment of older children and adults, whether the rescuer is kneeling, crouching or standing influences the rescuer's ability to rock the upper body backwards and forwards over their outstretched arms, locked extended at the elbows. This study suggests rescuers' physical characteristics may influence treatment preference and effectiveness. Variables including clothing styles may also influence rescuers' posture, comfort and even the onset of fatigue. [8,9] Questions have previously been raised about the most effective way to educate lay volunteers. This research should challenge health professionals to consider *all* characteristics influencing 'stakeholder willingness' to use specific CPR techniques – not simply the more usually acknowledged demographic variables of body size, hand-dominance, levels of fitness and agility.

Unfortunately, correct ventilation could not be objectively measured in this study. Additional limitations include the binary scoring of correctly released compressions, which prevented correlation with the rescuers' experience of pain. The location of pain within the body (hand, arms or back) differed between the two techniques. The researchers also commented that they felt the group format for training reduced the level of stress experienced by the lay rescuers during cardiac arrest, reducing the realistic nature of this simulation.

In summary, this study by Pellegrino and colleagues provides important data about the willingness and ability of lay care-givers to perform specific techniques during out-of-hospital infant CPR. Clearly, additional work supplementary to manikins is needed in animal models and real infants to explore the compression profiles of the growing array of infant chest

compression techniques. These techniques must be related to treatment outcomes. The practical challenges are great but, stimulated by these data, resuscitation scientists will continue to refine infant CPR techniques.

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Figure

Figure 1 – Variation in compression profiles of two health professionals treating the same young child during cardiac arrest

cpm = compressions per minute

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