**WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care**

**Worksheet author(s)**  
Leon Chameides  

**Date Submitted for review:**  
1-18-2009; search repeated 10-1-2009 and resubmitted

**Clinical question.**

For newborns within the first month of life (beyond the delivery room) who are not intubated and who are receiving CPR (P), does the use of a 3:1 compression to ventilation ratio (I), compared with a 15:2 compression to ventilation ratio (C) improve outcome (time to sustained heart rate >100, survival to ICU admission, survival to discharge, discharge with favorable neurologic status) (O)?

**Is this question addressing an intervention/therapy, prognosis or diagnosis? Intervention/therapy**

State if this is a proposed new topic or revision of existing worksheet: New topic

**Conflict of interest specific to this question**

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? None

**Search strategy (including electronic databases searched).**

<table>
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<tr>
<th>Database</th>
<th>Search Terms</th>
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| Medline           | Cardiopulmonary resuscitation (MeSH Keyword) and Infant (MeSH Keyword) – 612 hits  
|                   | Heart massage (MeSH Keyword) and Infant (MeSH Keyword) – 192 hits            |
|                   | Cause of Death (MeSH Heading) and Infant (MeSH Keyword) – 1075 hits          |
| Cochrane Library  | Cardiopulmonary resuscitation – 3 hits                                      |
|                   | Infant – 125 hits                                                           |
| Embase            | Cardiopulmonary resuscitation and infant - 112 hits                         |
| AHA Database      | 9 hits                                                                       |

**State inclusion and exclusion criteria**

Excluded review articles, abstracts only studies, non-peer reviewed, studies that did not answer question

**Number of articles/sources meeting criteria for further review:**

There were no articles that answered the question

10 articles were identified that had a peripheral impact on the question –
## Summary of evidence

### Evidence Supporting Clinical Question

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<th>Fair</th>
<th>Poor</th>
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*Level of evidence:*

- **A** = Return of spontaneous circulation
- **B** = Survival of event
- **C** = Survival to hospital discharge
- **D** = Intact neurological survival
- **E** = Other endpoint

*Italics = Animal studies*

### Evidence Neutral to Clinical Question

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### Evidence Opposing Clinical Question

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REVIEWER’S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

The following assumptions are made for this worksheet:

- The arrest is in-hospital
- Resuscitated by health care professionals

It should be noted that a “one month old newborn” can be term (3-5 kG) or preterm (1-3 kG)

Current Recommendations:

**Neonatal:** COSTR – not mentioned

**AHA Guidelines:** 3:1 ratio of compressions to ventilations with 90 compressions and 30 breaths to achieve approximately 120 events per minute and coordination between compressions and ventilations so as to avoid giving both at the same time.

**Infant:** COSTR – There is insufficient data to identify an optimal compression/ventilation ratio. For healthcare providers performing 2-rescuer CPR, a compression/ventilation ratio of 15:2 is recommended

**The Problem:** Should a one-month old be treated according to “neonatal” or “infant” guidelines?

In 2005 we moved from a 5:1 to 15:2 compression/ventilation (for professional rescuers) and 30:2 (for lay people) for infants and children for the following reasons:

- Manikin studies (Kinney 2000;115; Dorph 2002;259; Greengor 2002;263; Srikantan 2005;293) have shown that lone rescuers cannot deliver the desired number of chest compressions per minute at a ratio of 5:1.
- A mathematical model (Babbs 2004;173) supports compression/ventilation ratios greater than 5:1 for most infants and children
- An animal study (Berg 2001;2465) shows that coronary perfusion pressure, a major determinant of success in cardiac resuscitation, declines with interruptions in chest compressions after which several chest compressions are needed to restore the coronary perfusion pressure.
- Long interruptions in chest compressions reduce the likelihood of spontaneous circulation in adults with VF (Eftestol 2002;2270; Yu 2002;368; Kern 2002;645)
- We sought uniformity for educational reasons

Neither COSTR 2005 nor Guidelines 2005 have been clear on which compression/ventilation ratio (3:1 or 15:2) applies in the first month of life outside the delivery room and the question is scientifically unanswerable since there are no data. The following should however be considered:

- Babbs et al. (2004; 173) examined a model of the optimal C:V ratio (for single rescuer) taking into account oxygen delivery and blood flow during CPR. They found that the optimal C:V ratio increased with weight and could be defined by the formula 1.5 x √ weight in kg. According to this, the ideal c:v ratio for 2 kG = 3.24; for 3 kG = 2.7; for 5 kG = 3.04
- Srikantan et al (2005;293), although single rescuer, is the only manikin study to have included a 3:1 ratio. For the infant manikin they found that effective chest compressions per minute did not differ between ratios (3:1, 5:1, 10:2, and 15:2) but effective ventilations were greatest at 3:1 ratio
- The overwhelming majority of infants who die in the first month of life are prematurely born, and in 1/3 of neonatal deaths, prematurity is the direct cause of death (Callaghan 2006;1566). There is a paucity of data on the mechanism of death but clinicians are convinced that the overwhelming majority die an asphyxial death
- Delivery room and NICU staff are currently taught NRP (3:1 ratio); ped ICU personnel are taught PALS (15:2 ratio)

**Knowledge gaps:**

- Data on the mechanism of arrest in neonates who undergo resuscitation (this is different than the cause of death because in some neonates resuscitation might not be attempted – Finan 2006; Hagen 2004; Singh 2004)
- There are no clinical or animal studies on the effectiveness of a 3:1 compression/ventilation ratio in newborns
• Is the 15:2 ratio superior for cardiac cause of the arrest vs respiratory?
• Is there educational science to suggest that health care professionals will perform better if they have to learn only one rather than two ratios?

Acknowledgements:

Citation List


LOE 5 (mechanical model); Fair (Based on model with no control, not blinded). Authors examined a model of the optimal C:V ratio (for single rescuer) taking into account oxygen delivery and blood flow during CPR. They found that the optimal C:V ratio increased with weight and could be defined by the formula $1.5 \times \sqrt{\text{weight in kg}}$. According to this, the ideal c:v ratio for 2 kG = 3.24; for 3 kG = 2.7; for 5 kG = 3.04


LOE 5 (animal); Good (randomly assigned, not concealed and not blinded) shows that coronary perfusion pressure, a major determinant of success in cardiac resuscitation, declines with interruptions in chest compressions after which several chest compressions are needed to restore the coronary perfusion pressure


LOE 4 (retrospective); Good (role of preterm contribution to death subjective). This shows that the overwhelming majority of infants who die in the first month of life are prematurely born, and in 1/3 of neonatal deaths, prematurity, is the direct cause of death. There is no data on the mechanism of death (whether it is asphyxial.


LOE 5 (mechanical model); Fair (not randomized or blinded) shows that lone rescuers cannot deliver the desired number of chest compressions per minute at a ratio of 5:1.


LOE 5 (adult); Fair (not randomized or blinded) Long interruptions in chest compressions reduce the likelihood of spontaneous circulation in adults with VF

LOE 5 (manikin); Good (prospective but not randomized or blinded) shows that lone rescuers cannot deliver the desired number of chest compressions per minute at a ratio of 5:1.


LOE 5 (animal); Good (randomized but not blinded) Long interruptions in chest compressions reduce the likelihood of spontaneous circulation in adults with VF. Continuous chest compressions produced the greatest neurologic normal 24 hour survival


LOE 5 (manikin); Fair (not blinded) Comparing compression:ventilation ratios of 5:1, 10:2, and 15:2 delivered by nurses working in pairs, the number of breaths delivered was greatest for a ratio of 5:1 and the number of effective chest compressions were greatest at 5:1


LOE 5 (manikin); Good shows that ventilations were favored in a lower compression/ventilation ratio and compressions were favored in higher ratios. 30:2 ratio was not studied. Rescuers preferred a 15:2 ratio over 5:1 ratio and fatigued less with that ratio. Although single rescuer study, this is the only manikin study with a 3:1 ratio. For the infant manikin they found that effective chest compressions per minute did not differ between ratios (3:1, 5:1, 10:2, and 15:2) but effective ventilations were greatest at 3:1 ratio


LOE 5 (animal); Good Long interruptions (greater that 15 seconds) in chest compressions reduce the likelihood of spontaneous circulation in animals with VF