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

**Worksheet author(s)**

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**Clinical question.**

In neonates (P) receiving positive pressure during resuscitation, is positive pressure ventilation by T-piece resuscitator (I) superior to bag ventilation (C) for improving outcome - specify (O)?

For the purposes of this review outcome has been taken to mean “restoration of physiological stability”.

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

**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? No

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

Cochrane database for systematic reviews, central register of control trials, review of references from review articles.

PubMed, Embase and Scopus using MeSH terms: Positive-Pressure Respiration/*instrumentation OR Artificial respiration/*instrumentation OR Insufflation/*instrumentation OR Laryngeal Masks AND Cardiopulmonary resuscitation OR Heart arrest/*therapy AND Infant, newborn

In addition Keywords: T piece resuscitation; newborn resuscitation; neopuff

For PubMed the inclusive terms resulted in 11882 articles which reduced to 348 when the restrictive terms were added.

For Scopus the inclusive terms resulted in 11319 articles which reduced to 27 when the restrictive terms were added.

For Embase the inclusive terms resulted in 1393 articles which reduced to 5 when the restrictive terms were added.

The Cochrane library was searched just on the terms: Infant, newborn and this produced 616 articles.

AHA ECC Endnote library produced no relevant articles using the same terms.

Since the number of articles identified was small, all references in the selected articles were also assessed for relevance for inclusion as well as articles identified by Scopus as citing the selected article.

Only articles in peer review publications were included and no abstract only studies. Articles that assessed either T-piece resuscitation devices or bag systems in isolation were excluded. Studies which allowed a direct comparison of the two systems were included.

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**State inclusion and exclusion criteria**

Studies involving T piece devices that were used in ways that could not be compared to bag and mask systems eg with a naso pharyngeal tube were excluded. Similarly studies that related to care beyond immediate resuscitation were also excluded. Studies looking at patterns of use (eg surveys of practice) were excluded.

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

A total of 978 articles were identified as potentially eligible for inclusion. Following exclusions as outlined above 7 met the criteria for further review.
### Summary of evidence

#### Evidence Supporting Clinical Question

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
</table>

A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = Other endpoint: E1 Achievement of desired pressures; E2 Achievement of adequate duration of pressure.

*Italics = Animal studies*
## Evidence Neutral to Clinical question

| Fair | | | | |
| Poor | | | | |

### Level of evidence

| 1 | 2 | 3 | 4 | 5 |

A = Return of spontaneous circulation | C = Survival to hospital discharge  
B = Survival of event | D = Intact neurological survival  
E = Other endpoint: E1 Achievement of desired pressures; E2 Achievement of adequate duration of pressure.

## Evidence Opposing Clinical Question

| Good | | | | | |
| Poor | | | | |

### Level of evidence

| 1 | 2 | 3 | 4 | 5 |

A = Return of spontaneous circulation | C = Survival to hospital discharge  
B = Survival of event | D = Intact neurological survival  
E = Other endpoint: E1 Achievement of desired pressures; E2 Achievement of adequate duration of pressure.
REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

In trying to deal with this particular question it was necessary to make certain assumptions and judgments about what were the key elements of performance of the two systems in deciding which might be superior. These issues were:

a) What is the main clinical situation being considered? Are the devices being considered in terms of their performance in the hands of trained, but not expert, respirators dealing primarily with mature babies who present with an unexpected need for resuscitation? Or is it their performance in the hands of more expert clinicians who will rely on them in relation to a number of clinical conditions including both term and preterm babies needing resuscitation at birth? The studies that exist have considered, to some extent, both situations but in general terms those involving more expert clinicians have looked at the more detailed aspects of performance such as the ability of the device to deliver PEEP. In terms of ILCOR recommendations the non-expert group of resuscitators are probably the most relevant.

b) Consideration of first breath / physiological data. A good deal of the physiological data that exists about the first breath and the onset of breathing following resuscitation show that for most babies resuscitation leads to the onset of spontaneous breathing and it is this which then establishes gaseous FRC and permits normal respiration. This is, of course, quite different to the situation where there is the need to provide a prolonged period of resuscitation (either because a term baby has suffered a major encephalopathic insult or because the baby is very immature) and the demands on the respirator and the resuscitation device are then far greater. There were no studies which addressed specifically the issue of use in every day practice ie no pragmatic randomized trial and no studies that reflect the variation in the nature of the babies needing resuscitation. However I have taken the view that in terms of ILCOR recommendations it is probably the routine use rather than the specialized use which is the priority (in the specialized situation the respirator is likely to have recourse to other options such as intubation).

c) What is the appropriate outcome? Clearly the success of resuscitation can be judged by the baby’s response in the short term (ie was cardio-respiratory stability restored?) or in terms of the baby’s long term health. The latter is a more complex measure as it is the result of not only the resuscitation but also the events that led to the need for resuscitation and indeed by any on-going problems. All of these are important outcomes but in terms of ILCOR recommendations it seems clear that the short term measures (restoration of cardio-respiratory stability) are the most appropriate.

With the above in mind it is important to consider that all 7 studies chosen as being relevant were based on simulated resuscitations. Obviously none could be blinded and hence the potential for bias (personal preference) was for the most part clear although in some, analysis of the respiration achieved was able to be performed without knowledge of the device.

Three studies produced data suggesting superiority of a T-piece device (Oddie 2005:109; Hussey 2004:490; Finer NN 2001:299) all three focused on the ability of T-piece in comparison to bag and mask devices to produce consistent pressures (peak and PEEP in relation to Hussey and Finer, peak and sustained peak pressures in the relation to Oddie and Finer). Although all three studies showed better performance in relation to the T-piece system all 3 studies used experienced individuals (although the level of experience varied) in the assessment and we have no clear indication of the extent to which those individuals involved were familiar with the different devices being assessed ie what device were they used to using in day to day practice. To emphasise this point it is worth noting that Hussey included anaesthetists among the participants and they may have been responsible for the good performance of a flow inflating bag included for comparison.

Three studies produced data that was broadly neutral to the question (Bennett 2005:113; O'Donnell 2:392, 2005; O'Donnell 3, 2005:397) however the nature of these studies was somewhat different. Bennett's study used essentially skilled individuals and looked in some detail at the performance of different resuscitation devices. Although the T-piece system was superior in some aspect this was not uniform in relation to all of the assessed parameters. O'Donnell's two studies highlight the issue of leak from the mask dominating the performance of any system that uses a mask to “connect” to the baby. Use of a manometer did not improve performance and the paper makes the point that airway pressure is a poor proxy for delivered volume.

McHale’s study (McHale 2008:230) is in many ways very similar to those already described in terms of design but with the important difference that respirators were distracted during the simulated resuscitation with tasks such as calculating drug doses. The conclusions from the study were that experience lead to improved performance and that distraction reduced performance even amongst the most experienced operators.

When one considers all of these caveats I think it is fair to conclude that at the moment there is no clear evidence that T piece resuscitation is superior or inferior to bag and mask systems. It is also important to remember that self inflating bags can be used in all settings ie where pressurized gas is not available. However it is clear from a number of the studies that for both systems the mask / patient seal remains a key issue and equally training and experience emerged, not surprisingly, as being associated with improved performance. Just one study attempted to assess the effect of distraction / stress and a deterioration in performance was noted even in experienced resuscitators. Almost certainly this
is a key issue in relation to “real life” performance and hence the lack of any studies reflecting genuine resuscitation situations simply adds to the uncertainty over which type of device is superior.

Acknowledgements:

Citation List


LOE 5
Comment: This is essentially a well performed study in which various resuscitation devices were assessed using simulation. For most parameters the performance of the T piece system was superior to bag and mask however there were problems in increasing peak pressure on the T piece system quickly, if this was needed. The major weakness of the work was the fact that it used predominantly experienced resuscitators in a simulated clinical environment.


LOE 5
Comment: Essentially a well conducted study but again in simulated environment. In this study the performance of the T-piece system was definitely superior.


LOE 5
Comment: Another study from a simulated clinical environment and experienced resuscitators. Best results were obtained from the T-piece device and the anaesthetic bag (flow inflating). Those involved in the study included anaesthetists and this may explain the relatively good performance of anaesthetic bags.


LOE 5
Comment: Again a simulated clinical assessment focussing just on a T-piece system. Quite marked inconsistency was noted especially when the participants were distracted by being asked questions regarding other aspects of resuscitation such as drug administration.


LOE 5
Comment: This study also used a non clinical environment but here measurements were made on a test lung which did not provide the visual clues (such as chest movement) which can be obtained from some Baby simulators. The T-piece system performed best.


LOE 5
Comment: In this simulation the measurement of expired tidal volume allowed ventilatory volume to be assessed. The leak from the face mask meant that there was marked variation in the volume delivered for both T-piece and bag and mask systems even in the hands of experienced resuscitators.

LOE 5
Comment: This study is one of three in a series (the second is included above). The intention was to see, again in a simulated resuscitation, whether giving the resuscitator access to a manometer improved performance. The result was negative for both T piece and bag and mask systems.