**Clinical question.**

BLS 049B. *In adult patients suffering from a cardiac arrest (P) does provision of chest compressions (without ventilation) by EMS (I) compared to chest compressions plus ventilations (C) improve survival to hospital discharge (O)?*

<table>
<thead>
<tr>
<th>Is this question addressing an intervention/therapy, prognosis or diagnosis?</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>State if this is a proposed new topic or revision of existing worksheet:</td>
<td>Revision of Existing Worksheet</td>
</tr>
</tbody>
</table>

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

Interventional trials will be identified in the Cochrane Controlled Trials Register (CCTR), PUBMED, EMBASE, CINAHL, Current Contents, AHA Endnote database using the following initial search strategy: (chest compression*) AND (randomized controlled trial[Publication Type] OR (randomized[Title/Abstract] AND controlled[Title/Abstract] AND trial[Title/Abstract])). Text Word Headings were also searched using combinations of 'cardiac arrest', 'chest compression', 'continuous chest compression', and 'ventilation'. Reference lists of all available primary studies and review articles were reviewed to identify potential relevant citations. Trials were not excluded on the basis of language. Inquiries regarding other published or unpublished studies known and/or supported by the authors of the primary studies will be made so that these results could be included in this review. Several pathways will be used to locate authors including letters to an address presented in the article, Internet ‘People and Hospital Searches’, electronic author searches in library databases for the address on the most recent article published by the author, and contact with other reviewers in the where feasible. Personal contact with colleagues, collaborators and other researchers working in the field of resuscitation was made to identify potentially relevant studies. Papers were reviewed for relevance based on available title and abstract. Papers were reviewed for inclusion based on full article review. There was single author review for relevance and inclusion.

**State inclusion and exclusion criteria**


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

48 studies met criteria for further review, including: two LOE 1, three LOE 2, two LOE 3, thirteen LOE 5 (human studies looking with possible EMS professional response), sixteen LOE 5 (animal models), and thirteen LOE 5 (educational/mathematical models).
# Summary of evidence

## Evidence Supporting Clinical Question, N=16

<table>
<thead>
<tr>
<th>Good</th>
<th>Animal Model</th>
<th>Mathematical or Educational Models</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ewy 2007E</td>
<td>Heidenrich 2006E</td>
</tr>
<tr>
<td></td>
<td>Kern 2002E</td>
<td>Higdon 2006E</td>
</tr>
<tr>
<td></td>
<td>Sanders 2002E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Berg 2001E</td>
<td>Rittenberger 2006E</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heidenrich 2004E</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dias 2007E</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Woollard 2003E</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Babbs 2002E</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Turner 2002E</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fair</th>
<th>Level of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Poor</th>
<th>Level of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

### 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, N=21

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Animal Model</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hayes 2007E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Berg 1997E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Berg 1997E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Berg 1995E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noc 1995E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chandra 1994E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Berg 1993E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mathematical or Educational Models</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kelley 2006E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Odegaard 2006E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dorph 2003E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Swor 2003E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Williams 2006E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bystander Type/Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nagao 2007D</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Waalewjin 2001C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bystander Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bohm 2007C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Iwami 2007D</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No Descriptor Type/Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Olasveengen 2008C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ong 2008C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hallstrom 2000C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

**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 Opposing Clinical Question, N=11

<table>
<thead>
<tr>
<th>Good</th>
<th>Animal Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dorph 2004E</td>
</tr>
<tr>
<td></td>
<td>Kawamae 2001E</td>
</tr>
<tr>
<td></td>
<td>Berg 2000E</td>
</tr>
<tr>
<td></td>
<td>Berg 1999E</td>
</tr>
<tr>
<td></td>
<td>Idris 1994E</td>
</tr>
<tr>
<td></td>
<td>Bystander Type</td>
</tr>
<tr>
<td></td>
<td>Holmberg 2001C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fair</th>
<th>EMS Responder</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Krischner 1989C</td>
</tr>
<tr>
<td></td>
<td>Bystander Type</td>
</tr>
<tr>
<td></td>
<td>Wik 1994C</td>
</tr>
<tr>
<td></td>
<td>Van Hoeyweghen 1993B</td>
</tr>
<tr>
<td></td>
<td>Bossaert 1989C</td>
</tr>
<tr>
<td></td>
<td>No Descriptor</td>
</tr>
<tr>
<td></td>
<td>Type/Training</td>
</tr>
<tr>
<td></td>
<td>Gallagher 1995C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Poor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

The body of evidence was systematically searched and compiled using contemporary evidence-based medicine strategies. The original clinical question being evaluated was, “In adult patients suffering from a cardiac arrest (P) does calling of EMS and the provision of chest compressions (without ventilation) by trained laypersons or professionals (I) compared with calling EMS and starting chest compressions plus mouth-to-mouth breathing (C) improve survival to hospital discharge (O)?” However, this was modified over the worksheet evaluation cycle to separate into “In adult patients suffering from a cardiac arrest (P) does provision of chest compressions (without ventilation) by EMS (I) compared to chest compressions plus ventilations (C) improve survival to hospital discharge (O)?” and to have the bystander (trained and untrained) addressed in another worksheet (BLS 047).

The evidence spanning this question encompasses over 5 years of educational/mathematical models, 15 years for animal studies, and 25 years for human studies. Over this period there have been substantive changes to what is described as standard or conventional CPR including an evolution of compression to ventilation ratios from 5:1, to 15:2, to 30:2. There is a paucity of data comparing what is currently defined as ‘standard’ layperson CPR and compression only CPR, and this is reflected in one single porcine model.

Mathematical/Educational Model
Regarding compression only CPR in the mathematical/educational model, there is reasonably good evidence supporting chest compression only CPR over chest compression and ventilation (8 studies). Educational target groups have included patients waiting in the Emergency Department, firefighters, medical students, paramedics and senior citizens. There is also reasonably good evidence from five LOE 5 citations that there is no difference between the two forms of CPR.

Animal Models
Regarding compression only CPR in the animal model, there are four studies favoring compression only CPR over compression/ventilation CPR (all good quality), seven papers with neutral evidence (1 good, six fair quality), and five papers (4 good, 1 fair quality) favoring compression/ventilation CPR over compression only CPR. The majority (14/16) of these citations utilize a porcine model, with one canine and one rodent model, with inherent methodological limitations. For the porcine model of arrest, it is important to note that pigs will frequently gasp during effective CPR, and more importantly are able to maintain a patent airway during unresponsiveness. In contrast, evidence has demonstrated that based on human anatomy, pulseless patients with a head in the neutral position will have an obstructed airway (Ruben Anes 1961 22 271-279, Safar JAMA 1961 176 574-76, Steen CIRC 2007 116:2514-16.). For all of the studies with supporting, or neutral findings, there was an endotracheal tube inserted into the airway of the animal that remained patent through the resuscitation sequence. For those studies supporting compression/ventilation CPR over compression only CPR, these animals were either paralyzed (Idris et al), or had an endotracheal tube that was clamped mimicking the airway obstruction that would be presumed present in humans during compression only CPR.

The Ewy et al paper was the only contemporary paper that evaluated the 30:2 compression rate that is currently recommended by CoSTR/ILCOR, and it was demonstrated that compression only CPR was superior to compression/ventilation CPR. The same methodological limitations apply here with an unobstructed ETI and a model associated with spontaneous gasping during CPR.

Human Studies
<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Standard of Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olasveengen</td>
<td>2008</td>
<td>Norway</td>
<td>2003-2006</td>
</tr>
<tr>
<td>Ong</td>
<td>2008</td>
<td>Singapore</td>
<td>2001-2004</td>
</tr>
<tr>
<td>Kellum</td>
<td>2006</td>
<td>United States</td>
<td>2001-2005</td>
</tr>
<tr>
<td>Nagao</td>
<td>2007</td>
<td>Japan</td>
<td>2002-2003</td>
</tr>
<tr>
<td>Bohm</td>
<td>2007</td>
<td>Sweden</td>
<td>1990-2005</td>
</tr>
<tr>
<td>Bertrand</td>
<td>2006</td>
<td>France</td>
<td>2000-2003</td>
</tr>
<tr>
<td>Hallstrom</td>
<td>2000</td>
<td>United States</td>
<td>1998</td>
</tr>
<tr>
<td>Saissy</td>
<td>2000</td>
<td>France</td>
<td>5:1 ratio</td>
</tr>
<tr>
<td>Gallagher</td>
<td>1995</td>
<td>United States</td>
<td>6 month period unknown</td>
</tr>
<tr>
<td>Wik</td>
<td>1994</td>
<td>Norway</td>
<td>1985-1989</td>
</tr>
<tr>
<td>Van Hoeyweghen</td>
<td>1993</td>
<td>Belgium</td>
<td>1983-1989</td>
</tr>
<tr>
<td>Krischner</td>
<td>1989</td>
<td>United States</td>
<td>40 CCC</td>
</tr>
<tr>
<td>Bossaert</td>
<td>1989</td>
<td>Belgium</td>
<td>1983-1987</td>
</tr>
</tbody>
</table>

Of the 19 human studies, 7 were exclusively EMS responders [Bertrand 2006 p843, Bobrow 2008 p1158, Bobrow 2009 p656, Kellum 2006 p335, Kellum 2008 p244, Krischner 1989 p1263, Saissy 200 p1523]. In the remaining 12 studies only 8 studies made reference to the bystander type in various formats (eg professional responder, non-lay responder) [Bohm 2007 p2908, Bosseart 1989 p599, Holmberg 2001 p511, Iwami 2007 p2900, Nagao 2007 p920, Van Hoeyweghen 1993 p47, Waalewijn 2001 p273, Wik 1994 p195]. In these twelve papers is feasible that ‘off-duty’ EMS providers could have been the responder, but this was ascertainable from the available information neither in the manuscript nor through author contact. Hence these papers were included in the data summary but codified only in LOE 5.

**EMS Responders (N=7)**

Krischner et al evaluated nine hundred ninety-four patients were enrolled in a field trial in which ambulance crews were randomly assigned to use simultaneous compression-ventilation (SC-V) CPR or conventional CPR procedures in the prehospital setting. This citation was reflected in the evidence summary, but was allocated a LOE 5.

Two citations, Saissy 2000 and Bertrand 2006 evaluated continuous insufflations of oxygen during the resuscitation while providing continuous chest compressions. Saissy 2000 used a clinical trail model, but poor study methodology, an early closure of the trial, and lack of clinical outcome measures (the majority of the measure were physiological) limits its generalizability. Bertrand 2006 utilised an advanced airway device (Boussignac tube during the resuscitation) and predominantly physiological outcome measure which it too limits generalisability of the article to this worksheet.
Bobrow et al 2009 demonstrated that in subset of out-of-hospital cardiac arrest patients (adult, witnessed, ventricular fibrillation/ventricular tachycardia), resuscitated with minimally interrupted cardiac resuscitation, adjusted neurologically intact survival to hospital discharge was higher for individuals receiving initial passive ventilation than those receiving initial bag-valve-mask ventilation. This was illustrated in a 45 month period between Jan 1 2005 and Sept 2008. The analysis included consecutive adult out-of-hospital cardiac arrest patients receiving resuscitation with minimally interrupted cardiopulmonary resuscitation (CPR) consisting of uninterrupted preshock and postshock chest compressions, initial noninvasive airway maneuvers, and early epinephrine. Paramedics selected the method of initial noninvasive ventilation, consisting of either passive ventilation (oropharyngeal airway insertion and high-flow oxygen by nonrebreather facemask, without assisted ventilation) or bag-valve-mask ventilation (by paramedics at 8 breaths/min).

Bobrow et al 2008, demonstrated among the 886 patients, survival-to-hospital discharge increased from 1.8% (4/218) before MCIR (minimally interrupted cardiac resuscitation) training to 5.4% (36/668) after MICR training (odds ratio [OR], 3.0; 95% confidence interval [CI], 1.1-8.9). Methodological limitations of this study included: [1] BMV was still permitted at a rate of 8 breaths per minute; [2] endotracheal intubation was increased in the MCIR cohort, and [3] control group using AHA 2000 guidelines.

Kellum et al 2006 reported in the 3 years preceding the change in protocol, where standard CPR was utilized, there were 92 witnessed out-of-hospital adult cardiac arrests with an initially shockable rhythm. Eighteen patients survived, and 14 of 92 (15%) were neurologically intact. After implementing the uninterrupted chest compression protocol in early 2004, there were 33 witnessed out-of-hospital adult cardiac arrests with an initially shockable rhythm. Nineteen survived, and 16 of 33 (48%) were neurologically normal. Differences in both total and neurologically normal survival were reported are significant (chi-squared =0.001). In a further study on the expanded cohort, Kellum 2008 reported that in the 3 years preceding the change in protocol, there were 92 witnessed arrests with an initially shockable rhythm. Eighteen patients survived (20%) and 14 (15%) were neurologically intact. During the 3 years after implementation of the new protocol, there were 89 such patients. Forty-two (47%) survived and 35 (39%) were neurologically intact. The lack of a randomised clinical trial in this study limits its generalizability.

Potential EMS Responders (eg off duty EMS may have been present in the study population).
Four observational prospective cohort studies conducted between 1990 and 2005, demonstrated no statistical significant differences in survival between compression only CPR and compression:ventilation CPR. Nagao et al demonstrated no significant difference in 30 day survival (with favorable neurological outcome) for adult patients with witnessed OOHCA from both cardiac and noncardiac causes between compression only and compression/ventilation bystander CPR. Iwami et al, also reported no difference in one year neurologically intact survival between cardiac etiology OOHCA patients who received compression only versus compression/ventilation bystander CPR. Bohm et al, also found no statistically significant difference between OOHCA patients who received compression only versus compression/ventilation bystander CPR. Waalewijn et al, also reported similar findings of no statistically significant difference between the two groups in question. In each of these studies, compression only CPR was associated with statistically improved outcomes compared to no bystander CPR. As any EBM practitioner is aware, it is extremely important to note that these are observational studies, and the lack of evidence to demonstrate a difference, does not translate to say that there is evidence of a lack of difference between the two studies.

Regarding studies opposing the concept of compression only CPR, Holmberg et al demonstrated that survival to 1 month was 8.2% among patients who received bystander cardiopulmonary resuscitation vs 2.5% among patients who did not receive it (odds ratio 3.5, 95% confidence interval 2.9-4.3). The effect of bystander cardiopulmonary resuscitation on survival was related to: (1) the interval between collapse and the start of bystander cardiopulmonary resuscitation (effect more marked in patients who experienced a short delay); (2) the quality of bystander cardiopulmonary resuscitation (effect more marked if both chest compressions and ventilation were performed than if either of them was performed alone); (3) the category of bystander (effect more marked if bystander cardiopulmonary resuscitation was performed by a non-layperson); (4) interval between collapse and arrival of the ambulance (effect more marked if this interval was prolonged); (5) age (effect more marked in bystander cardiopulmonary resuscitation among the elderly); and (6) the location of the arrest (effect more marked if the arrest took place outside the home).

There were six papers of ‘fair’ methodological quality which oppose the concept of compression only CPR (five LOE 2, one LOE 4). Bossaert et al reported the following survival rates: no bystander CPR: longterm survival was 6%, normal CPR had survival of 12% (p<0.001) and ECC (external cardiac compression) had survival of 9% (p=0.05). Wik et al (LOE 2) demonstrated a survival to discharge rate after compression/ventilation CPR of 23%, ‘no good CPR’ of 1% (p<0.0005) and no BCPR of 6% (p<0.0005). Van Hoeyweghen et al (LOE 2), demonstrated a long-term survival of 16% in patients with compression:ventilation CPR, 10% in compression only CPR, and 7% in no bystander CPR.
<table>
<thead>
<tr>
<th>Layperson</th>
<th>EMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untrained</td>
<td>Trained</td>
</tr>
<tr>
<td>Unwilling</td>
<td>Willing</td>
</tr>
<tr>
<td>Unable</td>
<td>Able</td>
</tr>
<tr>
<td>Inexperienced</td>
<td>Experienced</td>
</tr>
<tr>
<td>CC only</td>
<td>CC only</td>
</tr>
</tbody>
</table>

Acknowledgements:
Nil
REFERENCES

EDUCATIONAL MODELS/SIMULATION STUDIES

  LOE: 5
  QUALITY: good
  DIRECTION OF SUPPORT: neutral
  COMMENTS: mathematical model, no evidence industry sponsorship, shows progressive rise in oxygen flow then drop off

  LOE: 5
  QUALITY: good
  DIRECTION OF SUPPORT: supporting
  COMMENTS: no report of industry sponsorship

  LOE: 5
  QUALITY: good
  DIRECTION OF SUPPORT: neutral
  COMMENTS: no report of industry sponsorship

  LOE: 5
  QUALITY: good
  DIRECTION OF SUPPORT: supporting
  COMMENTS: no industry support

  LOE: 5
  QUALITY: good
  DIRECTION OF SUPPORT: supporting
  COMMENTS: no industry support

  LOE: 5
  QUALITY: good
  DIRECTION OF SUPPORT: supporting
  COMMENTS: no industry support

  LOE: 5
  QUALITY: good
DIRECTION OF SUPPORT: supporting
COMMENTS: no report of industry sponsorship


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: supporting
COMMENTS: no obvious industry support


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: supporting
COMMENTS: no report of industry sponsorship, mathematical model, supportive for CCC in first four minutes, and then CCC is inferior after 4 minutes


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: supporting
COMMENTS: no report of industry sponsorship


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: supporting
COMMENTS: no report of industry sponsorship

ANIMAL STUDIES


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship.

LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship.


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship, used ischemic etiology for the cardiac arrest.


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship, in contrast to the above citation this was induced without ischemic etiology, there was no occlusion of the coronary artery.


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: opposing
COMMENTS: no report of industry sponsorship, asphyxia-precipitated etiology for the arrest, this applies to drowning, trauma, airway obstruction, acute respiratory distress, apnea +/- drugs, and prolonged cardiac arrest, ETI were actually clamped.


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: opposing
COMMENTS: no report of industry sponsorship, no report of industry sponsorship, asphyxia-precipitated etiology for the arrest, this applies to drowning, trauma, airway obstruction, acute respiratory distress, apnea +/- drugs, and prolonged cardiac arrest.


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: supporting
COMMENTS: no report of industry sponsorship, demonstrated reduced CPP and left median ventricular blood flow, and no difference in oxygen delivery, or neuro intact survival, all animals are intubated, and this may limit application to the bystander who is providing CCC without an open airway.


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship.

LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: opposing
COMMENTS: no report of industry sponsorship, they mimicked airway obstruction in the case, consistently shown that CCC is inferior when asphyxia related events are present.


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: supporting
COMMENTS: no report of industry sponsorship,


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no obvious industry support


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: opposing
COMMENTS: no report of industry sponsorship, pigs were paralyzed to avoid gasping, which occurs fairly frequently with pig models


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: opposing
COMMENTS: no report of industry sponsorship, asphyxia model of arrest, first arm had no airway management at all


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: supporting
COMMENTS: no report of industry sponsorship, simulated the delays when present as a single rescuer where there are 16 second pauses to administer the 2 breaths, in this study there was a 15:2 ratio, in the EWY 2007 paper there was 30:2 ratio,


LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship, partially it demonstrates that there is some airflow during CCC, but there was an ETI in situ, animals were intubated

LOE: 5
QUALITY: good
DIRECTION OF SUPPORT: supporting
COMMENTS: no report of industry sponsorship, good study as animals are intubated

HUMAN STUDIES


LOE: 1
QUALITY: poor, computer randomization by blocks, but high risk for breach of randomisation
DIRECTION OF SUPPORT: Neutral
COMMENTS: no report of industry sponsorship


LOE: 3
QUALITY: poor
DIRECTION OF SUPPORT: supporting
COMMENTS:


LOE: 2
QUALITY: Good
DIRECTION OF SUPPORT: Supporting
COMMENTS: No industry support. Increased ETI rate in CCC arm, also able to BMV in the CCC arm, survival rates seem very low before start at 1.8%, no actual comparison to 30:2


LOE: 3
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship, could not assess or control for the quality of bystander CPR, did not use the 30:2 or 2:30 guidelines, study ran from 1990-2005 (study ran 72 months)


LOE: 2
QUALITY: fair
DIRECTION OF SUPPORT: opposing
COMMENTS: sister article to the other Bossaert paper below. POOR QUALITY CPR DID NOT INCREASE SURVIVAL COMPARED WITH NO CPR.


LOE: 2
QUALITY: fair
DIRECTION OF SUPPORT: opposing
COMMENTS: no bystander CPR: longterm survival was 6%, normal CPR had survival of 12% (p<0.001) and ECC (external cardiac compression) had survival of 9% (p>0.05), enrolled people between 1983 and 1987, with 3083 OOHCA, with 998 with bystander CPR (2055 without) in Belgium, sister article for the other Bossaert paper, this included healthcare workers or trained people, POOR QUALITY CPR DID NOT INCREASE SURVIVAL COMPARED WITH NO CPR.

LOE: 4
QUALITY: fair
DIRECTION OF SUPPORT: opposing
COMMENTS: industry sponsorship with LUCAS device, late cardiac arrest lack of oxygenation


LOE: 2
QUALITY: fair
DIRECTION OF SUPPORT: opposing
COMMENTS: 32% bystander rate, if effective CPR then survival of 4.6%, if effective chest compressions (but ineffective vent) then survival was 2% (p1923), 2071 cardiac arrests in New York City over a six month period (undefined) POOR QUALITY CPR DID NOT INCREASE SURVIVAL COMPARED WITH NO CPR.


LOE: 1
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship, perhaps more of the clinical answer regarding dispatch instructions, telephone CPR should be limited to CCC only, study ran from January 1992 to August 30 1998 (study ran 80 months)


LOE: 3
QUALITY: fair
DIRECTION OF SUPPORT: opposing
COMMENTS: no obvious industry support


LOE: 2
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship, study period ran from May 1998 to April 2003 (60 months total)


LOE: 3
QUALITY: good
DIRECTION OF SUPPORT: supporting
COMMENTS: no obvious industry support, no comparison between 2:30 and CCC


LOE: 3
QUALITY: good
DIRECTION OF SUPPORT: supporting
COMMENTS:

LOE: 2, listed as RCT but no methods provided
QUALITY: fair
DIRECTION OF SUPPORT: opposing
COMMENTS: no obvious industry support


LOE: 2
QUALITY: good
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship, study period ran from Sept 1 2002 to Dec 31 2003 (16 months total)


LOE: 3
QUALITY: poor
DIRECTION OF SUPPORT: neutral
COMMENTS:


LOE: 2
QUALITY: poor
DIRECTION OF SUPPORT: neutral
COMMENTS:


LOE: 2
QUALITY: poor, randomization described as MDs drawing 'lots' on scene
DIRECTION OF SUPPORT: neutral
COMMENTS: no obvious industry support, very late in resuscitation


LOE: 3
QUALITY: fair
DIRECTION OF SUPPORT: opposing
COMMENTS: no report of industry sponsorship


LOE: 2
QUALITY: fair
DIRECTION OF SUPPORT: neutral
COMMENTS: no report of industry sponsorship, study ran from June 1st 1995 to August 1 1997


LOE: 2
QUALITY: fair
DIRECTION OF SUPPORT: opposing
COMMENTS: 'good' CPR lead to a survival rate of 23%, bad CPR resulted in 1% survival, and no CPR resulted in 6%, collected over 48 months between 1985 and 1989, POOR QUALITY CPR DID NOT INCREASE SURVIVAL COMPARED WITH NO CPR.