Do CPR assist devices work or are they a waste of money?

Pro

A/Prof Peter Morley
Director of Medical Education
Royal Melbourne Hospital
University of Melbourne
Do CPR assist devices work or Are they a waste of money?

Yes, Yes
Yes, No ("Goldilocks")
“You’re fired, Jack. The lab results just came back, and you tested positive for Coke.”
Conflict of interest disclosure

- Commercial/industry
  - Evidence Evaluation Expert (ILCOR/AHA)
- Potential intellectual conflicts
  - Deputy Chair Australian Resuscitation Council (ARC)
  - Chair ALS Committee ARC
  - ARC rep on International Liaison Committee on Resuscitation (ILCOR)
AUSTRALIA... A BIG COUNTRY!

9th International Spark of Life Conference
Hilton on the Park, Melbourne
Neonatal Satellite Meeting – 18 April 2013
SOL Conference 19-20 April 2013
Why am I not considered to be a bear?

I have all of the KOALAfications!
Why am I in the Water?
And what the #@% is THAT?
MOSES !!!
Cut the bullshit and take your bath!

MOSES...
His first years.
Historical attempts at CPR

Resuscitation of the Arrested Heart. Weil & Tang 1999

Figure 1–5. Barrel method.

Figure 1–10. Trotting horse method of chest compression.
Are you a lumper or a splitter
Mechanical versus manual chest compressions for cardiac arrest (Review)

Brooks SC, Bigham BL, Morrison LJ

2011, Issue 1

We included randomised controlled trials (RCTs), cluster RCTs and quasi-randomised studies comparing mechanical chest compressions to manual chest compressions during CPR for patients with atraumatic cardiac arrest.
There is **insufficient evidence from human RCTs to conclude** that mechanical chest compressions during cardiopulmonary resuscitation for cardiac arrest is associated with **benefit or harm**. **Widespread use of mechanical devices for chest compressions during cardiac is not supported by this review.** More RCTs that measure and account for CPR process in both arms are needed to clarify the potential benefit from this intervention.
For the purposes of this talk, assist devices include . . .

- Piston
- Active compression-decompression devices
- Impedance threshold device
- Vest/load distributing band
- LUCAS
So what is our starting point?
Appendix: Evidence-Based Worksheets

2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations and 2010 American Heart Association and American Red Cross International Consensus on First Aid Science With Treatment Recommendations

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The newly released resuscitation guidelines of various organisations throughout the world, including those of Australia and New Zealand, the European Resuscitation Council (ERC), and the American Heart Association (AHA), are based on this information.
Attention Dog Guardians
Pick up after your dogs. Thank you.

Attention Dogs
Grrrrr, bark, woof. Good dog.

District of North Vancouver.
Bylaw 5981-11(i)
Mechanical piston CPR
CoSTR: Treatment recommendation

• There is **insufficient evidence to support or refute** the use of piston-CPR instead of manual CPR for adult victims of cardiac arrest.

• “**Insufficient data to say worse, but in the absence of consistent benefits why bother?**”
Clinical Data: Vest CPR
Hemodynamics (Level 3) and Short-Term Survival (Level 2)

- CPP (N = 15)
  Vest: 23 ± 11 mm Hg
  Manual: 15 ± 8
  p < 0.003

- 6 Hr survival (N = 34)
  Vest: 6/17
  Manual: 1/17
  p = 0.085

No significant trauma

Load Distributing Band
High level evidence

- The sole RCT (LOE 1) that has been performed [Hallstrom, 2006, 2620-8] compared the load-distributing band with manual CPR in over 1000 patients with OOHCA, and demonstrated worse neurological outcomes, and a trend to lower hospital discharge (after being stopped early by the data and safety monitoring board).
How could this be?
Paradis 2010

- A post-hoc analysis of this study demonstrated significant heterogeneity between sites.
- One site (site C) had a substantive decrease in survival to hospital discharge, whereas the other sites did not reflect these “safety concerns” and these sites appeared to demonstrate a steadily “improving four hour survival” with patient enrollment.
- All authors consultants/employees of manufacturer
2011: The CIRC trial

“CIRCULATION IMPROVING RESUSCITATION CARE”
Comparison of Survival to Hospital Discharge between Integrated AutoPulse-CPR and Manual-CPR during out-of-hospital cardiac arrest of presumed cardiac origin: The Circulation Improving Resuscitation Care (CIRC) Trial

Methods: A randomized controlled trial of EMS treated adult out-of-hospital cardiac arrests of presumed cardiac origin was conducted at 3 US and 2 European sites between March 2009 and January 2011. Systematic study-wide training and monitoring of CPR quality was implemented. When CPR was indicated, EMS responders initiated manual compressions and then patients were randomized to receive immediate iA-CPR or continued M-CPR. The primary outcome was survival to hospital discharge. Secondary outcomes were return of spontaneous circulation (ROSC), 24-hour survival, and modified Rankin Score (mRS) ≤3 at discharge. The Group Sequential Double Triangular Test was used to analyze covariate adjusted survival data at predefined intervals to identify superiority - a log odds ratio (log OR) of 0.37 (OR 1.44) with a two-sided significance level of 5% and a power of 97.5% - or equivalence, defined as the 95% confidence interval (CI) for the log OR fully lying between -0.37 and 0.37.

Out of hospital cardiac arrests, presumed cardiac, start CPR 2123 in manual CPR group, 2099 in iA-CPR group
Short term CIRC outcomes

• Sustained ROSC
  – 28.6% with iACPR vs 32.3% with M-CPR
    • OR 0.84 (0.74-0.96)

• Survive to 24 hours
  – 21.8% with iA-CPR vs 25.1% with M-CPR
    • OR 0.84 (0.72-0.96)

• Survive to hospital discharge
  – 9.4% with iA-CPR vs 11.0% with M-CPR
    • OR 0.84 (0.69-1.02)
CIRC residual issues

• Unable to blind the providers of care
• No data about compression quality
  – Only chest compression fraction
• Depth of compression according to old guidelines
  – May still be <1.5” (4 cm)
• Hospital hypothermia only 10-12%
• PTCA/PCI only 4-6%
• Clarification around exclusions
CoSTR: Treatment recommendation

• There are insufficient data to support or refute the routine use of LDB-CPR instead of manual CPR.

• It may be reasonable to consider LDB to maintain continuous chest compression while undergoing CT scan or similar diagnostic studies, when provision of manual CPR would be difficult.
What about if you were in Richmond?

Would you stop using the “Autopulse”? 
<table>
<thead>
<tr>
<th>Outcome</th>
<th>Manual CPR</th>
<th>Manual CPR (95% CI)</th>
<th>LDB-CPR</th>
<th>LDB-CPR (95% CI)</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No./Total No. of Patients</td>
<td>%</td>
<td>No./Total No. of Patients</td>
<td>%</td>
<td>Unadjusted</td>
</tr>
<tr>
<td>Return of spontaneous circulation †</td>
<td>101/499</td>
<td>20.2 (16.9-24.0)</td>
<td>96/278</td>
<td>34.5 (29.2-40.3)</td>
<td>2.08 (1.49-2.89)</td>
</tr>
<tr>
<td>Survival to hospital admission †</td>
<td>54/485</td>
<td>11.1 (8.6-14.2)</td>
<td>58/277</td>
<td>20.9 (16.6-26.1)</td>
<td>2.11 (1.41-3.17)</td>
</tr>
<tr>
<td>Survival to hospital discharge ‡</td>
<td>14/486</td>
<td>2.9 (1.7-4.8)</td>
<td>27/278</td>
<td>9.7 (6.7-13.8)</td>
<td>3.23 (1.66-6.51)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; CPR, cardiopulmonary resuscitation; EMS, emergency medical services; LDB, load-distributing band; OR, odds ratio.

*Both crude and adjusted ORs are presented in the logistic regression models. For the LDB-CPR phase, the total number of patients is not 284 due to missing data.†Adjusted for differences in response time intervals and percentage of EMS witnessed.‡Adjusted for differences in response time intervals, percentage of EMS witnessed, and whether postresuscitation hypothermia was used. For the unadjusted and adjusted ORs and 95% CIs, a weighted logistic regression was performed.
Lund University Cardiac Arrest System
LETTERS TO THE EDITOR

Active compression–decompression CPR necessitates follow-up post mortem

In this letter we want to draw attention to the findings of atypical pathological tissue damage in some patients who did not survive after cardiopulmonary resuscitation with active mechanical compression–decompression, ACD-CPR.

In the south of Sweden, an ACD-CPR commercial device LUCAS®\textsuperscript{1} was introduced into the prehospital setting from 2003, with the aim of improving CPR in the ambulance service and the outcome after prehospital CPR. The overall results have been encouraging so far. With the aid of this device, it

There were also a few infra-diaphragmatic injuries, which included a ruptured aneurysm of the abdominal aorta and liver haemorrhage. These injuries were thought to emanate from the device sliding from its original position; sliding however has not been reported to occur previously.

Most of these injuries have previously been reported at autopsy in those who did not survive conventional manual CPR.\textsuperscript{3} However, according to a most extensive report from regular autopsy focused on CPR complications,\textsuperscript{4} the number of injuries in dead patients after ACD-CPR markedly exceeded those injuries seen in patients not surviving conventional/manual CPR.
CoSTR: Treatment recommendation

• There are insufficient data to support or refute the use of LUCAS CPR instead of manual CPR.

• It **may be reasonable to consider** LUCAS CPR to maintain continuous chest compression while undergoing CT scan or similar diagnostic studies, when provision of manual CPR would be difficult.
Prehospital randomised assessment of a mechanical compression device in cardiac arrest (PaRAMeDIC) trial protocol

Gavin D Perkins¹*, Malcolm Woollard², Matthew W Cooke³, Charles Deakin⁴, Jessica Horton¹, Ranjit Lall¹, Sarah E Lamb¹, Chris McCabe⁵, Tom Quinn⁶, Anne Slowther⁷, Simon Gates¹, PARAMEDIC trial collaborators¹
examined by a nationally recognized board of qualified examiners, payment of fees, and examination. “Board eligible” conveys none of the above, merely that the applicant believes himself to be qualified in a particular field. To equate these two in advertising copy conveys a vagueness of purpose incompatible with reality.

Michael F. Cleary, MD
Scottsdale, Ariz

CPR: The P Stands for Plumber’s Helper

To the Editor.—Though novel methods of cardiac resuscitation exist, the traditional cardiopulmonary resuscitation (CPR) techniques recommended by the American Heart Association have a proven track record.¹ This is not the case, however, in all families. We describe a 65-year-old Iranian man with severe triple vessel coronary atherosclerotic disease.

Keith G. Lurie, MD
Clinton Lindo, MD
Jerome Chin, MD
Medical Center
University of California
San Francisco

1. Standards and guidelines for cardiopulmonary resuscitation (CPR) and emergency cardiac care (ECC). JAMA. 1980;244:453-509.

Commercial device
Revised device
Table 1. Studies of ACD-CPR in human beings.

<table>
<thead>
<tr>
<th>Study</th>
<th>Outcome Measure</th>
<th>ACD-CPR (n)</th>
<th>Standard CPR (n)</th>
<th>P</th>
<th>95% CI of Difference*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nolan et al⁶</td>
<td>Hospital discharge</td>
<td>16/267 (6.0%)</td>
<td>16/309 (4.8%)</td>
<td>.6704</td>
<td>−2.5-4.9</td>
</tr>
<tr>
<td>Mauer et al⁵</td>
<td>Hospital discharge</td>
<td>17/106 (16%)</td>
<td>16/114 (14%)</td>
<td>.6777</td>
<td>−7.5-11.5</td>
</tr>
<tr>
<td>Plaisance et al⁷,⁸⁺</td>
<td>Hospital discharge (no neurologic impairment)</td>
<td>21/373 (5.6%)</td>
<td>7/377 (1.9%)</td>
<td>.006</td>
<td>3.8-26.5</td>
</tr>
<tr>
<td></td>
<td>Survival at 1 y</td>
<td>17/373 (4.6%)</td>
<td>7/377 (1.9%)</td>
<td>.036</td>
<td>0.0-5.2</td>
</tr>
<tr>
<td>Stiell et al¹⁰</td>
<td>Hospital discharge, out-of-hospital</td>
<td>23/501 (4.6%)</td>
<td>19/510 (3.7%)</td>
<td>.4908</td>
<td>−1.7-3.4</td>
</tr>
<tr>
<td></td>
<td>Hospital discharge, in-hospital</td>
<td>42/405 (10.4%)</td>
<td>42/368 (11.4%)</td>
<td>.6418</td>
<td>−5.6-3.5</td>
</tr>
<tr>
<td>Schwab et al⁹</td>
<td>Hospital discharge, Fresno</td>
<td>6/117 (5%)</td>
<td>10/136 (7%)</td>
<td>.4685</td>
<td>−8.2-3.7</td>
</tr>
<tr>
<td></td>
<td>Hospital discharge, San Francisco</td>
<td>14/297 (4.7%)</td>
<td>17/310 (5.5%)</td>
<td>.6666</td>
<td>−4.3-2.7</td>
</tr>
<tr>
<td>Lurie et al⁴</td>
<td>Hospital discharge, reported</td>
<td>12/53 (22.6%)</td>
<td>13/77 (16.9%)</td>
<td>.410</td>
<td>−8.3-19.8</td>
</tr>
<tr>
<td></td>
<td>Hospital discharge, intention to treat</td>
<td>9/61 (14.8%)</td>
<td>12/69 (17.4%)</td>
<td>.6835</td>
<td>−15.3-10</td>
</tr>
<tr>
<td>Luiz et al,¹³</td>
<td>Hospital discharge</td>
<td>3/26 (11.5%)</td>
<td>4/30 (13.3%)</td>
<td>1.0²</td>
<td>−19.1-15.5</td>
</tr>
<tr>
<td>Ellinger et al¹²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tucker et al⁵</td>
<td>Hospital discharge</td>
<td>6/25 (24%)</td>
<td>3/28 (11%)</td>
<td>.2785⁺</td>
<td>−7.34</td>
</tr>
<tr>
<td></td>
<td>Neurologically intact</td>
<td>5/25 (20%)</td>
<td>3/28 (11%)</td>
<td>.4527</td>
<td>−10-29</td>
</tr>
<tr>
<td>Cohen et al²</td>
<td>Hospital discharge</td>
<td>2/29 (7%)</td>
<td>0/33 (0%)</td>
<td>.2147⁺</td>
<td>−2.3-16.1</td>
</tr>
</tbody>
</table>

CI, Confidence interval.

* Ninety-five percent CI of absolute risk reduction.
⁺Investigators could not control for use of ACD by basic life support personnel before arrival of the resuscitation team.
²Fisher exact test (otherwise χ² analysis was used).
To determine the effect of active chest compression-decompression CPR, compared to standard chest compression CPR on mortality and neurological function in adults with cardiac arrest treated either in-hospital or out-of-hospital.
Analysis 1.2. Comparison 1 Out-of-hospital cardiac arrests, Outcome 2 Mortality at hospital discharge.

Review: Active chest compression-decompression for cardiopulmonary resuscitation

Comparison: 1 Out-of-hospital cardiac arrests

Outcome: 2 Mortality at hospital discharge

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>ACD CPR n/N</th>
<th>STR n/N</th>
<th>Risk Ratio M-H,Fixed,95% CI</th>
<th>Weight</th>
<th>Risk Ratio M-H,Fixed,95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goralski 1998</td>
<td>73/76</td>
<td>72/74</td>
<td></td>
<td>4.6 %</td>
<td>0.99 [ 0.93, 1.05 ]</td>
</tr>
<tr>
<td>Luiz 1996</td>
<td>28/31</td>
<td>26/30</td>
<td></td>
<td>1.7 %</td>
<td>1.04 [ 0.87, 1.25 ]</td>
</tr>
<tr>
<td>Lurie 1994</td>
<td>48/61</td>
<td>57/69</td>
<td></td>
<td>3.4 %</td>
<td>0.95 [ 0.80, 1.13 ]</td>
</tr>
<tr>
<td>Mauer 1996</td>
<td>89/106</td>
<td>98/114</td>
<td></td>
<td>5.9 %</td>
<td>0.98 [ 0.87, 1.09 ]</td>
</tr>
<tr>
<td>Nolan 1998</td>
<td>287/304</td>
<td>354/370</td>
<td></td>
<td>20.1 %</td>
<td>0.99 [ 0.95, 1.02 ]</td>
</tr>
<tr>
<td>Schwab-Fresno 1995</td>
<td>111/117</td>
<td>126/136</td>
<td></td>
<td>7.3 %</td>
<td>1.02 [ 0.96, 1.09 ]</td>
</tr>
<tr>
<td>Schwab-S.Francisco 1995</td>
<td>283/297</td>
<td>293/310</td>
<td></td>
<td>18.0 %</td>
<td>1.01 [ 0.97, 1.05 ]</td>
</tr>
<tr>
<td>Skogvoll 1999</td>
<td>139/159</td>
<td>130/147</td>
<td></td>
<td>8.5 %</td>
<td>0.99 [ 0.91, 1.07 ]</td>
</tr>
<tr>
<td>Stiell-Prehospital 1996</td>
<td>478/501</td>
<td>491/510</td>
<td></td>
<td>30.6 %</td>
<td>0.99 [ 0.97, 1.02 ]</td>
</tr>
</tbody>
</table>

Total (95% CI) 1652 1760

Total events: 1536 (ACD CPR), 1647 (STR)

Heterogeneity: Chi² = 2.30, df = 8 (P = 0.97); I² = 0.0%

Test for overall effect: Z = 0.66 (P = 0.51)
Paris trial ACD-CPR
Long-term survival

Plaisance P et al. NEJM 1999;341:569-75

Out-of-hospital (n=750); 80% asystole; Paris and Thionville, France

Well trained
Perform well

9th International Spark of Life Conference
Hilton on the Park, Melbourne
Neonatal Satellite Meeting – 18 April 2013
SOL Conference 19-20 April 2013

The Royal Melbourne Hospital
## Paris vs. Ontario pre-hospital trial

**Patient / resuscitation system characteristics**

<table>
<thead>
<tr>
<th></th>
<th>Paris Std</th>
<th>Paris ACD</th>
<th>Ontario Std</th>
<th>Ontario ACD</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>256</td>
<td>254</td>
<td>510</td>
<td>501</td>
</tr>
<tr>
<td>Bystander CPR</td>
<td>7%</td>
<td>6%</td>
<td>21%</td>
<td>18%</td>
</tr>
<tr>
<td>VF</td>
<td>12%</td>
<td>13%</td>
<td>33%</td>
<td>32%</td>
</tr>
<tr>
<td>Asystole</td>
<td>81%</td>
<td>81%</td>
<td>42%</td>
<td>41%</td>
</tr>
<tr>
<td>Collapse-to-CPR</td>
<td>9 min</td>
<td>10 min</td>
<td>5 min</td>
<td>5 min</td>
</tr>
<tr>
<td>Collapse-to-ACLS</td>
<td>20 min</td>
<td>21 min</td>
<td>16 min</td>
<td>16 min</td>
</tr>
</tbody>
</table>

Despite this!!!
ACDCPR 2010

CoSTR: Treatment recommendation

• There is insufficient evidence to support or refute the use of ACD-CPR.

• “Insufficient data to say worse, but in the absence of consistent benefits why bother?”
Impedance Threshold Device

Ventilation Port

Ventilation Timing Assist Lights
provide guidance to the rescuer on proper ventilation rate to optimize cardiac output and oxygenation.

Atmospheric Pressure Sensor System
augments blood flow to the heart when intrathoracic pressures are < 0 ATMs.

Resistance Regulator
enables inspiration if spontaneous respiration resumes.

Patient Port
allows fast and easy connection to an endotracheal tube or other airway adjuncts.

Single Use Only

Ventilation Guidance Switch
slide for use of the ventilation timing assist lights.
How does the ITD work?

• This enhanced vacuum increasing venous return, cardiac output and blood pressure during CPR.
• Patient ventilation and exhalation are not restricted in any way.
Hemodynamic Effects of the ResQPOD

Conventional CPR

- Ventilation
- Chest compressions empty heart (CARDIAC OUTPUT)
- Chest wall recoil refills the heart (PRELOAD)

Conventional CPR with the ResQPOD

Greater preload
Goal to improve blood flow

Example of how inspiratory impedance enhances the intrathoracic vacuum (negative pressure [mmHg]) in humans undergoing ACD CPR with an active vs. sham ResQPOD on a facemask.


CPR Alone

ResQPOD + CPR

CPR Alone

ResQPOD + CPR

RELEASE:
CPR alone delivers approximately 12% of normal blood flow to the heart.

RELEASE:
ResQPOD doubles blood flow back to the heart.

COMPRESSION:
CPR alone delivers approximately 25% of normal blood flow to the brain.

COMPRESSION:
ResQPOD delivers >70% of normal blood flow to the brain.
A Trial of an Impedance Threshold Device in Out-of-Hospital Cardiac Arrest


Active ITD vs sham ITD

Out-of-hospital cardiac arrest with standard CPR

Patients, investigators, study coordinators, and all care providers were unaware of the treatment assignments.

The primary outcome was **survival to hospital discharge with satisfactory function** (i.e., a score of ≤3 on the modified Rankin scale)
A Trial of an Impedance Threshold Device in Out-of-Hospital Cardiac Arrest  
Aufderheide et al NEJM 2011; 365: 798-806

Results

Sham ITD (Control)  N=4345  
Active ITD  N=4373  
\[ N=8718 \]

Primary outcome (MRS ≤ 3)

Sham ITD (Control)  N=260  (6.0%)  
Active ITD  N=254  (5.8%)  
\[ P=0.71 \]

There were also no significant differences in 2° outcomes:
- Rates of ROSC
- Survival to hospital admission
- Survival to hospital discharge.
Idris et al reported that few patients than anticipated received compressions at a rate of 100/min as taught and assumed in the ROC PRIMED study. Survival was lower with compression rates <80 and >120.
Sham vs. Active ITD: Survival to Hospital Discharge

Chest Compression Rate (CC/Minute)

Idris et al, AHA Scientific Sessions, 2012
So why not try more than one?
Substantive preliminary work

Ventilation Port

Ventilation Timing Assist Lights
provide guidance to the rescuer on proper ventilation rate to optimize cardiac output and oxygenation.

Atmospheric Pressure Sensor System
augments blood flow to the heart when intrathoracic pressures are < 0 ATMs.

Resistance Regulator
enables inspiration if spontaneous respiration resumes.

Ventilation Guidance Switch
slide for use of the ventilation timing assist lights.

Single Use Only

Patient Port
allows fast and easy connection to an endotracheal tube or other airway adjuncts.

Metrone (90bpm)

Force Gauge

Improved handle

Suction cup for Active decompression

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The Royal Melbourne Hospital
ResQTrial: 2 CPR Methods

Standard CPR (S-CPR) versus ACD CPR + ITD (ACD+ITD)
So in 2011 . . .

Standard cardiopulmonary resuscitation versus active compression-decompression cardiopulmonary resuscitation with augmentation of negative intrathoracic pressure for out-of-hospital cardiac arrest: a randomised trial

Tom P Aufderheide, Ralph J Frascone, Marvin A Wayne, Brian D Mahoney, Robert A Swor, Robert M Domeier, Michael L Olinger, Richard G Holcomb, David E Tupper, Demetris Yannopoulos, Keith G Lurie

Lancet 2011; 377: 301–11
Out-of-hospital EMS study.

Standard CPR or active compression-decompression CPR + ITD

Block randomisation (weekly schedule) in a 1:1 ratio.

Non-traumatic arrest of presumed cardiac cause.

The primary outcome was survival to hospital discharge with satisfactory function (i.e., a score of ≤3 on the modified Rankin scale)

2470 patients randomised; 827 (33%) excluded; 1653 enrolled

Aufderheide et al Lancet 2011;9762:301-11
Primary Endpoint

Survival to Hospital Discharge with Favorable Neurologic Outcome

- *53% improvement
- $P = 0.019$
- OR $1.58$
- CI $(1.07, 2.36)$

Control (n = 813) vs. Intervention (n = 840)

*Hilton on the Park, Melbourne
Neonatal Satellite Meeting – 18 April 2013
SOL Conference 19-20 April 2013*
Modified Rankin Score (MRS)

0. No symptoms.
1. No significant disability. Able to carry out all usual activities, despite some symptoms.
2. Slight disability. Able to look after own affairs without assistance, but unable to carry out all previous activities.
3. Moderate disability. Requires some help, but able to walk unassisted.
4. Moderately severe disability. Unable to attend to own bodily needs without assistance, and unable to walk unassisted.
5. Severe disability. Requires constant nursing care and attention, bedridden, incontinent.
6. Dead.
Treatment of Out-of-Hospital Cardiac Arrest with an Impedance Threshold Device and Active Compression Decompression CPR: the RESQTrial

<table>
<thead>
<tr>
<th></th>
<th>SCPR (n = 813)</th>
<th>ACD-ITD (n = 840)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosp Discharge</td>
<td>80 (9.8)</td>
<td>104 (12.4)</td>
<td>0.12</td>
</tr>
<tr>
<td>Hosp Discharge MRS ≤ 3 n (%)</td>
<td>47 (5.8)</td>
<td>75 (8.9)</td>
<td>0.019</td>
</tr>
<tr>
<td>CPC 1-2 90 days</td>
<td>47 (5.8)</td>
<td>72 (8.6)</td>
<td>0.036</td>
</tr>
</tbody>
</table>

Aufderheide TP.
Overall One Year Survival

Kaplan Meier Survival

Group
- S-CPR
- ACD-CPR+ITD
- S-CPR-censored
- ACD-CPR+ITD-censored

Cumulative Survival (%)

Survival Time (days)

Log rank p-value = 0.014

83%
72%
## One-year Survival

<table>
<thead>
<tr>
<th></th>
<th>Control (N = 813)</th>
<th>Intervention (N = 840)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One-Year Survival</strong></td>
<td>48 (5.9%)</td>
<td>74 (8.8%)</td>
<td>0.030</td>
</tr>
<tr>
<td><strong>Emotional:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Beck Depression Inventory (BDI)  
(Score range: 0 – 63) | 5.2 ± 6.3         | 5.5 ± 5.9              | 0.862   |
| **Functional:**          |                   |                        |         |
| Disability Rating Score (DRS)  
(Score range: 0 – 29)     | 1.4 ± 3.1         | 2.2 ± 5.7              | 0.358   |
| **Cognitive:**           |                   |                        |         |
| Cognitive Abilities Screening Instrument (CASI)  
(Score range: 0 – 100)  | 92.9 ± 12.0       | 94.5 ± 4.5             | 0.473   |
Neurological outcomes (CPC ≥3 at hospital discharge)

<table>
<thead>
<tr>
<th>Percentages of patients</th>
<th>S-CPR +TH</th>
<th>S-CPR +TH</th>
<th>ACD+ITD +TH</th>
</tr>
</thead>
<tbody>
<tr>
<td>*P = 0.024</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition</th>
<th>S-CPR without TH</th>
<th>S-CPR with TH</th>
<th>ACD+ITD without TH</th>
<th>ACD+ITD with TH</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPC ≤2 at HD</td>
<td>23</td>
<td>30</td>
<td>42</td>
<td>32</td>
</tr>
<tr>
<td>CPC ≥3 at HD</td>
<td>10</td>
<td>8</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Improved from CPC ≥3 at HD to CPC ≤2 at 90 days</td>
<td>3/10 (30.0%)</td>
<td>1/8 (12.5%)</td>
<td>3/11 (27.3%)</td>
<td>9/13 (69.2%)</td>
</tr>
</tbody>
</table>
Limitations include . . .

- Hawthorne effect (not blinded)
- ACD CPR provided metronome at 80/min, and force gauge to guide depth and recoil; 2 handed technique for ITD with facemask, ITD timing lights to guide ventilation.
- No feedback about quality CPR for standard group.
- Excluded 817 patients (non-cardiac and inability to ventilate), before these exclusions results for primary endpoint are not significant (I 101/1269 (8%) vs C 71/1201 (6%) 0.057).
- Approx. 60% hospital mortality.
- Only 39% received hypothermia.
Hawthorne effect?
Efficacy or effectiveness?
Why not consistent benefits if so much potential for the power of good?

- Efficiency versus effectiveness
- Hard to maintain that broad enthusiasm for the technique
- Aimed at shifting endpoints?
- Harder to titrate, more rigid in their application
- Improvements still occurring in devices
- Our control group continues to improve
In the hands of the expert proponents

May provide opportunities . . .
Computed tomography during cardiopulmonary resuscitation using automated chest compression devices—an initial study

Clinical paper
Cardiac arrest in the catheterisation laboratory: A 5-year experience of using mechanical chest compressions to facilitate PCI during prolonged resuscitation efforts

Henrik Wagner, Christian J. Terkelsen, Hans Friberg, Jan Harnek, Karl Kern, Jens Flensted Lassen, Goran K. Olvecrona

RCTs: remember . . .

- Can only really provide an answer to the question that was asked!
- The key to the clinicians is the external validity of the study:
  “how does this apply to my patients?”
The Tony Smith modification

- Level one – randomised trials that support my own opinion
- Level two – expert opinions that support my own opinion
- Level three – all other forms of evidence that support my own opinion
- Level four – any form of evidence that does not support my own opinion
- Level five – uninformed opinion of morons
- Level six – media reports of the opinion of helicopter pilots
So why not routinely use mechanical devices?
"SEE SON....THIS IS WHY I SAVE THESE BITS."
Trade off

• Key is good quality compressions and CPR
• Minimize delays
• Attaching device adds delays
• Incremental benefit must be better than loss of flow
Opportunity cost!

- Limited time and resource channeled into studies of limited return
- Diverts resources away from other valuable studies
- Cost required to implement would take away from other opportunities
Other techniques & devices to perform CPR (ANZCOR)

- Several techniques or adjuncts to standard CPR have been investigated and the relevant data was reviewed extensively as part of the Consensus on Science process.

- The success of any technique depends on the education and training of the rescuers or the resources available (including personnel).

- Techniques reviewed include: Open-chest CPR, Interposed Abdominal Compression CPR, Active Compression-Decompression CPR, Open Chest CPR, Load Distributing Band CPR, Mechanical (Piston) CPR, Lund University Cardiac Arrest System CPR, Impedance Threshold Device, and Extracorporeal Techniques.
Other techniques & devices to perform CPR (ANZCOR)

- Because information about these techniques and devices is often limited, conflicting, or supportive only for short-term outcomes, **no recommendations can be made to support or refute their routine use.**
- While no circulatory adjunct is currently recommended instead of manual CPR for routine use, some circulatory adjuncts are being routinely used in both out-of-hospital and in-hospital resuscitation. If a circulatory adjunct is used, rescuers should be well-trained and a program of continuous surveillance should be in place to ensure that use of the adjunct does not adversely affect survival. [Class B; LOE IV]
Mechanical chest compression

- May overcome the reported problems with compression quality
  - Consistent compressions
  - Reduce fatigue
  - Use in difficult circumstances
    - Limited staff numbers
    - Transport
    - Confined spaces
    - During interventions

- Commercial
But in Melbourne the median response time for an ambulance is 8 mins!

Transport to hospital with CPR???
But in Melbourne the median response time for an ambulance is 8 mins!
CO-PILOT CHECKLIST

1. DON'T TOUCH ANYTHING
2. KEEP YOUR MOUTH SHUT
Goldilocks: what is your baseline state?

- Great outcomes, lots of well trained people to do manual compressions
- Need to get hands and bodies away from patient (eg. cardiac catheter lab)
- Insufficient personnel to deliver good CPR
So when then?

• Standard CPR with lots of trained players? No
• Only small numbers in team? Possibly (including rural/remote)
• Need to safely transport? Yes (including Melbourne)
• Need to facilitate investigations and treatment (eg. PCI)? Yes
Unfortunately . . .

“[T]here are known knowns; there are things we know we know.
We also know there are known unknowns; that is to say we know there are some things we do not know.
But there are also unknown unknowns – the ones we don't know we don't know.”

Former US Secretary of Defense Donald Rumsfeld