

## **Manual CPR vs. Mechanical CPR on Cardiac Arrest Patient Outcomes**

Date of review: 10.03.2022

Paramedic Mini CAT – Fanshawe College

**Author:** Sam O’Neil, Primary Care Paramedic Student, Fanshawe College, Ontario, Canada.

**Second party appraiser:** Alan Batt, Professor, Paramedic Programs, Fanshawe College, Ontario, Canada.

### **Clinical Scenario:**

Paramedics are dispatched for a possible VSA in a wooded area. To reach the patient, they must walk 200 meters through the woods where they confirmed the patient does have a pulse. The paramedics must make a clinical decision regarding whether manual CPR or mechanical CPR will provide the best patient outcome.

### **Background**

The surge of interest in mechanical CPR devices began in the early 2000s to counteract the various challenges that cardiac arrests present in a prehospital setting. In theory, mechanical CPR may be superior to manual CPR in several ways. For one, they could eliminate provider fatigue caused by manual CPR potentially resulting in consistently high-quality compressions. They can also be used during difficult extrication environments such as staircases or remote areas. Finally, they can free up a care provider to initiate other treatments in limited resource situations.

### **Review question**

In prehospital medicine, does manual CPR or mechanical CPR result in more effective CPR and yield better outcomes for cardiac arrest patients.

**Search strategy:** (Paramedic OR emergency medical service OR EMS OR prehospital OR pre-hospital OR out-of-hospital) AND (manual compressions OR manual CPR) AND (mechanical compressions OR mechanical CPR)

**Limits:** 2015 – 2022, English

**Databases searched:** CINAHL, MEDLINE

**Search results:** CINAHL, 70 MEDLINE, 109

**Included for review:** 4 of the 179 studies were included in this review. They were included based on considering all the following criteria:

- Relevance to Review Question: All terms, or a variation of the terms from the PICO question must be prevalent in the study
- Study Design: Studies must collect and compare data for mechanical and manual CPR or, be a review/meta-analysis of studies that did so.
- Sample Size: Studies containing the largest number of participants/patients were included.
- Date of Publication: Studies conducted recently were included.

Title, author, year	Study design & LOE	Population	Intervention	Outcomes	Results	Weaknesses & Strengths
-Effectiveness of Mechanical Chest Compression Devices over Manual Cardiopulmonary Resuscitation: A Systematic Review with Trial Sequential Analysis, -Sheraton et al., -(2021)	-The study conducted a systematic search for randomized controlled trials between 2000 and 2020 that compared any device mechanical compressions to manual compressions for achieving a ROSC. - Random effects metanalysis and trial sequential analysis conducted.	-Included 18,474 adult patients in non-traumatic, out of hospital cardiac arrest.	-Mechanical CPR and manual CPR on adult cardiac arrest patients.	-The primary outcome was ROSC of 20 minutes or more after resuscitation.	-15 studies were reviewed (six RCTs, two cluster RCTs, five retrospective case-control, and two phased prospective cohort studies). - The pooled estimates summary effect indicated no significant difference between manual and mechanical compressions during CPR for ROSC.	<b>Strengths</b> -Inclusion of many studies increased the statistical power of the analysis. -Trial sequential analysis was used to confirm the sufficiency of evidence. -High validity in European and North American settings. <b>Weaknesses</b> -No uniform protocol for CPR, ventilation, training, timed device deployment or environmental factors across the studies that were reviewed.

Title, author, year	Study design & LOE	Population	Intervention	Outcomes	Results	Weaknesses & Strengths
<p>-Mechanical versus manual chest compressions for out-of-hospital cardiac arrest: a meta-analysis of randomized controlled trials -Tang, Gu, &amp; Wang -(2015)</p>	<p>-This study performed a meta-analysis of randomized controlled trials to compare mechanical and manual CPR. -5 randomized controlled trials included for analysis.</p>	<p>-12,510 out of hospital adult cardiac arrest patients.</p>	<p>-Mechanical CPR and Manual CPR on adult cardiac arrest patients.</p>	<p>-The primary outcome was patient survival with positive neurological outcome to hospital discharge -Secondary outcomes were survival to hospital admission, hospital discharge, ROSC, and long-term survival (6 months).</p>	<p>-Evidence gathered from the randomized controlled trials suggests that mechanical compressions did not improve survival, neurological outcomes, or ROSC. -Mechanical CPR reduced survival to hospital admission and hospital discharge.</p>	<p><b>Strengths</b> -Large sample size. -Studies taken from several different countries. -Variety of outcomes assessed to measure patient outcomes. <b>Weaknesses</b> -The quality of evidence ranked moderate to low due to high risk of bias -Not all the trials analyzed included the primary and secondary outcomes. Therefore, the data for each outcome varies in validity -there were a small number of trials analyzed and no publication bias analysis was conducted.</p>

<p>-Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): a pragmatic, cluster randomised controlled trial, -Perkins et al., -(2015).</p>	<p>-This study was a cluster-randomized open-label trial. -Assessed whether LUCAS-2 mechanical CPR devices would improve survival from out-of-hospital cardiac arrests compared to manual compressions. -Patients were randomly assigned at 1:2 to the LUCAS-2 group or control group -included four UK services consisting of 91 urban and semi-urban stations and took place over 3 years</p>	<p>-4,471 non-traumatic out of hospital adult cardiac arrest patients.</p>	<p>-1,652 patients assigned to received mechanical compressions from LUCAS-2 devices. -2,819 patients assigned to control group who received manual compressions.</p>	<p>-The primary outcome was survival at 30 days following cardiac arrest -The secondary outcomes were ROSC maintenance until transfer of care to medical staff, survival to 3 months, 12 months, and survival with favourable neurological outcomes at 3 months.</p>	<p>-30 day survival of LUCAS-2 group was 6% and 7% in the control group -ROSC was 32% in LUCAS-2 group compared to 31% in control group -Survived event was 23% in both groups -Survival to 3 months was 6% in both groups -Survival to 12 months was 5% in LUCAS-2 group and 6% in control group -Survival with good neurological outcomes was 5% in LUCAS-2 group and 6% in control group.</p>	<p><b>Weaknesses</b>          -no data regarding the quality of CPR delivered by either group.          -robustness of longitudinal results weak due to lack of reporting regarding additional care received.          -poor training and implementation of LUCAS-2 device procedure among care providers.  <b>Strengths</b>          -large sample size and consistent training and protocols among care providers.          -patients randomly assigned to treatment groups.</p>
--	---	--	---	--	--	--

<p>-The Efficacy of LUCAS in Prehospital Cardiac Arrest Scenarios: A crossover Mannequin Study, -Gyory et al., -(2017).</p>	<p>-A team of one paramedic and one EMT completed mock cardiac arrest scenario using a 50kg mannequin. -each team conducted the scenario twice; once using manual CPR and once using a LUCAS device. -crossover study in which the same mannequin receives each treatment from each team of care providers.</p>	<p>-13 paramedics and 13 EMTs. -one 50kg mannequin.</p>	<p>-EMS team completed one defibrillation, one airway placement two cycles of manual CPR prior to attachment of the LUCAS device , and continued CPR down two stairways and into the back of an ambulance. -the EMS team continued CPR until the standardized ambulance and driver arrived at the hospital.</p>	<p>-the primary outcome was to compare CPR compression rate, depth, release depth, hand/LUCAS position, and time off of the chest. -time elapsed to critical clinical and transport events were measured manually by evaluators.</p>	<p><b>-Using the LUCAS:</b> -Rate was 112/min, median compression depth, 36mm, compressions of adequate depth, 52%, compressions fully released was 93%, compressions with correct positioning, 91%, average time off chest was 15% -Arrival time at litter 422 seconds, arrival at ambulance 622 seconds, transport initiation 664 seconds. <b>-Using Manual Compressions:</b> -Rate was 125/min, median compression</p>	<p><b>Strengths</b> -The study used a realistic pre-hospital scenario to compare the methods of CPR. -consistent level of training, experience, procedure, and environment used to isolate compressions as a variable.</p> <p><b>Weaknesses</b> -Participants had a lack of training and experience using LUCAS device. -Poor mannequin/LUCAS contact. -Unable to examine patient outcomes. -Mannequin weight considerably lighter than that of the average cardiac arrest patient. -Manual compressions were completed during the first two cycles of CPR in both scenarios resulting in less LUCAS data and a lack of robust statistics.</p>
---	---	---	---	--	---	--

Title, author, year	Study design & LOE	Population	Intervention	Outcomes	Results	Weaknesses & Strengths
					depth was 37mm, compressions of adequate depth, 36%, compressions fully released was 78%, compressions with correct position, 96%, average time off chest was 20%. -Arrival time at litter 369 seconds, arrival at ambulance 538 seconds, transport initiation, 565 seconds.	

**Comments:**

The studies suggested that there was no significant difference in patient outcomes between manual and mechanical CPR regarding several factors. Considering this, it can be suggested that the routine use of mechanical CPR over manual CPR may be unwarranted. However, this does not mean that the use mechanical CPR devices should be completely discounted. It is well established that out of hospital cardiac arrests present additional challenges due to limited resources, difficult environments, and the need for transport. There

is potential for a mechanical CPR device to combat these challenges and improve patient care. Future research should look to compare mechanical and manual CPR in specific scenarios to refine the use of mechanical CPR in the pre-hospital environment.

### **Considerations:**

Throughout the literature on mechanical compressions and manual compressions there are several issues that continuously arise. The first of these issues is that the care providers often have limited training and experience using the mechanical CPR devices which lead to complications regarding its application and slowed transport. This is one issue that can be corrected in future research by offering pre-study training or drafting qualified study candidates. Another issue is the absence of double-blind clinical trials. This of course is unavoidable given the nature of CPR; however, it does leave the research more vulnerable to bias among the subjects. Comparing the effects of manual and mechanical CPR can also be difficult because there are many other factors that influence patient outcomes. This can make it difficult to isolate and analyze the intervention's impact. This comment can be made regarding nearly all pre-hospital care research because any research conducted in a controlled environment can be rendered useless given the infinite environmental variables. However, any research conducted under these variables is subject to scrutiny regarding their affect on the outcome.

### **Clinical bottom line:**

When determining the best option for patient care, a clinically sound decision should be made whether to use mechanical or manual CPR. Using a mechanical CPR device may be beneficial in complicated environments or where resources are limited. However, it can delay transport times and initiation of CPR in the prehospital setting. There is no conclusive evidence that mechanical CPR improves patient outcomes and therefore it should be used situationally to the best judgment of the paramedic.

### **References**

Gyory, R. A., et al. (2017). The Efficacy of LUCAS in Prehospital Cardiac Arrest Scenarios: A Crossover Mannequin Study. *The western journal of emergency medicine*, 18(3), 437–445. <https://doi.org/10.5811/westjem.2017.1.32575>

Perkins, G. D., et al. (2015). Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): a pragmatic, cluster randomised controlled trial. *The Lancet*, 385(9972), 947–955. doi: 10.1016/s0140-6736(14)61886-9

Sheraton, M., et al. (2021) “Effectiveness of Mechanical Chest Compression Devices over Manual Cardiopulmonary Resuscitation: A Systematic Review with Meta-analysis and Trial Sequential Analysis.” *Western Journal of Emergency Medicine* vol. 22(4), 810–819. doi:10.5811/westjem.2021.3.50932

Tang, L., et al. (2015) “Mechanical versus manual chest compressions for out-of-hospital cardiac arrest: a meta-analysis of randomized controlled trials.” Scientific reports vol. 5(15635), doi:10.1038/srep15635

## Appendix

The screenshot shows a web browser window displaying the EBSCOhost search results page. The browser's address bar shows the URL: `web-p-ebSCOhost-com.ezpxy.fanshawec.ca/ehost/resultsadvanced?vid=6&sid=4331c31f-a4f4-4ac9-8832-f9f7ba3e3743%40redis&bquery=(Paramedic+OR+emerg...`. The page header includes navigation links like "New Search", "Publications", and "CINAHL Subject Headings". The search bar contains the query: `(Paramedic OR emergency medical service OR EM`. Below the search bar, there are options for "AND" and "OR" operators, and a "Search" button. The search results section is titled "Search History/Alerts" and includes a table with search results. The first result is S1, with search terms: `(Paramedic OR emergency medical service OR EMS OR prehospital OR pre-hospital OR out-of-hospital) AND (manual compressions OR manual CPR) AND (mechanical compressions OR mechanical CPR)`. The table also shows search options like "Limiters" and "Expanders".

Searching: CINAHL Plus with Full Text | Choose Databases

(Paramedic OR emergency medical service OR EM  Select a Field (optional) Search

AND  Select a Field (optional) Clear ?

AND  Select a Field (optional) (+) (-)

[Basic Search](#) [Advanced Search](#) [Search History](#)

### Search History/Alerts

[Print Search History](#) [Retrieve Searches](#) [Retrieve Alerts](#) [Save Searches / Alerts](#)

Select / deselect all [Search with AND](#) [Search with OR](#) [Delete Searches](#) [Refresh Search Results](#)

Search ID#	Search Terms	Search Options	Actions
<input type="checkbox"/> S1	(Paramedic OR emergency medical service OR EMS OR prehospital OR pre-hospital OR out-of-hospital) AND (manual compressions OR manual CPR) AND (mechanical compressions OR mechanical CPR)	<b>Limiters</b> - Published Date: 20150101-20221231 <b>Expanders</b> - Apply related words; Apply equivalent subjects <b>Search modes</b> - Find all my search terms	<a href="#">View Results (70)</a> <a href="#">View Details</a> <a href="#">Edit</a>

Search Results: 1 - 10 of 70

The Efficacy of Mechanical Ventilation in the Management of Acute Respiratory Distress Syndrome: A Systematic Review and Meta-Analysis

Manual vs Mechanical Ventilation in the Management of Acute Respiratory Distress Syndrome: A Systematic Review and Meta-Analysis

Fanshawe College

Databases: PubMed

Result List: (109)

web-p-ebSCOhost-com.ezproxy.fanshawec.ca/ehost/resultsadvanced?vid=2&sid=c9d7f297-b587-4985-b184-6ebce4cacea1%40redis&bquery=(Paramedic+OR+emer...)

Apps Home - Netflix Ketamine Toxicity -... National EMS Rese... Reading list

New Search MeSH 2022 Publications Indexes Library Holdings Sign In Folder Preferences Languages Help

EBSCOhost Searching: MEDLINE | Choose Databases

(Paramedic OR emergency medical service OR EMS OR prehospital OR pre-hospital OR out-of-hospital) AND (manual compressions OR manual CPR) AND (mechanical compressions OR mechanical CPR)

Select a Field (optional) Search

AND Select a Field (optional) Clear

AND Select a Field (optional) + -

Basic Search Advanced Search Search History

### Search History/Alerts

Print Search History Retrieve Searches Retrieve Alerts Save Searches / Alerts

Select / deselect all **Search with AND** **Search with OR** **Delete Searches** **Refresh Search Results**

Search ID#	Search Terms	Search Options	Actions
<input type="checkbox"/> S1	(Paramedic OR emergency medical service OR EMS OR prehospital OR pre-hospital OR out-of-hospital) AND (manual compressions OR manual CPR) AND (mechanical compressions OR mechanical CPR)	<p><b>Limiters</b> - Date of Publication: 20150101-20221231</p> <p><b>Expanders</b> - Apply related words; Apply equivalent subjects</p> <p><b>Search modes</b> - Find all my search terms</p>	<p><a href="#">View Results (109)</a></p> <p><a href="#">View Details</a></p> <p><a href="#">Edit</a></p>

click to chat

Search Results: 1 - 10 of 109

7°C Rain showers 2:54 PM 2022-02-22