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| Question | |
| **Should Head up CPR vs. standard CPR be used for cardiac arrest?** | |
| **Population:** | cardiac arrest |
| **Intervention:** | Head up CPR |
| **Comparison:** | standard CPR |
| **Main outcomes:** | Admitted to hospital with spontaneous circulation; |
| **Setting:** | in-hospital and out-of-hospital setting |
| **Perspective:** |  |
| **Background:** |  |
| **Conflict of interests:** | None |

# Assessment

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| Problem Is the problem a priority? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ● Yes ○ Varies ○ Don't know | Mortality after cardiac arrest remains high, and there is broad consensus that new treatments and strategies are needed. |  |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial ○ Small ○ Moderate ○ Large ○ Varies ● Don't know | The limited observational evidence identified in this review suggest head-up CPR might have the potential to improve short-term outcome from cardiac arrest (RR, 1.90; 95%CI, 1.61–2.26), but the certainty of evidence is very low with very high risk of bias. Head-up CPR was only assessed as a bundle with mechanical CPR with active decompression and the use of an impedance threshold device questioning the generalizability of the results to other systems. With a before-and-after design, the study is also at additional risk of being influenced by unrelated changes in practice with time which are not fully reported in particular, a change in ventilation strategy and potentially more efficient deployment of mechanical CPR that accompanied the intervention. Outcome measures were also limited to ROSC to hospital arrival, without any information on longer-term survival or functional outcomes. |  |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large ○ Moderate ○ Small ○ Trivial ○ Varies ● Don't know | As the single clinical study evaluating this treatment strategy was a retrospective before-and-after without any information about prospectively registered complications, the frequency and extent of undesirable effects are unknown. In experimental animal studies, the head-up strategy is only effective with mechanical CPR, an impedance threshold device and a when performed in a certain sequence of sequential elevation. There would therefore be reason to suspect it could have undesirable effects, or be ineffective, if not performed correctly. |  |
| Certainty of evidence What is the overall certainty of the evidence of effects? | | |
| Judgement | Research evidence | Additional considerations |
| ● Very low ○ Low ○ Moderate ○ High ○ No included studies | The effect of head up CPR is very uncertain, and only short term outcomes have been reported.  Head-up CPR was only assessed as a bundle with mechanical CPR with active decompression and the use of an impedance threshold device questioning the generalizability of the results to other systems. With a before-and-after design, the study is also at additional risk of being influenced by unrelated changes in practice with time which are not fully reported in particular, a change in ventilation strategy and potentially more efficient deployment of mechanical CPR that accompanied the intervention. |  |
| Values Is there important uncertainty about or variability in how much people value the main outcomes? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Important uncertainty or variability ○ Possibly important uncertainty or variability ○ Probably no important uncertainty or variability ● No important uncertainty or variability | There is no important uncertainty about how much people value improving survival after cardiac arrest. |  |
| Balance of effects Does the balance between desirable and undesirable effects favor the intervention or the comparison? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention ○ Varies ● Don't know | As both desirable and undesirable effects are very uncertain, balancing them is not really possible. |  |
| Resources required How large are the resource requirements (costs)? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large costs ○ Moderate costs ○ Negligible costs and savings ○ Moderate savings ○ Large savings ○ Varies ○ Don't know | Implementation of head-up CPR requires purchase of expensive equipment (mechanical CPR and the impedance threshold device), along with a substantial amount of education and training both in the use of this equipment and in the manner in which head-up CPR itself is deployed. |  |
| Certainty of evidence of required resources What is the certainty of the evidence of resource requirements (costs)? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Very low ○ Low ○ Moderate ○ High ○ No included studies | The cost of mechanical CPR and impedance threshold devices are substatial when implemented in resuscitation systems, as is the cost of training and education. There are no important uncertainties regarding the required cost/resources. |  |
| Cost effectiveness Does the cost-effectiveness of the intervention favor the intervention or the comparison? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention ○ Varies ● No included studies | The doubling in short term survival reported with the bundle including head-up CPR is promicing, and if translated into improved long-term functional outcomes, and generalizable to other resuscitation systems, the intervention might be cost-effective. However, there is not enough evidence to determine the effectiveness of head-up CPR, and no evidence assessing cost-effectiveness. |  |
| Equity What would be the impact on health equity? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Reduced ○ Probably reduced ○ Probably no impact ● Probably increased ○ Increased ○ Varies ○ Don't know | As the strategy requires expensive equipment, health equity would likely be negatively impacted. |  |
| Acceptability Is the intervention acceptable to key stakeholders? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ● Probably no ○ Probably yes ○ Yes ○ Varies ○ Don't know | Without a demonstrable improvement in longer-term outcomes, it is unlikely to be an acceptable strategy for key stakeholders. The Basic Life Support Task Force does not find the current evidence sufficient to recommend routine use of this strategy and encourages further research before its clinical deployment. |  |
| Feasibility Is the intervention feasible to implement? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ○ Yes ○ Varies ● Don't know | The use of the bundle including head-up CPR has been implemented at two different EMS systems, so is feasible to implement for similar systems with similar resources. The feasibility of broader implementation is not known. |  |

# Summary of judgements

|  | **Judgement** | | | | | | |
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| **Problem** | No | Probably no | Probably yes | **Yes** |  | Varies | Don't know |
| **Desirable Effects** | Trivial | Small | Moderate | Large |  | Varies | **Don't know** |
| **Undesirable Effects** | Large | Moderate | Small | Trivial |  | Varies | **Don't know** |
| **Certainty of evidence** | **Very low** | Low | Moderate | High |  |  | No included studies |
| **Values** | Important uncertainty or variability | Possibly important uncertainty or variability | Probably no important uncertainty or variability | **No important uncertainty or variability** |  |  |  |
| **Balance of effects** | Favors the comparison | Probably favors the comparison | Does not favor either the intervention or the comparison | Probably favors the intervention | Favors the intervention | Varies | **Don't know** |
| **Resources required** | Large costs | Moderate costs | Negligible costs and savings | Moderate savings | Large savings | Varies | Don't know |
| **Certainty of evidence of required resources** | Very low | Low | Moderate | High |  |  | No included studies |
| **Cost effectiveness** | Favors the comparison | Probably favors the comparison | Does not favor either the intervention or the comparison | Probably favors the intervention | Favors the intervention | Varies | **No included studies** |
| **Equity** | Reduced | Probably reduced | Probably no impact | **Probably increased** | Increased | Varies | Don't know |
| **Acceptability** | No | **Probably no** | Probably yes | Yes |  | Varies | Don't know |
| **Feasibility** | No | Probably no | Probably yes | Yes |  | Varies | **Don't know** |

# Type of recommendation

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| Strong recommendation against the intervention | **Conditional recommendation against the intervention** | Conditional recommendation for either the intervention or the comparison | Conditional recommendation for the intervention | Strong recommendation for the intervention |
| ○ | **●** | ○ | ○ | ○ |

# Conclusions

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| Recommendation |
| We suggest against the routine use of head-up CPR during CPR (weak recommendation, very-low-certainty evidence).  We suggest that the usefulness of head-up CPR during CPR be assessed in clinical trials or research initiatives (weak recommendation, very-low-certainty evidence). |
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| Justification |
| This topic was prioritized by the BLS Task Force based on increasing interest and debate surrounding head-up CPR within the resuscitation community. The BLS Task Force was aware of the growing body of animal research addressing head-up CPR,(2-7) and aware that this strategy is currently being used in some Emergency Medical Services Systems.  The limited observational evidence identified in this review suggest head-up CPR might have the potential to improve short-term outcome from cardiac arrest, but the certainty of evidence is very low with very high risk of bias. Head-up CPR was only assessed as a bundle with mechanical CPR with active decompression and the use of an impedance threshold device questioning the generalizability of the results to other systems. With a before-and-after design, the study is also at additional risk of being influenced by unrelated changes in practice with time which are not fully reported in particular, a change in ventilation strategy and potentially more efficient deployment of mechanical CPR that accompanied the intervention. Outcome measures were also limited to ROSC to hospital arrival, without any information on longer-term survival or functional outcomes.  Implementation of head-up CPR requires purchase of expensive equipment (mechanical CPR and the impedance threshold device), along with a substantial amount of education and training both in the use of this equipment and in the manner in which head-up CPR itself is deployed. Without a demonstrable improvement in longer-term outcomes, it is unlikely to be an acceptable strategy for key stakeholders. The Basic Life Support Task Force does not find the current evidence sufficient to recommend routine use of this strategy and encourages further research before its clinical deployment. |

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| Subgroup considerations |
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| Implementation considerations |
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| Monitoring and evaluation |
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| Research priorities |
| · We did not identify any RCTs that evaluated the effect of head-up CPR  · In the identified observational study, only short term/surrogate outcomes were evaluated, and future studies should document survival/neurologically intact survival to hospital discharge/30days.  · Head-up CPR has only been evaluated as a bundle with mechanical CPR with active decompression and the use of an impedance threshold device. |