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| Question | |
| **Should Backboards or other interventions [intervention] vs. standard mattress be used for cardiac arrest in a bed?** | |
| **Population:** | Adults or children in cardiac arrest on a bed (out-of-hospital and in-hospital |
| **Intervention:** | CPR on a hard surface e.g. backboard, floor, deflatable or specialist mattress |
| **Comparison:** | CPR on a regular mattress |
| **Main outcomes:** | Survival, survival with a favourable neurological outcome, ROSC, CPR quality |
| **Setting:** | Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) are eligible for inclusion. Randomised manikin / simulation / cadaver studies will only be included if insufficient human studies are identified. Unpublished studies (e.g., conference abstracts, trial protocols), non-randomised manikin / simulation / cadaver studies, animal studies, experimental / lab models, mathematical models, narrative reviews, editorials and opinions with no primary data were excluded. |
| **Perspective:** |  |
| **Background:** | This topic was prioritised for review by the BLS Task Force as it had not been updated since 2010. [Koster 2010, e48; Sayre S298]. Members of the Task Force reported variation in backboard use and the practice of moving a patient from the a bed to the floor to improve the quality of CPR, thus it was considered timely to review the published evidence. |
| **Conflict of interests:** | The ILCOR Continuous Evidence Evaluation process is guided by a rigorous ILCOR Conflict of Interest policy. The following Task Force members and other authors were recused from the discussion as they declared a conflict of interest: (none applicable)  The following Task Force members and other authors declared an intellectual conflict of interest and this was acknowledged and managed by the Task Force Chairs and Conflict of Interest committees: (Perkins, author on one of the included papers) |

# 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 | ILCOR recommends a chest compression depth of 5-6cm to optimise outcomes from cardiac arrest. When CPR is performed on soft surface (e.g. mattress), the chest wall as well as the support surface is compressed. This has the potential to diminish effective chest compression depth.  Effective compression depths can be achieved even on a soft surface, providing the CPR provider increases overall compression depth to compensate for mattress compression.[Beesums 2014, 1439; Nishisaki 2012, 1013; Sato 2011,770; Song 2013,469; Lee 2015, 1425; Oh 2012, 500; Ruiz 2016, 6596040]. CPR feedback devices which account for mattress compression (e.g. the use of dual accelerometers or increasing compression depth targets) can help CPR providers to ensure adequate compression depth when CPR is performed on a mattress.[Perkins 2009, 540; Lee 2015, 1425; Beesems 2014, 1439 ; Lee; Hellevuo 2014, 323; Lin 2017, 22; Perkins Ruiz de Gauna 2016, 6596040] |  |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ● Trivial ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know | There were minimal changes in chest compression depth when the CPR function was activated on the mattresses tested.    Use of a CPR backboard was associated with a small improvement in chest compression depth 3mm (95% CI 1-4)  Performing CPR on a bed versus the floor had a negligible effect on compression depth.  No studies examined harms or adverse events. |  |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large ○ Moderate ○ Small ○ Trivial ○ Varies ● Don't know | There were minimal changes in chest compression depth when the CPR function was activated on the mattresses tested.  Use of a CPR backboard was associated with a small improvement in chest compression depth 3mm (95% CI 1-4)  Performing CPR on a bed versus the floor had a negligible effect on compression depth.  No studies examined harms or adverse events. | Risks of harm to the patient and resuscitation team from moving a patient to the bed to the floor.    Placing a backboard under a patient risks interruptions to chest compressions and the potential to dislodge airway devices and vascular access. |
| 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 evidence was derived from studies conducted on resuscitation manikins which may not reflect the response seen in clinical practice. |  |
| 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 | The absence of human studies leads to persistent uncertainty on clinical effects of interventions |  |
| 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 | The Task Force supported performing chest compressions on a firm surface when possible as this reduces the risks of shallow compressions attributable to performing CPR on a soft surface.  The Task Force considered, where available, activating a CPR function on a mattress, although unlikely to substantially improve compression depth, posed a low risk of harm to rescuers and patients leading to a weak recommendation of support.  In considering whether to transfer a patient from a hospital bed to the floor to improve compression depth, the Task Force considered the risks of harm to the patient and resuscitation team outweighed any small improvement in chest compression depth, leading to a weak recommendation against routine use of this practice.  The Task Force made a conditional recommendation for the use of a CPR backboard during in-hospital cardiac arrest. Within the limitations of manikin studies, the available evidence indicates a marginal benefit to chest compression depth from use of a backboard. No studies specifically evaluated backboard deployment and any impact this has on interruptions to chest compressions and / or displacement of tubes and lines during insertion. For healthcare systems which have already incorporated backboards in to routine use during in-hospital arrest, the evidence was considered insufficient to suggest against their continued use. For healthcare systems which have not introduced backboards, the limited improvement in compression depth, and uncertainty about harms, seemed insufficient to justify the costs of purchasing backboards and training staff in their use. Where backboards are deployed, users should be aware that mattress stiffness, backboard size and orientation influence their effectiveness.[Cloete 2011,1064; Cloete 2011;1167; Cloete 2011, 2484; Cheng 2017, 364; Perkins 2009, 79] |  |
| 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 | Providing CPR backboards across healthcare settings would require moderate investment. |  |
| 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 |  |  |
| 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 | No evidence about cost effectiveness | Costs of backboard purchase and training personnel, probably outweighs marginal benefits. |
| 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 |  |  |
| Acceptability Is the intervention acceptable to key stakeholders? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know |  |  |
| Feasibility Is the intervention feasible to implement? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know |  |  |

# 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 performing chest compressions on a firm surface when possible (weak recommendation, low certainty of evidence)  · During in-hospital cardiac arrest, we suggest, where a bed has a CPR mode which increases mattress stiffness, it should be activated (weak recommendation, low certainty of evidence).  · During in-hospital cardiac arrest, we suggest against moving a patient from a bed to floor, to improve chest compression depth (weak recommendation, low certainty of evidence).  · During in-hospital cardiac arrest, we suggest in favour of either a backboard or no-backboard strategy, to improve chest compression depth, (Conditional recommendation, low certainty of evidence). |
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| Justification |
| · This topic was prioritised for review by the BLS Task Force as it had not been updated since 2010. [Koster 2010, e48; Sayre S298]. Members of the Task Force reported variation in backboard use and the practice of moving a patient from the a bed to the floor to improve the quality of CPR, thus it was considered timely to review the published evidence.  · The context for this question was that when chest compressions are performed on a mattress the compression force is dissipated through both chest compression and compression of the mattress under the patient. Manikin models indicate the amount of mattress compression ranges between 12-57% of total compression depth, with softer mattresses being compressed the most.[Lin 2017,22;Noodergraaf 2009,546; Oh 2013, 987; Song 2013, 469]. This can lead to reduced spinal-sternal displacement and a reduction in effective chest compression depth.  · Effective compression depths can be achieved even on a soft surface, providing the CPR provider increases overall compression depth to compensate for mattress compression.[Beesums 2014, 1439; Nishisaki 2012, 1013’ Sato 2011,770; Song 2013,469; Lee 2015, 1425; Oh 2012, 500; Ruiz 2016, 6596040]. CPR feedback devices which account for mattress compression (e.g. the use of dual accelerometers or increasing compression depth targets) can help CPR providers to ensure adequate compression depth when CPR is performed on a mattress.[Perkins 2009, 540; Lee 2015, 1425; Beesems 2014, 1439 ; Lee; Hellevuo 2014, 323; Lin 2017, 22; Perkins Ruiz de Gauna 2016, 6596040]  · In making these recommendations the Task Forces highlights the importance of high quality chest compressions for optimising outcomes from cardiac arrest.  · The Task Force noted that there were no clinical studies reporting on the critical outcomes of survival and favourable neurological outcome or important outcome of chest compression quality.  · The weak recommendations are based on extrapolation from manikin studies, typically undertaken on a mattress placed on a hospital bed, where CPR was performed by a trained healthcare professional. The hospital beds involved in the studies typically had a rigid base. The Task Force noted that although this configuration is common in many developed country hospitals, this may not be applicable to all hospitals or the out of hospital setting. The absence of studies simulating out-of-hospital settings (where beds may be softer) and where the CPR provider may be a single untrained rescuer, led to the Task Force focusing recommendations on the in-hospital setting.  · The Task Force supported performing chest compressions on a firm surface when possible as this reduces the risks of shallow compressions attributable to performing CPR on a soft surface.  · The Task Force considered, where available, activating a CPR function on a mattress, although unlikely to substantially improve compression depth, posed a low risk of harm to rescuers and patients leading to a weak recommendation of support.  · In considering whether to transfer a patient from a hospital bed to the floor to improve compression depth, the Task Force considered the risks of harm to the patient and resuscitation team outweighed any small improvement in chest compression depth, leading to a weak recommendation against routine use of this practice.  · The Task Force made a conditional recommendation for the use of a CPR backboard during in-hospital cardiac arrest. Within the limitations of manikin studies, the available evidence indicates a marginal benefit to chest compression depth from use of a backboard. No studies specifically evaluated backboard deployment and any impact this has on interruptions to chest compressions and / or displacement of tubes and lines during insertion. For healthcare systems which have already incorporated backboards in to routine use during in-hospital arrest, the evidence was considered insufficient to suggest against their continued use. For healthcare systems which have not introduced backboards, the limited improvement in compression depth, and uncertainty about harms, seemed insufficient to justify the costs of purchasing backboards and training staff in their use. Where backboards are deployed, users should be aware that mattress stiffness, backboard size and orientation influence their effectiveness.[Cloete 2011,1064; Cloete 2011;1167; Cloete 2011, 2484; Cheng 2017, 364; Perkins 2009, 79] |

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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 |
| · Studies reporting clinical outcomes  · Studies examining the logistical aspects of backboard deployment or moving a patient from a bed to the floor  · Studies relevant to out of hospital cardiac arrest |