

QUESTION

Should backboard/floor vs. normal mattress/soft surface be used for cardiopulmonary resuscitation?	
POPULATION:	For adults or children in cardiac arrest (out-of-hospital and in-hospital)
INTERVENTION:	The performance of CPR using a hard surface (e.g. backboard, floor, or deflatable or specialist mattress)
COMPARISON:	The performance of CPR on a regular mattress or other soft surface
MAIN OUTCOMES:	9 – Critical outcome : Survival with favourable neurological outcome 8 – Critical outcome: Survival 7 – Critical outcome: Return of spontaneous circulation 6 – Important outcome: CPR quality (compression depth, rate, fraction)
SETTING:	All settings
PERSPECTIVE:	
BACKGROUND:	<p>Delivery of chest compressions on a soft surfaces (e.g. mattress), can lead to compression of both chest and surface, with up to 57% of compression absorbed by the mattress. This can have the dual impact of inadequate compression depth, and increased provider fatigue, as additional force is required to compensate for the mattress. Given these risks, compression quality may increase if the patient is on a firmer surface, such as a backboard, floor, compressed mattress or deflated mattress. However, modifying the patient surface risks interruption to compression and creating a more hazardous environment for CPR providers.</p> <p>ILCOR has previously published a systematic review in 2010 and 2020 to describe the evidence on the impact of firm surfaces on CPR delivery. As per these reviews, the current ILCOR recommendation is to perform chest compressions on a firm surface when possible (weak recommendation, very low-certainty evidence). The aim of this systematic review is to update the 2020 ILCOR review and describe the evidence regarding CPR delivery on firm surfaces.</p>
CONFLICT OF INTERESTS:	Gavin Perkins has authored included research.

ASSESSMENT

Problem		
Is the problem a priority?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> <input type="radio"/> No <input type="radio"/> Probably no <input type="radio"/> Probably yes <input checked="" type="radio"/> Yes <input type="radio"/> Varies <input type="radio"/> Don't know 	<p>ILCOR recommends a chest compression depth of 5-6 cm to improve outcomes from cardiac arrest. When CPR is performed on a soft surface (e.g. mattress), the chest wall as well as the support surface is compressed. This has the potential to diminish chest compression depth delivered to the patient.</p> <p>ILCOR last reviewed this topic as part of the 2020 evidence review.¹ Since that time several studies have been conducted.</p>	
Desirable Effects		

How substantial are the desirable anticipated effects?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> • Trivial ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know 	<p>In addition to the 11 manikin simulation RCTs²⁻¹² identified by Holt et al.¹, we identified one observational study¹³ and 6 additional manikin RCTs¹⁴⁻¹⁹ published since 2019 addressing this PICOST.</p> <p>No studies reported patient outcomes or delays in CPR commencement.</p> <p>There was minimal changes in chest compression depth in mannikin simulation studies between soft and firm surfaces.</p> <p>No noted harms or adverse effects.</p>	
Undesirable Effects		
How substantial are the undesirable anticipated effects?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> ○ Trivial ○ Small ○ Moderate ○ Large ○ Varies • Don't know 	<p>Few studies reported undesirable effects. Rescuer fatigue and discomfort was greater when CPR was performed on a softer mattresses in one study (Ahn 2021).</p>	<p>Risks and difficulties in moving patient to the floor.</p>
Certainty of evidence		
What is the overall certainty of the evidence of effects?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> • Very low ○ Low ○ Moderate ○ High ○ No included studies 	<p>The certainty of evidence remains very low with only one very small single centre observational study and 17 simulated resuscitations on mannequins available. Only one study used lay rescuers.¹⁹</p> <p>When performing chest compressions on a mattress, the compression force is dissipated through both chest compression and compression of the surface beneath the patient. Prior studies using mannequins indicate that mattress compression can be as high as 57% of total compression depth, with greater compression seen in softer mattresses.²⁰⁻²² This can lead to reduced spinal-sternal displacement and a reduction in effective chest compression depth.</p>	<p>Manikins do not reflect the different sizes and weights of humans.</p> <p>Most studies used inbuilt sensors in manikins to determine CPR quality.</p> <p>The observational study¹³ used a handheld feedback device strapped to the patients chest to measure compressions -which may not be reliable when used on a mattress.³⁴</p>

	<p>It is known that effective compression depths can be achieved on soft surfaces if the CPR provider increases overall compression depth to compensate for mattress compression.²³⁻²⁶ CPR feedback devices, which account for mattress compression (e.g. the use of dual and not single accelerometers or increasing compression depth targets) can help CPR providers to ensure adequate compression depth when CPR is performed on a mattress.^{4,26-28}</p>	
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Values
Is there important uncertainty about or variability in how much people value the main outcomes?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> ○ Important uncertainty or variability ○ Possibly important uncertainty or variability • Probably no important uncertainty or variability ○ No important uncertainty or variability 	<p>The ILCOR COSCA document identifies patient outcomes as important.</p>	

Balance of effects
Does the balance between desirable and undesirable effects favor the intervention or the comparison?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> ○ 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 	<p>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.</p> <p>In considering whether to transfer a patient from a 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 unless necessary.</p>	<p>Studies on bystander CPR report significant loss of time due to difficulties in moving the patient to the floor²⁹ or that CPR is not performed because the patient could not be moved.^{29,30} Emergency Medical Services are likely to move patients in confined spaces to perform resuscitation.</p>

Resources required
How large are the resource requirements (costs)?"

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> ○ Large costs • Moderate costs ○ Negligible costs and savings 	<p>Some firm surfaces (e.g. backboards and CPR mode mattress) have additional costs.</p>	

<ul style="list-style-type: none"> ○ Moderate savings ○ Large savings ○ Varies ○ Don't know 		
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Certainty of evidence of required resources

What is the certainty of the evidence of resource requirements (costs)?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> ○ Very low ○ Low ○ Moderate ○ High • No included studies 	Some firm surfaces (e.g. backboards and CPR mode mattress) may require specific training (e.g. manual movement of patients).	

Cost effectiveness

Does the cost-effectiveness of the intervention favor the intervention or the comparison?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> ○ 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 cost effectiveness studies.	

Equity

What would be the impact on health equity?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> ○ Reduced ○ Probably reduced ○ Probably no impact ○ Probably increased ○ Increased ○ Varies • Don't know 	No evidence.	The cost of backboards/specialty mattress may not be affordable in resource restricted settings.

Acceptability
Is the intervention acceptable to key stakeholders?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<input type="radio"/> No <input type="radio"/> Probably no <input type="radio"/> Probably yes <input type="radio"/> Yes <input checked="" type="radio"/> Varies <input type="radio"/> Don't know	We have not identified any research that assessed acceptability. Although backboards and specialty mattresses are widely used in hospital settings.	

Feasibility
Is the intervention feasible to implement?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<input type="radio"/> No <input type="radio"/> Probably no <input type="radio"/> Probably yes <input type="radio"/> Yes <input checked="" type="radio"/> Varies <input type="radio"/> Don't know	Possible concerns around feasibility with single rescuer in the home environment but not studied. Backboards and specialty mattresses are widely used in hospital settings.	Moving unconscious victims to a firm surface may not be feasible in all settings with lay rescuers.

SUMMARY OF JUDGEMENTS

PROBLEM	JUDGEMENT						
	No	Probably no	Probably yes	Yes		Varies	Don't know
DESIRABLE EFFECTS	Trivial	Small	Moderate	Large		Varies	Don't know
UNDESIRABLE EFFECTS	Trivial	Small	Moderate	Large		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	Probably favors the intervention	Favors the intervention	Varies	Don't know

	JUDGEMENT						
			intervention or the comparison				
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

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 ○
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CONCLUSIONS

Recommendation

We suggest performing chest compressions on a firm surface when this is practical and does not significantly delay the commencement of chest compressions (weak recommendation, very low certainty evidence).

We suggest against moving a patient from a firm mattress to the floor to improve chest compression depth (weak recommendation, very low certainty of evidence).

We suggest activation of CPR mode to increase mattress stiffness if available for in-hospital cardiac arrest (Good Practice Statement).

For healthcare systems that have already incorporated backboards into routine use during resuscitations, the evidence was considered insufficient to suggest against their continued use (weak recommendation, very low certainty of evidence).

For healthcare systems that 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 (weak recommendation, very low certainty of evidence).

Justification

In making these recommendations, the Task Force considered the importance of high-quality chest compressions and minimizing delays to the initiation of CPR to improve outcomes from in-hospital and out-of-hospital cardiac arrest.

Within the limitations of mannequin studies, the available evidence indicates the use of backboard only results in a marginal depth benefit and one that is unlikely to be clinically significant.

The lack of clinical studies reporting on the critical outcomes of favorable neurological outcome, survival, ROSC and delays to commencement of CPR.

The addition of two studies simulating out-of-hospital settings (where beds may be softer) and one where the CPR provider may be a single untrained rescuer, led to the Task Force to broaden the recommendations to include in-hospital and out-of-hospital cardiac arrest.

In considering whether to transfer a patient to the floor when performing chest compressions to improve compression depth, the Task Force considered the risks of harm (e.g. interruption in CPR, risk of losing vascular access if IV lines and more confined space) to the patient and resuscitation team outweighed any small improvement in chest compression depth. In addition, studies on bystander CPR report significant loss of time due to difficulties in moving the patient to the floor²⁹ or that CPR is not performed at all because the patient could not be moved.^{29,30}

Emergency Medical Services are likely to move patients in confined spaces to perform resuscitation.

Subgroup considerations

n/a

Implementation considerations

For healthcare systems that have already incorporated backboards into routine use during resuscitations, the evidence was considered insufficient to suggest against their continued use. For healthcare systems that 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.³¹⁻³⁴

Monitoring and evaluation

Health care services should monitor CPR metrics, but be aware that CPR feedback devices may not accurately measure compression depth when CPR is performed on a mattress.

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 in both high and low-resource settings where hospital bed or pre-hospital stretcher configurations may vary.
- No studies evaluating pediatrics.

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