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| Question | |
| **Should higher fidelity manikins vs. lower fidelity manikins be used for life support education?** | |
| **Population:** | **For participants undertaking basic and advanced life support training in an education setting** |
| **Intervention:** | does the use of high-fidelity manikins |
| **Comparison:** | compared with the use of low-fidelity manikins |
| **Main outcomes:** | improve patient outcomes, change skill performance in actual resuscitations, change skill/knowledge at 1 year, skill/knowledge at time between course conclusion and 1 year, skill/knowledge at course conclusion; learner confidence, learner preference, cost/resource utilization? |
| **Setting:** | Life support education settings |
| **Perspective:** | This research question is conducted from the perspective of life support training learners (either laypeople of healthcare professionals) as well as life support instructors and training centers with a goal of optimizing the realism, and hence the engagement and educational effectiveness, of the physical devices used in training. |
| **Background:** | Higher fidelity manikins have physical features that make them more realistically resemble actual patients, including changes in simulated physical states and pathophysiology. A greater degree of realism during life support training may enhance learner engagement and make it easier for them to ‘suspend disbelief’. Previous published evidence suggests that higher fidelity manikins may be associated with better clinical performance at course conclusion. However, using higher fidelity manikins depends on the availability of resources to purchase, properly implement, and maintain them; additionally, center require trained personnel who can operate such manikins. |
| **Conflict of interests:** | Members of the review team were first authors and/or co-authors of two of the included studies; those individuals were recused from any data extraction or risk of bias assessment on their own studies. Additionally, the previous publication summarizing the 2015 ILCOR systematic review on this topic was authored by two review team members; the assessment of that systematic review for inclusion (via AMSTAR-2) was performed by two other review team members. |

# 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 | Higher fidelity in simulation may be associated with a greater degree of engagement and "suspension of disbelief" | Simulating a cardiac arrest victim does not require any physical features to be present.  Cost and resources (material and personnel) are necessary to implement properly. |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial ● Small ○ Moderate ○ Large ○ Varies ○ Don't know | Meta-analysis of available studies found a slight benefit in clinical performance at course conclusion with higher fidelity manikins  Meta-analysis of available studies found no significant effect on knowledge at course conclusion  Most studies reporting on affective responses (confidence, learner preference) found positive findings | No studies demonstrated a negative effect of higher fidelity simulation on educational outcomes.  Few studies examined longer-term impact (i.e. skill or knowledge retention).  No studies reported on patient outcomes |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial ○ Small ○ Moderate ○ Large ○ Varies ● Don't know | No studies demonstrated a negative effect of higher fidelity simulation on educational outcomes  Learners generally expressed favorable responses to questions about higher fidelity simulation's effectiveness | No studies balanced the impact of fidelity with the cost of equipment, instructor training, and infrastructure maintenance involved with higher fidelity |
| 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 | Six out of seven selected outcomes exhibited very low certainty evidence, based on risk of bias, inconsistency, and imprecision  Both meta-analyses (skill at course conclusion, knowledge at course conclusion) demonstrated very high degree of heterogeneity |  |
| 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 |  |  |
| 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 | While results were mixed for all outcomes, there was a significant increase in clinical performance at course conclusion as a positive outcome from one meta-analysis | Cost, training, personnel, and infrastructure are very important logistical considerations that could amount to obstacles to implementation; none of those phenomena were directly studied |
| Resources required | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large costs ○ Moderate costs ○ Negligible costs and savings ○ Moderate savings ○ Large savings ○ Varies ● Don't know | No studies examined cost or savings with regard to higher fidelity manikin use | Most of the manikins used in the included studies require electricity and/or connection to a computer interface. Additionally, instructors and facilitators need to be trained in their use and maintenance. |
| 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 |  | Even if detailed data from research studies are missing, there are definitively increased costs with the use of high fidelity manikins for resuscitation training. |
| 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 |  | Increased cost is implied with high-fidelity manikins, but we have no data on that. |
| 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 | No studies examined issues of equity directly | The inability to utilize high fidelity simulation based on cost and/or availability could amount to a source of inequity. |
| Acceptability Is the intervention acceptable to key stakeholders? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know | Among the included studies, the responses from learners were generally favorable | No studies examined responses from simulation instructors or facilitators with regard to ease of use, etc. |
| Feasibility Is the intervention feasible to implement? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ○ Yes ○ Varies ● Don't know | No studies examined implementation directly | Implementation of high fidelity simulators involves cost, available infrastructure (e.g. space, computer support, etc.) and trained instructors and facilitators |

# Summary of judgements

|  | **Judgement** | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Problem** | 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 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 the use of high-fidelity manikins when training centers/organizations have the infrastructure, trained personnel, and resources to use them (weak recommendations based on very-low-quality evidence).  If high-fidelity manikins are not available, we suggest that the use of low-fidelity manikins is acceptable for standard life support training in an educational setting (weak recommendations based on low-quality evidence). |
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| Justification |
| A majority of studies found a positive impact on skill and/or knowledge at course conclusion. There were no studies that demonstrated a negative effect of higher fidelity manikins on educational outcomes. Given that resource utilization and cost were not directly studied, along with the fact that higher fidelity manikins are likely more expensive to obtain and maintain, we limit our recommendation to centers where these resources are available.  Four RCTs were identified that demonstrated improvement from pre- to post- training in all subject groups, irrespective of what level of fidelity of manikin was used for training. These studies are the basis of the second recommendation above (that low fidelity manikins are acceptable for training). |

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| Subgroup considerations |
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| Implementation considerations |
| No studies reported on cost or on resources needed to implement higher fidelity manikins. Our recommendation is predicated on the higher fidelity manikins being used in a setting with appropriate space, infrastructure, personnel, and resources to use them properly. Educational settings where these resources are less available might make implementation difficult. |

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| Monitoring and evaluation |
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| Research priorities |
| * Cost-effectiveness and implementation studies * Studies examining longer term educational outcomes (skill and/or knowledge retention and/or decay) * Specific simulation features that are most associated with improved learning * Translational research from simulation to actual patient care processes and patient outcomes |

# References Summary