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| Question |
| **Should Self-directed digital CPR training vs. Instructor-led CPR training be used for Adults and children undertaking CPR training?** |
| **Population:** | Adults and children undertaking CPR training |
| **Intervention:** | Self-directed digital CPR training |
| **Comparison:** | Instructor-led CPR training |
| **Main outcomes:** | Patient outcomes: Good neurological outcome at hospital discharge/30-days; Survival at hospital discharge/30-days; Return of spontaneous circulation (ROSC); Rates of bystander CPR; Bystander CPR quality during an OHCA (any available CPR metrics); Rates of automated external defibrillator (AED) use. Educational outcomes at the end of training and within 12 months: CPR quality (chest compression depth and rate; chest compression fraction; full chest recoil, hand position, ventilation rate) and AED competency; CPR and AED knowledge; Confidence and willingness to perform CPR. |
| **Setting:** | Any |
| **Background:** | Bystander CPR more than doubles the chance of surviving an out-of-hospital cardiac arrest (OHCA). CPR and AED training is known to improve the willingness and confidence in someone performing bystander CPR. Little is known about whether self-directed digital CPR training is superior to instructor-led training in developing sufficient skills to provide adequate CPR. |
| **Conflict of interests:** | The following Task Force members declared an intellectual conflict of interest and this was acknowledged and managed by the Task Force Chairs and Conflict of Interest committees: Andrew Lockey, Joyce Yeung, and Robert Greif. |

# Assessment

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| ProblemIs the problem a priority? |
| Judgement | Research evidence | Additional considerations |
| ○ No○ Probably no○ Probably yes● Yes○ Varies○ Don't know | Out-of-hospital cardiac arrest (OHCA) is a significant cause of death. Given the recent pandemic, with issues in attending training, the EIT Task Force considered this question a priority. Two related PICOS were performed as part of the 2015 ILCOR review: # 647 (CPR instruction methods: self-instruction versus traditional) and #651 (AED training methods). A significant number of RCTs on this topic have been conducted since that time.  | Access to digital self-direct training is important during periods where access to training can be limited eg. pandemics, low-resource settings, or when geographical barriers exist because 1) more OHCA occur in the home and 2) access to instructor-led training may not be possible or is restricted.  |
| Desirable EffectsHow substantial are the desirable anticipated effects? |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial○ Small● Moderate○ Large○ Varies○ Don't know | **Patient outcomes** No studies were identified reporting on the subsequent use of skills and patient outcomes.**Educational outcomes (CPR, AED skills, knowledge, confidence and willingness)**Educational outcomes of CPR quality, automated external defibrillator (AED) use, knowledge, confidence and willingness were examined in 29 RCTs.(1-29) For CPR quality there was 27 studies(1-4, 6-19, 21-29), AED use (10 studies(2, 5, 6, 9, 18, 20-22, 24, 25), knowledge (7 studies(7, 12, 17, 23, 24, 26, 27)), confidence (10 studies(1, 10, 12-14, 16, 18, 20, 22, 29)) and willingness (6 studies(4, 14, 16, 18-20)). 25 studies tested participants immediately to <1 month(1, 3-13, 15-25, 28, 29), three studies conducted their first assessment at delayed intervals (4 months(14); 6 months (2) and between 2-6 months(26)) and 11 studies conducted follow-up testing between one to six months after training(3, 5, 8, 11, 12, 20, 22-24, 28, 29). Significant heterogeneity exists across all the studies in population, interventions, comparators, outcomes and measurement methods precluding any pooling of data or meta-analysis. For the important CPR skills outcome of compression rate we found 15 studies. (1, 3, 4, 6, 9, 11, 13, 18, 19, 21, 22, 25, 27-29) Eleven studies showed no difference between the self-directed digital training versus instructor-led training(1, 3, 4, 6, 9, 13, 19, 21, 22, 28, 29), favored instructor-led training three studies(11, 18, 25); and favored self-directed digital training in two studies(11, 27) (low certainty of evidence downgraded for risk of bias and indirectness).For the important CPR skills outcome of compression depth we found 15 studies(1, 3, 4, 6, 8, 9, 11, 15, 18, 21, 22, 24, 27-29). Ten of these studies found no difference between self-directed digital training versus instructor-led training(1, 3, 6, 8, 9, 11, 15, 22, 27, 28), six studies favored instructor-led training(4, 11, 18, 21, 24, 29) and one study favored self-directed digital training(9) (very low certainty of evidence, downgraded for serious risk of bias, inconsistency, and indirectness).For the important CPR skills outcome of chest compression fraction we found four studies, (1, 3, 21, 29) with three finding no difference between self-directed digital training versus instructor-led training(1, 3, 29) and one favoring instructor-led training(21).For the important outcome of chest recoil we found five studies(1, 9, 18, 21, 22) with two studies finding no difference between self-directed digital training versus instructor-led training(1, 22), two favoring self-directed digital training(9, 18) and one favoring instructor-led training(21) (very low certainty of evidence downgraded for very serious inconsistency and serious risk of bias, indirectness and imprecision).For the important CPR skills outcome of hand position 14 studies were identified(1, 4, 6, 8, 9, 11, 15, 18, 19, 22, 24, 25, 27, 28). Nine studies found no difference between self-directed digital training versus instructor-led training,(1, 6, 9, 11, 18, 22, 25, 27, 28) four studies favored instructor-led training (4, 8, 19, 24) and two studies favoured self-directed digital training(11, 15). (Very low certainty of evidence downgraded for very serious risk of bias, indirectness and imprecision).For the important CPR skills outcome of ventilation rate seven studies were identified and all found no difference between self-directed digital training versus instructor-led training(4, 6, 8, 9, 13, 22, 27)(low certainty of evidence downgraded for serious risk of bias and imprecision).For the important AED skills outcome eight studies were identified,(5, 6, 9, 20-22, 24, 25) with five identifying no difference between self-directed digital training versus instructor-led training(9, 20, 22, 24, 25) and three studies favored instructor-led training(5, 6, 21) (very low certainty of evidence downgraded for very low for serious risk of bias, indirectness and imprecision). For the important outcome of knowledge, six studies were identified(7, 12, 17, 23, 24, 27). Three studies found no difference between self-directed digital training versus instructor-led training,(17, 23, 27) two studies favored instructor-led training(7, 12) and one study favored self-directed digital training(23) (very low certainty of evidence (downgraded for very serious risk of bias and inconsistency, and serious indirectness and imprecision).For the important outcome of confidence, nine studies were identified(1, 10, 12, 13, 16, 18, 20, 22, 29). Five studies found no difference between self-directed digital training versus instructor-led training(13, 16, 18, 20, 29), three studies favored instructor-led training(10, 12, 22) and one study favored self-directed digital training(1) (very low certainty of evidence downgraded for very serious risk of bias, indirectness and imprecision).For the important outcome of willingness, five studies were identified and all found no difference between self-directed digital training versus instructor-led training(4, 16, 18-20) (very low certainty of evidence downgraded for very serious indirectness and serious risk of bias and imprecision).  | The significant variation in all aspects of the studies limits in-depth interpretation. Despite most outcomes demonstrating no difference between the groups (potentially suggesting a trivial effect), the population are still receiving the educational outcomes. Therefore, the desirable effects are listed as moderate.  |
| Undesirable EffectsHow substantial are the undesirable anticipated effects? |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial● Small○ Moderate○ Large○ Varies○ Don't know | Some studies showed a statistical difference for chest compression depth favouring instructor-led training. However, it is difficult to know how clinically significant these differences were, because in some studies compression depth was low in both groups and most differences were marginal. Furthermore: * Use of feedback devices for compression depth varied widely.
* Manikins vary with respect to the maximum allowable depth (e.g. some allow compressions beyond depth guidelines, while others do not), force required to generate guideline compliant depth (i.e. resistance), and chest size.
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| Certainty of evidenceWhat is the overall certainty of the evidence of effects? |
| Judgement | Research evidence | Additional considerations |
| ● Very low○ Low○ Moderate○ High○ No included studies | The overall certainty of evidence was very low for this study.  |  |
| ValuesIs 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 little uncertainty or variability in how much people value the main outcomes. However, there was significant uncertainty in the findings from the studies included in this review due to the vast heterogeneity in all aspects of the study methodologies. |  |
| Balance of effectsDoes 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 shown in the Desirable Effects section, for each outcome, the vast majority of findings do not favor either the intervention or comparison irrespective of the significant heterogeneity in all aspects of the study methodologies. |  |
| Resources required |
| Judgement | Research evidence | Additional considerations |
| ○ Large costs○ Moderate costs● Negligible costs and savings○ Moderate savings○ Large savings○ Varies○ Don't know | One study(4) compared costs to users and determined digital self-directed learning to be more expensive –but this included the costs of purchasing a separate manikin (which is now sold as part of video kits) and assessment. Van Raemdonck used low-cost tools instead of manikins to conduct CPR training and identified an ability to train many people at some expense to the quality of skills produced.(28)Digital training requires viewing equipment and the cost of training materials. Video-kits with manikins are generally cheap and comparable in costs to instructor-led classes. Most currently available digital training allows free multiple viewings, viewing at the learners convenience, the potential for training others (e.g. kits trained 2.5 people), and free retraining.Instructor-led training resources include personnel, space and equipment. Learner’s time and travel costs to classes.  | Some of the digital resources may have a high initial cost, however, they can be reused and may be more economical in the long run, particularly when factoring in events such as the COVID-19 pandemic.  |
| Certainty of evidence of required resourcesWhat is the certainty of the evidence of resource requirements (costs)? |
| Judgement | Research evidence | Additional considerations |
| ● Very low○ Low○ Moderate○ High○ No included studies | Across all outcomes there was low, or very low certainty of evidence.  | Some of the digital resources may have a high initial cost, however, they can be reused and may be more economical in the long run, particularly when factoring in events such as the COVID-19 pandemic.  |
| Cost effectivenessDoes 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 | Hasselager(10) reported a cost-effectiveness analyses of video CPR training with an infant manikin (clicker feedback). They accounted for participant time costs, cleaning, equipment and instructor time) Each 10,000 USD spent: 233 laypersons trained using self-directed digital training and 71 will be competent after training. For instructor-led training, 109 can be trained and 65 will be competent. They identified self-directed digital training to be more cost effective than instructor-led training, but less effective.(10) | Digital self-training is becoming cheaper and can allow for free re-training and provide opportunities to train others.  |
| EquityWhat 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 | The convenience and accessibility of digital self-directed training is likely to be more equitable than instructor-led training.  |  |
| AcceptabilityIs the intervention acceptable to key stakeholders? |
| Judgement | Research evidence | Additional considerations |
| ○ No○ Probably no● Probably yes○ Yes○ Varies○ Don't know | Digital training methods scored higher by participants for acceptability(1, 2). |  |
| FeasibilityIs the intervention feasible to implement? |
| Judgement | Research evidence | Additional considerations |
| ○ No○ Probably no● Probably yes○ Yes○ Varies○ Don't know | Most people have access to equipment to view digital training. Many self-directed kits can be mailed or made digitally accessible.  |  |

# 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** | 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 either instructor-led training or self-directed digital training with for the acquisition of CPR or AED skills in lay-adults and high school aged (>10 years) children (weak recommendation, very low quality of evidence).We suggest self-directed digital training be used when instructor-led training is not accessible, or when quantity over quality of CPR training is needed in adults and children (weak recommendation, very low quality of evidence).There was insufficient evidence to make a recommendation on game-in-film, virtual reality, computer programmes, online tutorials or app-based training as a CPR or AED training method. There was insufficient evidence to suggest a treatment effect on bystander CPR rates or patient outcomes. |

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| Justification |
| In making these recommendations the Education, Implementation and Teams (EIT) considered the following:* Significant variation in all aspects of the study methodologies exists and therefore limits definitive recommendations.
* That any form of CPR/AED training is likely improve knowledge, confidence and willingness in simulated settings, however, this may not translate to real-life situations.
* Cost-effectiveness analysis performed typically favored digital-training(10, 28). Instructor-led classes require human resources, organization, location and equipment.
* Acquisition of different CPR skills may vary across different mediums and age groups.
* The known barriers that exist to attend instructor-led CPR classes (e.g. time, costs, and accessibility) and the need to make CPR training available to everyone.
* The need and ease for updating digital and instructor-led materials to ensure training complies with CPR recommendations.
* Digital training allows skills to be refreshed at any time, and at no additional cost, and provide the opportunity to teach others.
* Digital training enables more people to be educated in periods of need (e.g. pandemics).
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| Subgroup considerations |
| No consideration has been given to subgroups in arriving at the treatment recommendations, however future research should consider population differences as well as resourcing and setting factors. |

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| Implementation considerations |
| The initial cost of developing self-directed digital training may be large, however over time, this may prove to be a more economical means of delivering CPR and AED education to large populations.  |

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| Monitoring and evaluation |
| Ongoing monitoring of self-directed CPR and AED digital education methods should occur and future studies should compare these interventions to standardised accepted instructor-led training programmes to determine their efficacy. |

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| Research priorities |
| Future research should focus on standardised outcome measures to allowing for pooling of data. Comparator groups should be aligned using standardised, accepted instructor-led training programmes to reduce inconsistency and uncertainty. Future research should also investigate the ability of these interventions and comparators to produce findings that meet accepted standards for adequate CPR that are maintained at defined time intervals. Regarding specific self-directed digital interventions, further research is required for methods such as game-in-film, virtual reality, computer programmes, online tutorials or app-based training to determine their effectiveness. Finally, the treatment effect on bystander CPR rates and patient outcomes needs to be included in future research. |

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