

## Appendix A4 EIT-1 EtD Table Self-Directed vs. Instructor Led BLS Training

### QUESTION

Should self-directed digital vs. instructor-led training be used to teach adults and children basic life support skills?	
<b>POPULATION:</b>	Adults and children undertaking BLS training.
<b>INTERVENTION:</b>	Self-directed digitally-based BLS training.
<b>COMPARISON:</b>	Instructor-led BLS training
<b>MAIN OUTCOMES:</b>	<p>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.</p> <p>Educational outcomes at the end of training and within 12 months: CPR quality (chest compression depth and rate; chest compression fraction; full chest recoil, ventilation rate, overall CPR competency) and AED competency; CPR and AED knowledge; Confidence and willingness to perform CPR.</p>
<b>SETTING:</b>	Lay person BLS training
<b>BACKGROUND:</b>	Bystander CPR and automated external defibrillator (AED) use in OHCA more than doubles OHCA survival. BLS training provides knowledge and skills to perform CPR and use an AED. BLS training is associated with increased confidence and willingness to perform BLS skills.
<b>CONFLICT OF INTERESTS:</b>	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 Lockety, Joyce Yeung, Koen Monsieurs and Robert Greif.

### ASSESSMENT

Problem		
Is the problem a priority?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<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>Out-of-hospital cardiac arrest (OHCA) is a significant cause of death. Given the current pandemic, with issues in attending training, the EIT Task Force considered this question a priority.</p> <p>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.</p>	<p>Access to digital self-directed training is important during pandemics because 1) more OHCA occur in the home and 2) access to instructor-led training may not be possible or is restricted.</p>

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**Desirable Effects**  
How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> <li>○ Trivial</li> <li>○ Small</li> <li>● Moderate</li> <li>○ Large</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>	<p><b>Subsequent use of skills and patient outcomes</b></p> <p>Two RCTs reported results for subsequent use of BLS skills and patient outcomes following training. Only Dracup et al. (2000 3289) reported any OHCA events (n=13) where trainees used skills, however there were too few events (n=13) and outcomes of this study were of too low quality (very low certainty of evidence, downgraded for risk of bias and imprecision) to be confident in the findings.</p> <p><b>Educational outcomes (CPR and AED skills immediate and to one year)</b></p> <p>Testing of CPR and AED skills was conducted immediately to one-month after training in 36 studies (29 RCTs and 7 non-RCTs) and between two-months and one-year in 24 studies (20 RCTs and 4 non-RCTs: Barr 2013 538; Braslow 1997 207; Edwards 1987 492; Isbye 2006 435). Methods of measurement and the types of educational outcomes varied widely between studies, which precluded any pooling of data or meta-analysis.</p> <p>Moderate certainty of evidence (downgraded for risk of bias) from 28 studies, comparing instructor-led training and digital training using video or interactive computer programs with manikin practice, showed comparable educational outcomes for most CPR skills and knowledge gained immediately following training and to one-year.</p> <p>Low certainty of evidence (downgraded for risk of bias and imprecision) from 9 studies, comparing instructor-led training and digital training using video-only, showed comparable educational outcomes for most CPR skills and knowledge gained immediately following training and to one-year and overall CPR competency and knowledge immediately.</p> <p>Low certainty of evidence (downgraded for risk of bias and imprecision) from 11 RCTs testing methods of digital training for AED skills, suggests instructor-led training may be more effective immediately following training but not in the long-term.</p> <p>Insufficient (low quality, downgraded for risk of bias and inconsistency) evidence (3 studies) was found comparing gaming training to instructor-led training.</p>	<p>Two excluded studies mailed out digital training kits and examined the impact on OHCA CPR and patient outcomes. No change was noted in bystander CPR or patients outcomes when compared to a period of time before or a region that did not receive BLS training kits.</p> <p>Compared to no training arms or before-and-after studies –both digital and instructor-led improved learning outcomes.</p> <p>Testing of educational outcomes varied in terms of duration of testing and methods of data collection (manikin and checklists). Varied use of manikin practice, feedback devices, and assessment of CPR performance was also noted.</p> <p>Manikins have different technical specifications with respect to delivery of CPR.</p> <p>Most currently available digital training allows free multiple viewings, viewing at the learners convenience, the potential for training others (e.g. kits trained &gt;2 people), and free retraining.</p>

**Undesirable Effects**  
How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
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<ul style="list-style-type: none"> <li>○ Trivial</li> <li>○ Small</li> <li>○ Moderate</li> <li>○ Large</li> <li>● Varies</li> <li>○ Don't know</li> </ul>	<p>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.</p> <p>Furthermore:</p> <ul style="list-style-type: none"> <li>● Studies with pre-testing or with a no training control groups showed improved compression depth outcomes in digital training arms.</li> <li>● Use of feedback devices for compression depth varied widely.</li> <li>● 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.</li> <li>● One study noted that although some video kit manikins contained feedback devices, the video did not always explained its use (Jones 2007 350). How widespread this issue was across other studies is unknown due to lack of reporting.</li> <li>● One study suggested differences in achieving CPR skills may related to the different manikins used in practice and assessment, with only the instructor-led group training on the same manikins used in assessment (Jones 2007 350).</li> </ul> <p>Video only training may not achieve acceptable education outcomes for all CPR and AED skills.</p>	<p>Data suggests CPR and AED training must included skills practice –preferably with corrective feedback.</p> <p>One study suggested insufficient emphasis in AED use in digital training may explain worse AED educational outcomes (Doucet 2019 317).</p>
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**Certainty of evidence**  
 What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS												
<ul style="list-style-type: none"> <li>○ Very low</li> <li>○ Low</li> <li>● Moderate</li> <li>○ High</li> <li>○ No included studies</li> </ul>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Outcome</th> <th colspan="2" style="text-align: left;">Certainty of evidence</th> </tr> </thead> <tbody> <tr> <td>Patient outcomes</td> <td>Very low</td> <td>⊕</td> </tr> <tr> <td>Educational outcomes immediate to one-month</td> <td>Moderate</td> <td>⊕⊕⊕</td> </tr> <tr> <td>Educational outcomes to one-year</td> <td>Low</td> <td>⊕⊕</td> </tr> </tbody> </table>	Outcome	Certainty of evidence		Patient outcomes	Very low	⊕	Educational outcomes immediate to one-month	Moderate	⊕⊕⊕	Educational outcomes to one-year	Low	⊕⊕	<p>Most studies were downgraded due to loss to follow-up (&gt;95%) for both short and long term outcomes.</p> <p>Most non-RCTs did not adjust for differences in characteristics and confounders (e.g. prior CPR training) at baseline between groups.</p>
Outcome	Certainty of evidence													
Patient outcomes	Very low	⊕												
Educational outcomes immediate to one-month	Moderate	⊕⊕⊕												
Educational outcomes to one-year	Low	⊕⊕												

**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"> <li>○ Important uncertainty or variability</li> <li>○ Possibly important uncertainty or variability</li> <li>● Probably no important uncertainty or variability</li> <li>○ No important uncertainty or variability</li> </ul>	<p>Main outcome is survival, and neurologically intact survival. COSCA has confirmed importance of these outcomes.</p> <p>COSCA: Haywood K, Whitehead L, Nadkarni VM, Achana F, Beesems S, Bottiger BW, et al. COSCA (Core Outcome Set for Cardiac Arrest) in Adults: An Advisory Statement From the International Liaison Committee on Resuscitation. Resuscitation. 2018;127:147-63.</p>	

	Educational outcomes were decided and prioritised by the EIT Task Force.	
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**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"> <li><input type="radio"/> Favors the comparison</li> <li><input type="radio"/> Probably favors the comparison</li> <li><input checked="" type="radio"/> Does not favor either the intervention or the comparison</li> <li><input type="radio"/> Probably favors the intervention</li> <li><input type="radio"/> Favors the intervention</li> <li><input type="radio"/> Varies</li> <li><input type="radio"/> Don't know</li> </ul>	<p>The systematic review found no difference for most CPR educational outcomes for video kits/ video with manikin practice.</p>	<p>Self-directed digital training is already widespread and more convenient for learners</p>

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

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> <li><input type="radio"/> Large costs</li> <li><input type="radio"/> Moderate costs</li> <li><input type="radio"/> Negligible costs and savings</li> <li><input type="radio"/> Moderate savings</li> <li><input type="radio"/> Large savings</li> <li><input checked="" type="radio"/> Varies</li> <li><input type="radio"/> Don't know</li> </ul>	<p>Most studies comparing cost of video kits (with manikin) to instructor-led training state digital self-training is cheaper (see cost-effectiveness below).</p> <p>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.</p> <p>Instructor-led training resources include personnel, space and equipment. Learner's time and travel costs to classes.</p>	<p>One study (Chung 2010 165) 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.</p>

**Certainty of evidence of required resources**  
What is the certainty of the evidence of resource requirements (costs)?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
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<ul style="list-style-type: none"> <li><input type="radio"/> Very low</li> <li><input checked="" type="radio"/> Low</li> <li><input type="radio"/> Moderate</li> <li><input type="radio"/> High</li> <li><input type="radio"/> No included studies</li> </ul>	<p>Low quality evidence.</p>	
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**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"> <li><input type="radio"/> Favors the comparison</li> <li><input type="radio"/> Probably favors the comparison</li> <li><input type="radio"/> Does not favor either the intervention or the comparison</li> <li><input checked="" type="radio"/> Probably favors the intervention</li> <li><input type="radio"/> Favors the intervention</li> <li><input type="radio"/> Varies</li> <li><input type="radio"/> No included studies</li> </ul>	<p>Hasselager (2019 28) 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 71 will be competent after training. For instructor-led training, 109 can be trained and will be 65 competent.</p>	<p>Digital self-training is becoming cheaper and can allow for free re-training and provide opportunity to train others.</p> <p>Li (2011 357) reported a cost-effectiveness analyses of video only CPR training compared to interactive instructor-led BLS training and instructor-led lectures. They reported much higher cost/passed student (knowledge only), for instructor-led training 2.1 to 3.7 times higher than video only.</p>

**Equity**  
What would be the impact on health equity?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> <li><input type="radio"/> Reduced</li> <li><input type="radio"/> Probably reduced</li> <li><input type="radio"/> Probably no impact</li> <li><input type="radio"/> Probably increased</li> <li><input type="radio"/> Increased</li> <li><input checked="" type="radio"/> Varies</li> <li><input type="radio"/> Don't know</li> </ul>	<p>The convenience and accessibility of digital self-directed training is likely to be more equitable than instructor-led training.</p>	

**Acceptability**  
Is the intervention acceptable to key stakeholders?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

<ul style="list-style-type: none"> <li><input type="radio"/> No</li> <li><input type="radio"/> Probably no</li> <li><input checked="" type="radio"/> Probably yes</li> <li><input type="radio"/> Yes</li> <li><input type="radio"/> Varies</li> <li><input type="radio"/> Don't know</li> </ul>	Digital training methods scored higher by participants for acceptability (Assadi 2015 291; Ali 219 30; Barr 2013 538).	
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<b>Feasibility</b> Is the intervention feasible to implement?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<ul style="list-style-type: none"> <li><input type="radio"/> No</li> <li><input type="radio"/> Probably no</li> <li><input checked="" type="radio"/> Probably yes</li> <li><input type="radio"/> Yes</li> <li><input type="radio"/> Varies</li> <li><input type="radio"/> Don't know</li> </ul>	Most people have access to equipment to view digital training. Video kits can be mailed.	

### SUMMARY OF JUDGEMENTS

JUDGEMENT							
PROBLEM	No	Probably no	Probably yes	Yes		Varies	Don't know
DESIRABLE EFFECTS	Trivial	Small	<b>Moderate</b>	Large		Varies	Don't know
UNDESIRABLE EFFECTS	Large	Moderate	<b>Small</b>	Trivial		Varies	Don't know
CERTAINTY OF EVIDENCE	Very low	Low	<b>Moderate</b>	High			No included studies
VALUES	Important uncertainty or variability	Possibly important uncertainty or variability	<b>Probably no important uncertainty or variability</b>	No important uncertainty or variability			
BALANCE OF EFFECTS	Favors the comparison	Probably favors the comparison	<b>Does not favor either the intervention or the comparison</b>	Probably favors the intervention	Favors the intervention	Varies	Don't know

	JUDGEMENT						
RESOURCES REQUIRED	Large costs	Moderate costs	Negligible costs and savings	<b>Moderate savings</b>	Large savings	Varies	Don't know
CERTAINTY OF EVIDENCE OF REQUIRED RESOURCES	Very low	<b>Low</b>	Moderate	High			No included studies
COST EFFECTIVENESS	Favors the comparison	Probably favors the comparison	Does not favor either the intervention or the comparison	<b>Probably favors the intervention</b>	Favors the intervention	Varies	No included studies
EQUITY	Reduced	Probably reduced	Probably no impact	<b>Probably increased</b>	Increased	Varies	Don't know
ACCEPTABILITY	No	Probably no	<b>Probably yes</b>	Yes		Varies	Don't know
FEASIBILITY	No	Probably no	<b>Probably yes</b>	Yes		Varies	Don't know

### TYPE OF RECOMMENDATION

Strong recommendation against the intervention <input type="radio"/>	Conditional recommendation against the intervention <input type="radio"/>	Conditional recommendation for either the intervention or the comparison <input checked="" type="radio"/>	Conditional recommendation for the intervention <input type="radio"/>	Strong recommendation for the intervention <input type="radio"/>
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<b>Recommendation</b>	<ul style="list-style-type: none"> <li>• We recommend instructor-led training (with manikin practice with feedback device) or the use of self-directed training with video kits (instructional video and manikin practice with feedback device) for the acquisition of CPR theory and skills in lay-adults and high school aged (&gt; 10 years) children (strong recommendation, moderate quality of evidence).</li> <li>• We recommend instructor-led training (with AED scenario and practice) or the use of self-directed video kits (instructional video with AED scenario) for the acquisition of AED theory and skills in lay-adults and high school aged (&gt;10 years) children (strong recommendation, low quality of evidence).</li> <li>• We suggest BLS video education (without manikin practice) be used when instructor-led training or self-directed training with video kits (instructional video plus manikin with feedback device) are not accessible, or when quantity over quality of BLS training is needed in adults and children (weak recommendation, weak quality of evidence).</li> <li>• There was insufficient evidence to make a recommendation on gaming as a CPR or AED training method.</li> <li>• There was insufficient evidence to suggest a treatment effect on bystander CPR rates or patient outcomes.</li> </ul>
<b>Justification</b>	<p>In making these recommendations, the EIT Task Force acknowledges that:</p> <ul style="list-style-type: none"> <li>• the current evidence suggests some AEDs skills were superior with instructor-led training; however, the Task Force considered the significant improvement in AED skills with both methods when compared to baseline or groups with no training more important since modern AEDs include voice prompts for use.</li> <li>• adequate training outcomes for some BLS skills may not be achieved with video-only training; however, the Task Force considered the improvement in BLS skills with video-only training when compared to baseline or groups with no training more important.</li> <li>• high-school aged children may not be able to achieve guideline recommendations for chest compression depth; however, the Task Force considered the acquisition of BLS skills at this age more important.</li> </ul> <p>The EIT Task Force also considered the following:</p> <ul style="list-style-type: none"> <li>• Testing of educational outcomes varied in terms of duration of testing and methods of data collection (manikin and checklists). Varied use of manikin practice, feedback devices, and assessment of CPR performance was also noted.</li> <li>• Manikins have different technical specifications with respect to delivery of CPR.</li> <li>• The difference in compression depth were discussed at length. Of particular importance:             <ul style="list-style-type: none"> <li>- Although compression depth favored instructor-led training, 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.</li> <li>- Studies with pre-testing or with a no training control groups showed improved compression depth outcomes in digital training arms.</li> <li>- Use of feedback devices for compression depth varied widely.</li> <li>- 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.</li> <li>- One study noted that although some video kit manikins contained feedback devices, the video did not always explained its use (Jones 2007 350). How widespread this issue was across other studies is unknown due to lack of reporting.</li> </ul> </li> </ul>



	<ul style="list-style-type: none"> <li>- One study suggested differences in achieving CPR skills may related to the different manikins used in practice and assessment, with only the instructor-led group training on the same manikins used in assessment (Jones 2007 350).</li> <li>• That any form of BLS training improves knowledge, confidence and willingness to perform CPR compared to control groups with no training.</li> <li>• One study suggested insufficient emphasis in AED use in digital training may explain worse AED educational outcomes (Doucet 2019 317).</li> <li>• Video-only digital training is probably not comparable to instructor-led training, due to the differences in BLS practice and feedback between groups.</li> <li>• The relevance of older RCTs was discussed, including: advancements in RCT methods; modern training focuses on chest compressions; advancements in technology for CPR assessments.</li> <li>• Cost-effectiveness analysis performed typically favors digital- training (Hasselager 2019 28; Li 2011 357). Instructor-led classes require human resources, organization, location and equipment. Digital training is generally cheaper and more convenient than instructor-led training.</li> <li>• Data suggest CPR and AED training must include skills practice –preferably with corrective feedback.</li> <li>• That provision of bystander CPR and AED use are strong predictors of OHCA patient outcomes.</li> <li>• Acquisition of different BLS skills may vary across different mediums and age groups.</li> <li>• The known barriers that exist to attend instructor-led BLS classes (e.g. time, costs, and accessibility) and the need to make BLS training available to everyone.</li> <li>• The need and ease for updating digital and instructor-led materials to ensure training complies with BLS recommendations.</li> <li>• Digital training allow skills to be refreshed at any time, and at no additional cost, and provide the opportunity to teach others (~2.5 additional people trained per kit Isbye 2007 1380, Barr 2013 538). Refreshment of CPR skills using digital methods may explain why some skills improved when measured in the longer term (Yeung 2017 138).</li> <li>• Digital training enables more people to be educated in periods of need (e.g. pandemics).</li> </ul>
<b>Subgroup considerations</b>	<ul style="list-style-type: none"> <li>• Not all high school aged children were able achieve guideline recommended compression depth with digital training.</li> </ul>
<b>Implementation considerations</b>	<ul style="list-style-type: none"> <li>• Both methods will require updating educational materials if guideline recommendations change.</li> </ul>
<b>Monitoring and evaluation</b>	<ul style="list-style-type: none"> <li>• New digital training methods will require evaluations to ensure educational outcomes can be achieved.</li> <li>• Manikins have different technical specifications with respect to delivery of CPR.</li> </ul>
<b>Research possibilities</b>	<ul style="list-style-type: none"> <li>• New digital training methods will require evaluations to ensure educational outcomes can be achieved.</li> <li>• Continued research in methods to improve the achievement of guideline recommended CPR metrics (compression rate and depth) and AED outcomes are needed.</li> <li>• Reporting and standardization of manikin technical specifications represents an opportunity for future research.</li> <li>• Studies comparing gaming training to instructor-led training are needed.</li> <li>• Future studies should use objective methods (e.g. sensor manikins) in CPR skill assessments and include important CPR metrics (Meaney 2013 417).</li> </ul>