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| Question |
| **Should training with a specific emphasis on teamwork competencies vs. training without a specific emphasis on teamwork competencies be used for life support training?** |
| **Population:** | Learners undertaking life support training in any setting |
| **Intervention:** | Life support training with a specific emphasis on teamwork competencies |
| **Comparison:** | Life support training without a specific emphasis on teamwork competencies |
| **Main outcomes:** | Patient survival; CPR skill performance (course completion); CPR skill performance (beyond course completion but <1 yr); CPR skill performance (>1year); CPR quality (at course completion); CPR quality (beyond course completion but <1 year); CPR quality (> 1 year); Confidence (course completion); Confidence (beyond course completion but < 1 year); Confidence (> 1 year); Teamwork competencies (at course completion); Teamwork competencies (beyond course completion but < 1 year); Teamwork competencies >1 year); resources (time, equipment, cost) |
| **Setting:** | Any setting of life support courses |
| **Perspective:** | Teamwork competencies is considered to be an important barrier and facilitator for resuscitation. Investigating whether specific training of teamwork competencies improves learning following resuscitation training can impact the organization of resuscitation training worldwide and potentially improve patient care and survival outcomes. |
| **Background:** | Resuscitation training is recommended to improve quality of care and survival outcomes following cardiac arrest. Teamwork competencies represent the interpersonal skills affecting the teamwork and is considered to be an important facilitator for clinical resuscitation. The International Liaison Committee on Resuscitation previously recommended use of specific leadership training for resuscitation courses based on very low-certainty evidence. This systematic review aimed to assess the effect of specific training on teamwork competencies as part of the resuscitation training. |
| **Conflict of interests:** | Joyce Yeung had a grant to investigate introducing NTS to ALS course for Resuscitation Council UK and was excluded from study selection and bias assessment. |

# 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 | No evidence was identified on the priority of this question. However, the International Liaison Committee on Resuscitation previously assessed whether specific leadership training improved learning following resuscitation training and recommended use of specific leadership training for resuscitation courses based on very low-certainty evidence (CoSTR 2020). | Resuscitation training is generally recognized as an important step to improve survival by resuscitation councils and is widely conducted all over the world. Training in teamwork competencies is generally recommended as part of the training and knowledge on the effect of including training on teamwork competencies is warranted. |
| Desirable EffectsHow substantial are the desirable anticipated effects? |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial● Small○ Moderate○ Large○ Varies○ Don't know | **Survival**For the critical outcome of patient survival we identified one RCT which reported descriptive data on patient outcomes, reporting 11% patients died in intervention group vs 13% patients in control but not powered to make inferences. **CPR skill performance**For the important outcome of CPR skill performance at course completion, we found 11 studies (10 RCTs3,4,7,8,11,12,13,14,16,17 and one before and after1). Four1,4,11,14 of 61,3,4,11,12,14 studies reporting time to key resuscitation behaviours reported no significant difference between intervention and control groups. One RCT12 reported significantly shorter time for 1 (time to chest compressions) of 5 behaviours measured and another3 for 8 of 9 behaviours. Seven4,8,12-14,16,17 of 81,4,8,12-14,16,17 studies reporting CPR performance scores found no significant difference between intervention and control groups and nor did single RCT11 reporting rate of correct arm and shoulder positioning. One non-randomised study1 reported higher median scores in a checklist of expected CPR acts in intervention group (95%) vs control (85%), p=0.001. A single RCT7 reported adherence to ALS guidelines, finding greater adherence in intervention group (37.58) vs control (31.41), 95% CI: -10.3, -2.4, p=0.002).For the critical outcome of CPR skill performance beyond course completion, we found 4 RCTs4,11,13,17. Two13,17 reported no significant difference in performance scores at 4 months17 and 6 months13. One RCT4 reported significantly higher technical CPR skill scores (calculated from compression depth and rate; detection of shockable rhythm; ventilation efficiency and time to CPR initiation) in the intervention group (70%) vs control (62%), p=0.014 at follow-up (time unspecified) despite finding no difference at course completion. One RCT11 reported significantly shorter time to first meaningful resuscitation measure in intervention group at 4 months.**CPR quality**For the important outcome of CPR quality at course completion, we found 4 RCTs6,7,9,11. Two RCTs6,7 measured no-flow time, one6 reported significantly shorter no flow time in intervention group (31.4 secs) vs. in the control group (36.3 sec), (p=0.014) and the other7 found no significant difference between the intervention and control. One RCT11 measured hands-on time and compression rate and found no difference between intervention and control group. One RCT9 found no difference in chest compression quality or in chest compression pauses. For the critical outcome of CPR quality beyond course completion, we found one RCT11. Four months after intervention increased hands-on time was reported in the intervention group (120 secs) vs control (87 secs), p=0.001; higher rates of recommended rate of compression in the intervention group (19) vs. control (6), p=0.002 and higher median compressions per minute in intervention group (109 cpm) vs. control (93 cpm), p=0.001.**Confidence**For the important outcome of confidence at course completion we identified one RCT4 which found no significant difference between intervention and control group.For the important outcome of confidence beyond course completion we identified one RCT4 which found no significant difference between intervention and control group at follow-up (time unspecified)**Teamwork competencies**For the important outcome of teamwork competencies at course completion we identified 14 studies (12 RCTs3-6, 9-12,14-17 and 2 non-randomised studies1,2).***Communication*** Two RCTs9,15 reported significantly greater proportion of leadership statements in intervention group vs control and three RCTs5,14,15 identified significantly increased directed team communication in intervention group vs control. One14 also reported increased completed closed-loop communication and follower-initiated communication in intervention group vs control. One RCT6 measured 'teamwork verbalisations' and found significantly higher verbalisations in intervention group vs control: directed orders, task assignments, undirected orders and planning. One RCT11identified more leading utterances in the control group vs intervention**.*****Decision making and leadership behaviour*** Two RCTs8,10 reported increased leadership behaviour in intervention group vs control. One10 trial also reported significantly increased correction of improper chest compressions in intervention group. One RCTs9 reported increased decision-making in intervention group vs control. One non-randomised study2 reported no significant difference in leadership behaviour between intervention and control.***Teamwork*** One RCT4 reported significantly higher team-level efficacy in intervention group vs control and one non-randomised study1 reported more teamwork intervention events in intervention group vs control. Two RCTs16,17 and a non-randomised study2 found no significant difference in measures of teamwork between intervention and control groups. ***Non-technical skills*** Two RCTs3,12 reported significantly higher non-technical skill performance3 and total behavioural skills scores12 in the intervention group vs control. ***Workload management*** Two RCTs15,16 reported significantly improved workload management in intervention group vs control.For the important outcome of teamwork competencies beyond course completion we identified 3 RCTs4,11,17. One RCT11 reported more leadership utterances, task assignments, commands and decisions about what to do in intervention group at 4 months than control group. One RCT4 reported significantly higher self-reported teamwork in intervention group at follow-up (timepoint of FU not reported). One RCT17 reported no significant difference between intervention and control group in TEAM scores at 3 months (following no significant difference at course completion)No evidence was identified for critical outcomes of CPR skill performance and CPR quality beyond 1 year, nor for the important outcomes of confidence and teamwork competencies beyond 1 year. | Training of teamwork competencies resulted in improved non-technical skills. Such improved non-technical skills are associated with improved performance in clinical studies. Moreover, shortcomings of teamwork competencies have been reported as a barrier for clinical skill performance. |
| Undesirable EffectsHow substantial are the undesirable anticipated effects? |
| Judgement | Research evidence | Additional considerations |
| ● Trivial○ Small○ Moderate○ Large○ Varies○ Don't know | No undesirable effects were observed.  |  |
| 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 | Certainty of evidence across outcomes was low to very-low downgraded for risk of bias, and imprecision. | Greater certainty of evidence for teamwork competencies than for other outcomes |
| 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 no specific evidence of the variability in the value of the main outcomes.  | Higher Kirkpatrick levels (i.e. patient outcomes) are by some researchers considered more important than lower Kirkpatrick levels (e.g. knowledge). However, simulation-based skills are generally considered an important proxy and prerequisite for clinical skills.  |
| 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 | Several studies reported improved skill performance when training teamwork competencies in contrast to not training teamwork competencies and no undesirable effects were observed. |  |
| Resources requiredHow 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 | No evidence on cost and cost-effectiveness was identified. | Some studies used extra training on teamwork competencies, which resulted in longer training with presumably higher costs. In other cases, training on teamwork competencies did not prolong the course why costs are presumed to be similar. |
| 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 | No evidence was identified | Some studies used extra training on teamwork competencies or use of extra simple device needed (videos, computers) which resulted in longer training with presumably higher costs. In other cases, training on teamwork competencies did not prolong the course why costs are presumed to be similar.  |
| 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 | No studies were identified. | Assuming that training in teamwork competencies would not increase costs significantly, the cost-effectiveness would probably benefit the intervention. |
| 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 | We found no evidence and training in teamwork competencies are not believed to impact equity. |  |
| AcceptabilityIs the intervention acceptable to key stakeholders? |
| Judgement | Research evidence | Additional considerations |
| ○ No○ Probably no● Probably yes○ Yes○ Varies○ Don't know | We found no evidence on acceptability. | Training in teamwork competencies is generally accepted as important and already widely implemented. |
| FeasibilityIs the intervention feasible to implement? |
| Judgement | Research evidence | Additional considerations |
| ○ No○ Probably no● Probably yes○ Yes○ Varies○ Don't know | There was not reported any difficulties in implementing the intervention in the included studies. | Teamwork competencies is already widely included in resuscitation training. |

# 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 |
| Based on the evidence found in this systematic review the Task Force suggests that teaching teamwork competencies be included in BLS and all kind of advanced life support training (weak recommendation, very low quality of evidence). |

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| Justification |
| - We identified no harmful or negative effects of team competence training and several studies reported that training in teamwork competencies improved clinical skill performance when compared to training resuscitation without specific emphasis on teamwork competencies.- The evidence relating to teamwork competencies, whilst still variable was mostly positive and again two RCTs found benefits to extend beyond course completion and thus with potential clinical benefit.- Clinical studies suggest that a lack of teamwork competencies is a barrier to successful resuscitation. Moreover, teamwork competencies have been associated with improved skill performance during clinical resuscitation attempts.- We valued that training in teamwork competencies is widely accepted and implemented in resuscitation courses. It is likely cost-effective despite no study investigated that. |

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| Subgroup considerations |
| The specific teamwork competencies being trained should likely be tailored to the type of resuscitation course aiming to train contextualized skills (technical and non-technical). |

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| Implementation considerations |
| We consider training in teamwork competencies to be widely accepted but the best way of implementation is still unclear.The studies included suggest that training in teamwork competencies may be implemented using a variety of methods, e.g. lectures, videos, simulation-based team training, and debriefing. The instructional design might be tailored for the needs of the learners |

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| Monitoring and evaluation |
| No monitoring needed. |

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| Research priorities |
| Benefits of training teamwork competencies on clinical resuscitation performance outcomes and patient outcomes are unknown.We were unable to identify the optimal instructional design and the optimal duration of training on teamwork competencies.We found no evidence on whether training of certain teamwork competencies are more important than other teamwork competencies and whether this depends on the group of learners.We did not identify any studies evaluating the teaching of team competencies outside the hospital environmentWe found no evidence on cost-effectiveness and no studies from low-resource settings.References1. Gonçalves, B. A. R., Melo, M. D. C. B. D., Ferri Liu, P. M., Valente, B. C. H. G., Ribeiro, V. P., & Vilaça e Silva, P. H. (2022). Teamwork in Pediatric Resuscitation: Training Medical Students on High-Fidelity Simulation. *Advances in Medical Education and Practice*, 697-708.
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