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| Question | |
| **Should Rapid Cycle Deliberate Practice vs. other approaches be used for resuscitation training?** | |
| **Population:** | Learners training in basic or advanced life support |
| **Intervention:** | Instruction using Rapid Cycle Deliberate Practice |
| **Comparison:** | Compared to traditional instruction or other forms of learning without Rapid Cycle Deliberate Repetition |
| **Main outcomes:** | Time to chest compressions; Time to recognize cardiac arrest; Time to ventilate; Time to defibrillation; Time to first epinephrine; Compression fraction / No-flow fraction; No-ventilation fraction; Defibrillation within 2 or 3 min; Defibrillation pre-pause; Quality of performance (adherence to protocol); Team leader performance; Self-reported confidence; Participants’ subjective perception of the teaching effectiveness; Retention; |
| **Setting:** | In any education setting |
| **Perspective:** | The original definition for deliberate practice was proposed by Ericsson, considering deliberate practice as individualized training with lessons with a teacher, who designs practice activities for carrying out between meetings. However, deliberate practice is often confused with repetitive practice. Rapid Cycle Deliberate Practice (RCDP), introduced by Hunt, is a type of training in which debriefing occurs within the training. |
| **Background:** | Traditionally, debriefing occurs the simulation (after-event debriefing with reflection on action), but it could also occur within the training (reflection in action). This is the case of RCDP, an approach characterized by a stop-and-go practice with immediate feedback on the performance and ample time for repetition to improve performance. The aim of this systematic review was found evidence about the use of Rapid Cycle Deliberate Practice compared to other approach teaching. |
| **Conflict of interests:** | Nothing to declare |

# 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 | Simulation-based training for resuscitation is an important approach to acquire knowledge and both technical and non-technical skills. Often times, participants are given limited opportunity to practice and master critical skills (i.e. individual and team-based skills) during training. Within that training plays debriefing a key role in acquiring the learning outcomes (9). However, debriefing characteristics are usually inconsistently described in clinical-simulation research (10). Traditionally, debriefing occurs after trainees finalize the simulated-scenario (after-event debriefing with reflection on action). RCDP addresses these issues by incorporating stop-and-go practice with immediate feedback on the performance and ample time for repetition to improve performance (1). This approach increases time of practice and aims to enhance training methodologies to produce improvements in clinical outcomes. | Key points of RCDP (1):  - There is a goal to achieve.  - Stop-and-go practice with immediate feedback on the performance.  - Ample time for repetition to improve performance.  - “Safe” environment, fostering an atmosphere where students have no fear to make mistakes and receive feedback from a constructive perspective. |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial ● Small ○ Moderate ○ Large ○ Varies ○ Don't know | Eight studies were identified which addressed the PICOST question comparing Rapid Cycle Deliberate Practice with after-event debriefing under simulated conditions (1, 7, 4, 2, 8, 6, 5, 3). Study cohorts were comprised of residents (1, 3, 4), interns (2, 8), physicians (6), medical students (5), and a mix of fellows, nurses and respiratory therapists (7), who were involved in adult (5, 6), pediatric (1, 3, 4, 7, 8) and neonatal (2) simulated scenarios. Most of the studies reported comparisons between RCDP and other approaches after a single session of simulation-based training, lasting 20-60 minutes (2, 3, 4, 5, 6, 7). Seven were randomized studies (2, 3, 4, 5, 6, 7, 8) and one an observational study with a before-after design (1). In addition, seven of them referred directly to RCDP (1, 2, 3, 4, 6, 7, 8) and the other one used an “In simulation debriefing” during the clinical scenario meeting the key components of the RCDP (5). No studies reported clinical outcomes. Meta-analysis was performed only for one outcome (time to chest compressions) due to the low number of studies per outcome, heterogeneity in the study designs and the reported outcome measures.  **Time to chest compressions:**  For the important outcome **Time to chest compressions**, we identified very-low-certainty evidence (downgraded for risk of bias, inconsistency, indirectness and imprecision) from three randomized studies (4, 2, 3) enrolling 66 participants tested individually and 41 teams, which showed no benefit from the use of Rapid Cycle Deliberate Practice when compared with after-event debriefing; the estimated standardized mean difference (SMD) for the outcome, using random effects model, was -0.1734 (95% CI: -0.6900 to 0.3431). Therefore, the SMD did not differ significantly from zero (z = -0.6581, p = 0.5105).  In addition, in an observational study, participants of the RCDP group spent less time between the onset of pulseless ventricular tachycardia and initiation of chest compressions (1).  **Time to recognize cardiac arrest:**  One study assessed the time to recognize cardiac arrest with no differences between RCDP and after-event debriefing (6). **Time to ventilate:**  One randomized study assessed time to positive pressure ventilations (from birth) (2), where participants in the intervention group initiated positive pressure ventilation within 1 minute more frequently than controls. The observational study measured time to use bag-valve mask (1), with no differences found between groups. **Time to defibrillation:**  Four studies, 3 randomized studies (4, 6, 3) and 1 observational (1) study assessed time to defibrillation. The 3 randomized studies comprised 82 participants (RCDP: n=41; after-event debriefing: n=41). Two of the randomized studies found that participants from the RCDP group had significantly lower time between recognition of the rhythm and defibrillation (4, 6).  In the observational study, participants of the RCDP group spent significantly less time between the onset of pulseless ventricular tachycardia and defibrillation (1). **Time to first epinephrine:**  Two randomized studies assessed the time to the administration of epinephrine (4, 2). They comprised 75 participants (RCDP: n=37; after-event debriefing: n=38). One of the studies found that participants of the RCDP group had significantly shorter time to the administration of epinephrine than controls (2). **Compression fraction / No-flow fraction:**  One randomized study evaluated compression fraction (6) and one observational study no-flow fraction (1). Both articles found significant differences between groups in favor of RCDP participants. **No-ventilation fraction:**  The observational study analyzed the no-ventilation fraction (1), described as the proportion of time a pulseless patient received no respiratory support, and found differences between groups in favor of RCDP participants.  **Defibrillation within 2 or 3 min:**  One randomized study evaluated successful defibrillation within 3 minutes (3) and the observational study within 2 minutes (1). In the randomized study, RCDP participants had more than 5 times the odds of defibrillation occurring within 3 minutes (3). The observational study, by means of hazard ratio, found that RCDP participants had 1.65 times the odds of defibrillating within 2 min (1). **Defibrillation pre-pause:**  One randomized study (6) and the observational study (1) assessed defibrillation pre-pause. Both articles found that RCDP participants registered significantly shorter defibrillation pre-pause. **Quality of performance (adherence to protocol):**  Three randomized studies evaluated quality of performance with different tools (7, 2, 8). RCDP participants reached higher scores of performance by using the Megacode Assessment Form (MCAF) (2), but no differences were found with the Simulation Team Assessment Tool (7) or Pediatric Advance Life Support performance (8). **Team leader performance:**  One randomized study evaluated team leader performance, with significantly higher scores in the RCDP group (3).  **Self-reported confidence:**  Two randomized studies evaluated self-reported confidence (2, 5). One did not report specific information about the instrument (2). In the other study, both groups increased their confidence level with no differences between groups (5). **Participants’ subjective perception of the teaching effectiveness:**  One study aimed to analyze teaching effectiveness by means of 8 questions (5). In 3 of the 8 questions (help to learn effectively, help to understand the correct actions, effectiveness of the debriefing) the after-event debriefing group had high-median scores compared to the RCDP group.  **Retention:**  Retention of skills was analyzed in one randomized study (4-month follow-up) (2). No differences were found between groups in any variable (MCAF scores, time to positive pressure ventilations, time to chest compressions, time to epinephrine administration), although RCPD participants decreased the overall score of the MCAF in a higher proportion than controls. | Certainty of evidence from the studies were downgraded because of risk of bias, inconsistency, indirectness, and imprecision. |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ● Trivial ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know | One study reported differences in one outcome (teaching effectiveness) in favour of controls (5). No more differences in favour of controls were found in any outcome in any study. | This article was the one that used an "In simulation debriefing" during the clinical scenario meeting the key components of the RCDP. |
| 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 | The certainty of evidence was very low across all outcomes, and downgraded for risk of bias, inconsistency, indirectness, and imprecision. | Many outcomes were assessed only by one study or two (one observational and one randomized); the type of patient in the simulated scenario varied across the studies; outcomes measured in different ways across the studies. |
| 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 | No studies reported outcomes in real cardiac arrest.  One study showed that controls valued more the after-event debriefing compared with in-simulation debriefing (5). The rest of the manuscripts reported no differences or differences in favor of intervention. | This article was the one that used an "In simulation debriefing" during the clinical scenario meeting the key components of the RCDP. |
| 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 | There was one outcome in which the effect favored comparators (teaching effectiveness) (5).  There were three outcomes in which the effect did not favor either the intervention or the comparison: retention (2), time to recognize CA (6) and self-reported confidence (5).  In most of outcomes there were found more articles that reported effects favored to intervention (time to chest compressions, time to defibrillate, compression fraction / No-flow fraction, no-blow fraction, defibrillation within 2 or 3 min, defibrillation pre-pause, Team leader performance, workload). |  |
| Resources required How 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 | None of the studies evaluated resources required. | Development of a curriculum based on RCDP might be negligible costs and savings, but no evidence is available in this regard. However, resources for implementation or training of the instructors are topics not studied. |
| 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 | No evidence available. | There was not found evidence about the resources for creating RCDP curriculums, training of instructors and implementation of the programs. |
| 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 | No evidence available. |  |
| 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 evidence available. |  |
| Acceptability Is the intervention acceptable to key stakeholders? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know | The teaching effectiveness of RCDP approach was rated with high scores (5), and high levels of self-confidence were described by the participants after the training (5). |  |
| Feasibility Is the intervention feasible to implement? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ○ Yes ○ Varies ● Don't know | Although two of the studies stated that RCDP was implemented as part of the training/curriculum (1, 8), none of the studies aimed to analyze variables related to the implementation such as instructor preference/workload or specific resources needed in comparison with other approaches. In addition, the implementation would depend on the characteristics of the setting (eg. short-term courses (few hours) vs long-term trainings (residents' 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 it may be reasonable to include Rapid Cycle Deliberate Practice as an instructional design feature of basic and advanced life support training (weak recommendation, very low quality of evidence). |
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| Justification |
| Simulation-based training for resuscitation is an important approach to acquire knowledge and both technical and non-technical skills. Often times, participants are given limited opportunity to practice and master critical skills (i.e. individual and team-based skills) during training. Within that training plays debriefing a key role in acquiring the learning outcomes (9). However, debriefing characteristics are usually inconsistently described in clinical-simulation research (10). Traditionally, debriefing occurs after trainees finalize the simulated-scenario (after-event debriefing with reflection on action). RCDP addresses these issues by incorporating stop-and-go practice with immediate feedback on the performance and ample time for repetition to improve performance (1). This approach increases time of practice and aims to enhance training methodologies to produce improvements in clinical outcomes.  Direct evidence of the use of RCDP during resuscitation training were considered in informing the treatment recommendation.   * Although more differences in favor of RCDP were found across the studies, the only meta-analysis performed (time to chest compression) did not show a difference. Two of 4 studies found differences in this variable in favor of intervention group, one randomized (4) and one observational study (1). However, compression fraction was higher in the RDCP group in the two studies analyzed (1, 6). * Different studies showed that RCDP group had shorter time to ventilate (1, 2), to deliver a shock (1, 4, 6), and to the administration of epinephrine (2). * Two studies found that RCDP group had more odds of reaching defibrillation within 2 (1) and 3 min (3). Defibrillation pre-pause was also significantly shorter in intervention participants (1, 6). * One study reported differences in one outcome (teaching effectiveness) in favor of controls (5). No more differences in favor of controls were found in any outcome in any manuscript. * Findings were in favor of RCDP across many studies, but the majority of these studies had trainees as participants, thus making it difficult to generalize these findings to other groups such as experienced healthcare providers. |

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| Subgroup considerations |
| No evidence available for laypeople, first responders (eg. lifeguards, firefighters...) or experienced healthcare providers. |

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| Implementation considerations |
| For the implementation of Rapid Cycle Deliberate Practices would be necessary to educate to those personnel in charge of the training of residents, students, healthcare professionals. |

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| Monitoring and evaluation |
| N/A |

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| Research priorities |
| The following knowledge gaps were identified:   * The use of Rapid Cycle Deliberate Practice in other populations (laypeople, first responders, and experienced healthcare providers). * The effect of Rapid Cycle Deliberate Practice after a medium/long-term follow-up. * Resources required and costs of implementation of Rapid Cycle Deliberate Practice in simulation-based training curriculum of health care providers and other populations. * The effect of the implementation of curriculums based on Rapid Cycle Deliberate Practice on clinical outcomes and patient survival. * There is heterogeneity in the use of terms and a not standardized definition of Deliberate Practice and Rapid Cycle Deliberate Practice.  References Summary 1. Hunt, Elizabeth,A, Duval-Arnould, Jordan,M., Nelson-McMillan, Kristen,L., Bradshaw, Jamie,Haggerty, Diener-West, Marie, Perretta, Julianne,S., Shilkofski, Nicole,A. Pediatric resident resuscitation skills improve after “Rapid Cycle Deliberate Practice” training. Resuscitation; 2014.  2. Magee, Maclain,J, Farkouh-Karoleski, Christiana, Rosen, Tove,S. Improvement of Immediate Performance in Neonatal Resuscitation Through Rapid Cycle Deliberate Practice Training. Journal of Graduate Medical Education; 2018.  3. Won, Sharon,K, Doughty, Cara,B, Young, Ann,L, Welch-Horan, T,Bram, Rus, Marideth,C, Camp, Elizabeth,A, Daniel S, Lemke. Rapid Cycle Deliberate Practice Improves Retention of Pediatric Resuscitation Skills Compared With Postsimulation Debriefing. Simulation in Healthcare; 2022.  4. Lemke, Daniel,S, Young, Ann,L, Won, Sharon,K, Rus, Marideth,C, Villareal, Nadia,N, Camp, Elizabeth,A, Doughty, Cara. Rapid-cycle deliberate practice improves time to defibrillation and reduces workload: A randomized controlled trial of simulation-based education. AEM Education and Training; 2021.  5. Van Heukelom, Jon,N, Begaz, Tomer, Treat, Robert. Comparison of Postsimulation Debriefing Versus In-Simulation Debriefing in Medical Simulation. Simulation in Healthcare; 2010.  6. Teixeira de Castro, Leandro, Melo Coriolano, Andreia, Burckart, Karina, Bezerra Soares, Mislane, Duenhas Accorsi, Tarso,Augusto, Egypto Rosa, Vitor,Emer, de Santis Andrade Lopes, Antônio,Sérgio, Bittencourt Couto, Thomaz. Rapid‑cycle deliberate practice versus after‑event debriefing clinical simulation in cardiopulmonary resuscitation: a cluster randomized trial. Advances in Simulation; 2022.  7. Lemke, Daniel,S, Fielder, Elaine,K, Hsu, Deborah,C, Doughty, Cara,B. Improved Team Performance During Pediatric Resuscitations After Rapid Cycle Deliberate Practice Compared With Traditional Debriefing. A Pilot Study. Pediatric Emergency Care; 2019.  8. Raju, Sai,Surapa, Tofil, Nancy,M, Gaither, Stacy,L, Norwood, Carrie, Zinkan, J,Lynn, Godsey, Veronica, Aban, Inmaculada, Xue, Yumo, Rutledge, Chrystal. The Impact of a 9-Month Booster Training Using Rapid Cycle Deliberate Practice on Pediatric Resident PALS Skills. Simulation in Healthcare; 2021.  9. Cheng A, Nadkarni VM, Mancini MB, Hunt EA, Sinz EH, Merchant RM, et al. Resuscitation Education Science: Educational Strategies to Improve Outcomes From Cardiac Arrest: A Scientific Statement From the American Heart Association. Circulation. 2018;138:e82–e122.  10. Cheng A, Eppich W, Grant V, Sherbino J, Zendejas B, Cook DA. Debriefing for technology-enhanced simulation: a systematic review and meta-analysis. Med Educ. 2014;48:657–666. |