**Author(s):** Andrea Cortegiani, Cristian Abelairas-Gómez C, Sabine Nabecker , Alexander Olaussen, Kasper G Lauridsen, Jeffrey Lin J, Mariachiara Ippolito, Taylor Sawyer, Andrew Lockey, Adam Cheng A, Robert Greif

**Question:** Should In situ simulation-based training vs. Traditional training be used for Cardiopulmonary resuscitation training?

**Setting**: Educational setting

**Bibliography:**

1. Knight LJ, Gabhart M, Earnest KS, Leong KM, Anglemyer A, Franzon D. Improving code team performance and survival outcomes: implementation of pediatric resuscitation team training. Crit Care Med. 2014 Feb;42(2):243–51.

2. Xu C, Zhang Q, Xue Y, Chow C-B, Dong C, Xie Q, et al. Improved neonatal outcomes by multidisciplinary simulation-a contemporary practice in the demonstration area of China. Front Pediatr. 2023;11:1138633.

3. Herbers MD, Heaser JA. Implementing an in Situ Mock Code Quality Improvement Program. Am J Crit care an Off Publ Am Assoc Crit Nurses. 2016 Sep;25(5):393–9.

4. Hammontree J, Kinderknecht CG. An In Situ Mock Code Program in the Pediatric Intensive Care Unit: A Multimodal Nurse-Led Quality Improvement Initiative. Crit Care Nurse. 2022 Apr;42(2):42–55.

5. Kurosawa H, Ikeyama T, Achuff P, Perkel M, Watson C, Monachino A, et al. A randomized, controlled trial of in situ pediatric advanced life support recertification (“pediatric advanced life support reconstructed”) compared with standard pediatric advanced life support recertification for ICU frontline providers\*. Crit Care Med. 2014 Mar;42(3):610–8.

6. Sullivan NJ, Duval-Arnould J, Twilley M, Smith SP, Aksamit D, Boone-Guercio P, et al. Simulation exercise to improve retention of cardiopulmonary resuscitation priorities for in-hospital cardiac arrests: A randomized controlled trial. Resuscitation. 2015 Jan;86:6–13.

7. Rubio-Gurung S, Putet G, Touzet S, Gauthier-Moulinier H, Jordan I, Beissel A, et al. In situ simulation training for neonatal resuscitation: an RCT. Pediatrics. 2014 Sep;134(3):e790-7.

8. MEI Qimin, ZHANG Ting, CHAI Jingjing, LIU Anlei, LIU Yecheng ZH. Application of In Situ Scenario Simulation in Advanced Cardiac Life Support Training for Eight-year Medicinal Students. Med J Pekin Union Med Coll Hosp [Internet]. 2023;14(3):660–4. Available from: https://xhyxzz.pumch.cn/cn/article/doi/10.12290/xhyxzz.2022-0676

9. Clarke SO, Julie IM, Yao AP, Bang H, Barton JD, Alsomali SM, et al. Longitudinal exploration of in situ mock code events and the performance of cardiac arrest skills. BMJ Simul Technol Enhanc Learn. 2019 Jan;5(1):29–33.

| **Certainty assessment** | **№ of patients** | **Effect** | **Certainty** | **Importance** |
| --- | --- | --- | --- | --- |
| **№ of studies** | **Study design** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Other considerations** | **In situ simulation-based training** | **Traditional traininig** | **Relative(95% CI)** | **Absolute(95% CI)** |
| **Patient survival** |
| 1 | non-randomised studies | seriousa | not serious | not serious | very seriousb | none | 50/124 (40.3%)  | 28/46 (60.9%)  | **OR 2.06**(1.02 to 4.25) | **153 more per 1.000**(from 5 more to 260 more) | ⨁◯◯◯Very low | CRITICAL |
| **Patient outcomes** |
| 1 | non-randomised studies | very seriousc | not serious | not serious | very seriousd | none | One non-randomised study (Xu 2023) reported **Patient Outcomes**. This study showed in the post intervention (in situ simulation) vs. pre-intervention period a lower incidence of neonatal asphyxia [88 (0.64%) vs. 133 (0.84%), P=.045], severe asphyxia [8 (0.058%) vs. 22 (0.138%), p =.029], hypoxic-ischemic encephalopathy [2 (0.01%) vs. 16 (0.1%), p = 0.003], and meconium aspiration syndrome [12 (0.09%) vs. 31 (0.19%), p = 0.014] but no difference in the composite outcome of neonatal asphyxia or low apgar score [111 (0.8%) vs. 154 (0.97%), p = 0.128], and low Apgar score [23 (0.17%) vs. 21 (0.13%), p = 0.445].  | ⨁◯◯◯Very low | CRITICAL |
| **Clinical performance in actual resuscitation** |
| 3 | non-randomised studies | very seriouse | seriousf | not serious | seriousb | none | Three non-randomised studies **Clinical performance in actual resucutation outcomes.** One non-randomised before-after study (**Knight 2013**) reported no significant difference in neurologic morbidity from admission to discharge assessed by pediatric cerebral performance category in the intervention group (0.11 vs 0.27; p = 0.37), no significant improvement in the performance of chest compressions < 60 s from heart rate < 60 s [OR, 0.63 (95% CI, 0.29-1.35)], significant improvement in Performance of 2 min continuous chest compressions between rhythm checks [OR, 2.23 (95% CI, 1.18-4.22] and no significant difference in the performance of shock < 3 min from recognized ventricular fibrillation/pulseless ventricular tachycardia [OR, 1.51 (95% CI, 0.38-5.96)] between the in situ simulation period vs. control. One non-randomised before-after study (**Herbers 2016**) reported improved time for calling for help by 12% between baseline and final evaluation, improved time elapsed by initiation of chest compressions by 52% and improved time to initial defibrillation 37% between the in situ simulation period vs. control. One non-randomised before-after study (**Hammontree 2022**) reported non-adherence to PALS guidelines for subsequent epinephrine timing decreased by 39% and non-significant difference behaviors of administering epinephrine every 3 to 5 min (p = 0.30). | ⨁◯◯◯Very low | CRITICAL |
| **Teamwork competencies in actual resuscitation at course completion <1yr**  |
| 1 | non-randomised studies | seriousg | not serious | not serious | very seriousd | none | One non-randomised study reported **Teamwork competencies in actual resuscitation at course completion <1yr** as outcome. This study (**Knight 2013**) reported higher adherence to resuscitation standard operating performance as a measure of pediatric code team performance in the in situ simulation period [38/183 (20.8%) (23/64 (35.9); OR 2.14 (95% CI, 1.15-3.99)].  | ⨁◯◯◯Very low | CRITICAL |
| **Clinical performance in simulation** |
| 5 | randomised trials | serioush | seriousf | not serious | seriousb | none | Four RCTs and one non-randomised studies reported **Clinical performance in simulation** outcomes. One RCT (**Kurosawa 2014**) reported improved skill performance measured by the clinical performance tool [6.2 (± 4.3) vs (± 2.9); p = 0.004]. One RCT (**Sullivan 2015**) compared different intervention groups involving in situ simulation training sessions performed at different follow-ups compared to standard training. This RCT reported shorted time elapse to call for help and initiation of chest compression in the intervention groups vs. control (p< 0.001), time elapse to successful defibrillation (p < 0.001), and better score in the composite outcome of key priorities, compressions within 20 s defibrillation within 180 s and use of a backboard (p < 0.001). One RCT (**Rubio-Gurung 2014**) reported better technical score assessing technical skills and adherence to guidelines in the two simulation scenarios in the in situ simulation group vs. control [Scenario I: 24.4 (18.7–26.6) vs. 17.4 (15.6–19.5), p= .01); Scenario II: 22.7 (21.3–25.0) vs. 17.5 (15.3–19.6), p=0.004], lower occurrence of hazardous events in the in situ simulation group vs. control [23 (8%) vs. 52 (21%), P=<0.001], higher percentage of scenarios in which the heart rate was considered as the result of efficient resuscitation at 3 minutes [14 (24%) vs. 2 (4%), =0.003] and 5 minutes [40 (68%) vs. 25 (47%), P= 0.06] in the in situ simulation group. vs. control. One RCT (**Mei 2023**) reported better medical management test in the in situ simulation group vs. control [57.09 (±9.18) vs. 38.47 (±15.69), p < 0.001]. One non-randomised study (**Clarke 2019**) reported no difference through the course of in situ mock code training in time to first epinephrine dosing and time to first defibrillation). | ⨁◯◯◯Very low | IMPORTANT |
| **Teamwork competencies in simulation at course completion <1yr**  |
| 3 | randomised trials | seriousi | seriousf | not serious | seriousb | none | Three RCTs reported **Teamwork competencies in simulation at course completion <1yr** as outcomes. One RCT (**Kurosawa 2014**) reported no difference in teamwork assessed by the Behavioral Assessment Score in the intervention group [2.8 (± 3.6) vs. 3.0 (± 4.0); p: 0.69]. One RCT (**Rubio-Gurung 2014**) reported better team performance score in the in situ simulation group [31.1 (20.8–36.8) vs. 19.9 (13.3–25.0); p<0.001]. Another RCT (**Mei 2023**) reported better teamwork in the in situ simulation group vs. control [10.84 (±3.26) vs 7.87 (±4.14), p < 0.001]. | ⨁◯◯◯Very low | IMPORTANT |
| **CPR skill performance in simulation at course completion** |
| 1 | non-randomised studies | very seriousc | not serious | not serious | very seriousd | none | One non-randomised study (**Clarke 2019**) reported **CPR skill performance at course completion.** This study evaluated CPR fraction as measure of skill and found an improving overall trend of 1.8% per time interval of training (p = 0.02)  | ⨁◯◯◯Very low | IMPORTANT |

**CI:** confidence interval; **OR:** odds ratio

#### Explanations

a. Overall risk of bias was judged as Serious

b. Small overall sample size

c. Risk of bias was judged as Critical

d. Small sample size from a single study

e. Risk of bias was judged as critical in two study and serious in one study

f. High heterogeneity in interventions, settings, outcome definitions, measurements

g. Risk of bias was judged as Serious

h. Risk of bias was judges as High for one RCT, Some concerns for three RCTs and Critical for one non-randomised study

i. Risk of bias was judged as High in one RCT, serious in two RCTs