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| Question | |
| **Should a blood pressure target vs. no blood pressure target be used for infants and children receiving resuscitation after in-hospital cardiac arrest with intra-arterial blood pressure (IABP) monitoring in place at the time of arrest?** | |
| **Population:** | infants and children receiving resuscitation after in-hospital cardiac arrest with intra-arterial blood pressure (IABP) monitoring in place at the time of arrest |
| **Intervention:** | A specific blood pressure target during arrest |
| **Comparison:** | no blood pressure target |
| **Main outcomes:** | Return of spontaneous circulation; Survival to hospital discharge; Survival with favorable neurological outcome (PCPC 1-3 or no change from baseline); Functional status scale increase by 3 or increase by 2 in single domain (in survivors); any outcome included in the P-COSCA |
| **Setting:** |  |
| **Perspective:** |  |
| **Background:** |  |
| **Conflict of interests:** | none |

# 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 | There are approximately 15,000 pediatric in-hospital cardiac arrests in children in the United States every year, with many occurring in highly monitored settings such as intensive care units (Berg et al., 2013; Holmberg et al., 2019). In these monitored settings, children may have an intra-arterial catheter placed for blood pressure monitoring, which may provide information about the quality of compressions during arrest events (Berg et al., 2016).  ILCOR and member resuscitation councils provide recommendations for high-quality CPR but not all provide recommendations regarding intra-arterial blood pressure (IABP) monitoring in pediatric cardiac arrest. Furthermore, there are no prior systematic reviews on IABP in pediatric cardiac arrest and existing guidelines are consensus driven. The American Heart Association Pediatric Advanced Life Support Guidelines state “it is reasonable to for providers to use diastolic blood pressure to assess CPR quality” (Topjian et al., 2020) and the European Resuscitation Council states “the level of certainty of the available evidence is too low to make any recommendation for or against the use of diastolic blood pressure to guide resuscitation efforts in children with cardiac arrest” (Van de Voorde et al., 2021).  Providing a review of the existing literature will provide clinicians with more confidence and decrease variability in blood pressure monitoring and/or targets in pediatric in-hospital cardiac arrest. Potential benefits of providing specific guidance include both more survivors to hospital discharge and more survivors with favorable neurological outcome. | This is the first systematic review on this topic for the ILCOR pediatric life support task force. Intra-arrest blood pressure monitoring is invasive and generally limited to high-resource settings, such as intensive care units. |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial ○ Small ● Moderate ○ Large ○ Varies ○ Don't know | Five studies were included in the systematic review. (1, 2, 3, 4, 5) All five were observational in-hospital cardiac arrest cohort studies, with all being secondary analyses of larger cohorts. Three were analyses of the same cohort, but examined different sub-populations or different outcomes.(2, 3, 5)  **Diastolic blood pressure**  For the critically important outcome of return of spontaneous circulation (ROSC), we identified very low-certainty evidence (downgraded for imprecision and indirectness) from two observational studies enrolling 577 children with in-hospital cardiac arrest and invasive arterial blood pressure monitoring in place at the time of arrest(1, 2). In these infants and children, diastolic blood pressures above the cutoffs for the first 10 minutes of CPR were associated with an unadjusted relative risk of ROSC of 1.33 (95% CI 1.12-1.59).  For the critically important outcome of survival to hospital discharge (SHD), we identified very low-certainty evidence (downgraded for imprecision and indirectness) from two observational studies enrolling 577 children with in-hospital cardiac arrest and invasive arterial blood pressure monitoring in place at the time of arrest(1, 2). In these infants and children, diastolic blood pressures above the cutoffs for the first 10 minutes of CPR were associated with a pooled adjusted relative risk of SHD of 1.55 (95% CI 1.18-1.91).  For the critically important outcome of survival with favorable neurological outcome (defined as pediatric cerebral performance category of 1-3 or no change from baseline), we identified very low-certainty evidence (downgraded for imprecision and indirectness) from two observational studies enrolling 577 subjects with in-hospital cardiac arrest and invasive blood pressure monitoring in place at the time of arrest(1, 2). In these infants and children, diastolic blood pressures above the cutoffs for the first 10 minutes of CPR were associated with a pooled adjusted relative risk of favorable neurological outcome of 1.37 (95% CI 1.04-1.69).  For the critically important outcome of new substantive morbidity in survivors (defined as Functional Status Scale increase of at least 3 points or increase of 2 in a single domain), we identified very low-certainty evidence (downgraded for imprecision and indirectness) from a single study enrolling 77 subjects with in-hospital cardiac arrest and invasive blood pressure monitoring in place at the time of arrest (4). In these infants and children, there was no assocation between diastolic blood pressure cutoffs for the first 10 minutes of CPR and new substantive morbidity in survivors (unadjusted relative risk of 1.7 [95% CI 0.83-3.41]). There was no difference between the median diastolic blood pressures between subjects with new substantive morbidity and those without (30.5 mmHg and 30.9 mmHg, p = 0.5).  **Systolic blood pressure**  For the critically important outcome of survival to hospital discharge (SHD), we identified very low-certainty evidence (downgraded for imprecision and indirectness) from two observational studies enrolling 577 children with in-hospital cardiac arrest and invasive arterial blood pressure monitoring in place at the time of arrest (1, 2). In these infants and children, systolic blood pressures above the cutoffs for the first 10 minutes of CPR were associated with an unadjusted relative risk of ROSC of 1.12 (95% CI 0.95 - 1.32), showing no benefit. For the critically important outcome of survival with favorable neurological outcome (defined as pediatric cerebral performance category of 1-3 or no change from baseline), we identified very low-certainty evidence (downgraded for imprecision and indirectness) from one observational study enrolling 164 subjects with in-hospital cardiac arrest and invasive blood pressure monitoring in place at the time of arrest(2). In these infants and children, systolic blood pressures above the cutoffs for the first 10 minutes of CPR were associated with an adjusted relative risk of favorable neurological outcome of 1.0 (95% CI 0.7-1.4), suggesting no benefit. For the critically important outcome of new substantive morbidity in survivors (defined as Functional Status Scale increase of at least 3 points or increase of 2 in a single domain), we identified very low-certainty evidence from a single study enrolling 77 subjects with in-hospital cardiac arrest and invasive blood pressure monitoring in place at the time of arrest (4). In these infants and children, there was no assocation between systolic blood pressure cutoffs for the first ten minutes of CPR and new substantive morbidity in survivors (unadjusted relative risk of 0.7 [95% CI 0.4-1.24]). There was no difference between the median diastolic blood pressures between subjects with new substantive morbidity and those without (76.3 mmHg and 63 mmHg, p = 0.2).  **Presence of monitoring**  For the critically important outcomes of ROSC, SHD, FNO, we identified very low-certainty evidence that there was no significant difference between clinician-reported use of invasive monitoring of diastolic blood pressure to monitor CPR performance.   | **Outcomes** | **Anticipated absolute effects\* (95% CI)** | | **Relative effect (95% CI)** | **№ of participants (studies)** | **Certainty of the evidence (GRADE)** | **Comments** | | --- | --- | --- | --- | --- | --- | --- | | **Risk with no blood pressure target** | **Risk with a diastolic blood pressure of 25 for infants <1 and 30 for children >=1** | | Return of spontaneous circulation (ROSC) | Study population | | **RR 1.33** (1.12 to 1.59) | 577 (2 non-randomised studies)1,2 | ⨁◯◯◯ Very lowa | Favors DBP target of 25mmHg for infants <1yr and 30 for children >=1 in 1st 10 minutes of CPR | | 528 per 1,000 | **703 per 1,000** (592 to 840) | | Survival to hospital discharge (SHD) | Study population | | **RR 1.55** (1.18 to 1.91) | 577 (2 non-randomised studies)1,2 | ⨁◯◯◯ Very lowa | Favors DBP target of 25mmHg for infants <1yr and 30 for children >=1 in 1st 10 minutes of CPR | | 407 per 1,000 | **630 per 1,000** (480 to 776) | | Survival with favorable neurological outcome (PCPC 1-3 or no change from baseline) (FNO) | Study population | | **RR 1.37** (1.04 to 1.69) | 577 (2 non-randomised studies)1,2 | ⨁◯◯◯ Very lowa,b | Favors DBP target of 25mmHg for infants <1yr and 30 for children >=1 in 1st 10 minutes of CPR | | 390 per 1,000 | **535 per 1,000** (406 to 660) | | Functional status scale increase by 3 or increase by 2 in single domain (in survivors) (FSS) | Study population | | **RR 1.69** (0.83 to 3.42) | 77 (1 non-randomised study)3 | ⨁◯◯◯ Very lowc | No difference between the median diastolic blood pressures between subjects with new substantive morbidity and those without | | 222 per 1,000 | **376 per 1,000** (184 to 760) |  1. Berg, Robert A., Morgan, Ryan W., Reeder, Ron W., Ahmed, Tageldin, Bell, Michael J., Bishop, Robert, Bochkoris, Matthew, Burns, Candice, Carcillo, Joseph A., Carpenter, Todd C., Dean, J. Michael, Diddle, J. Wesley, Federman, Myke, Fernandez, Richard, Fink, Ericka L., Franzon, Deborah, Frazier, Aisha H., Friess, Stuart H., Graham, Kathryn, Hall, Mark, Hehir, David A., Horvat, Christopher M., Huard, Leanna L., Maa, Tensing, Manga, Arushi, McQuillen, Patrick S., Meert, Kathleen L., Mourani, Peter M., Nadkarni, Vinay M., Naim, Maryam Y., Notterman, Daniel, Palmer, Chella A., Pollack, Murray M., Sapru, Anil, Schneiter, Carleen, Sharron, Matthew P., Srivastava, Neeraj, Tabbutt, Sarah, Tilford, Bradley, Viteri, Shirley, Wessel, David, Wolfe, Heather A., Yates, Andrew R., Zuppa, Athena F., Sutton, Robert M.. Diastolic Blood Pressure Threshold During Pediatric Cardiopulmonary Resuscitation and Survival Outcomes: A Multicenter Validation Study\*.Critical Care Medicine; 01/2023. 2. Berg, Robert A, Sutton, Robert M, Reeder, Ron W, Berger, John T, Newth, Christopher J, Carcillo, Joseph A, McQuillen, Patrick S, Meert, Kathleen L, Yates, Andrew R, Harrison, Rick E, Moler, Frank W, Pollack, Murray M, Carpenter, Todd C, Wessel, David L, Jenkins, Tammara L, Notterman, Daniel A, Holubkov, Richard, Tamburro, Robert F, Dean, J Michael, Nadkarni, Vinay M. Association Between Diastolic Blood Pressure During Pediatric In-Hospital Cardiopulmonary Resuscitation and Survival..Circulation; 2018. 3. Wolfe, Heather A, Sutton, Robert M, Reeder, Ron W, Meert, Kathleen L, Pollack, Murray M, Yates, Andrew R, Berger, John T, Newth, Christopher J, Carcillo, Joseph A, McQuillen, Patrick S, Harrison, Rick E, Moler, Frank W, Carpenter, Todd C, Notterman, Daniel A, Holubkov, Richard, Dean, J Michael, Nadkarni, Vinay M, Berg, Robert A. Functional outcomes among survivors of pediatric in-hospital cardiac arrest are associated with baseline neurologic and functional status, but not with diastolic blood pressure during CPR..Resuscitation; 2019. 4. Two secondary analyses of prospective cohorts 5. Berg 2018 showed an improvement to FNO with the intervention, but Berg 2023 did not 6. Secondary analysis of a single cohort with 77 subjects included      | **Outcomes** | **Anticipated absolute effects\* (95% CI)** | | **Relative effect (95% CI)** | **№ of participants (studies)** | **Certainty of the evidence (GRADE)** | **Comments** | | --- | --- | --- | --- | --- | --- | --- | | **Risk with no blood pressure target** | **Risk with a diastolic blood pressure of 25 for infants <1 and 30 for children >=1** | | Survival to hospital discharge (SHD) | Study population | | **RR 1.64** (1.06 to 2.54) | 88 (1 non-randomised study)1 | ⨁◯◯◯ Very lowa | Showed no difference between exposure to a DBP of ≥25 mmHg for infants <1 and ≥30 mmHg for children ≥1 for the first 10 minutes of CPR | | 405 per 1,000 | **665 per 1,000** (430 to 1,000) |  1. Yates, Andrew R, Sutton, Robert M, Reeder, Ron W, Meert, Kathleen L, Berger, John T, Fernandez, Richard, Wessel, David, Newth, Christopher J, Carcillo, Joseph A, McQuillen, Patrick S, Harrison, Rick E, Moler, Frank W, Pollack, Murray M, Carpenter, Todd C, Notterman, Daniel A, Dean, J Michael, Nadkarni, Vinay M, Berg, Robert A. Survival and Cardiopulmonary Resuscitation Hemodynamics Following Cardiac Arrest in Children With Surgical Compared to Medical Heart Disease..Pediatric critical care medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies; 2019. 2. Secondary analysis of a multi center prospective cohort  | **Outcomes** | **Anticipated absolute effects\* (95% CI)** | | **Relative effect (95% CI)** | **№ of participants (studies)** | **Certainty of the evidence (GRADE)** | **Comments** | | --- | --- | --- | --- | --- | --- | --- | | **Risk with no blood pressure target** | **Risk with a diastolic blood pressure of 25 for infants <1 and 30 for children >=1** | | Survival to hospital discharge (SHD) | Study population | | **RR 0.47** (0.15 to 1.41) | 25 (1 non-randomised study)1 | ⨁◯◯◯ Very lowa | Showed benefit from exposure to a DBP of ≥25 mmHg for infants <1 and ≥30 mmHg for children ≥1 for the first 10 minutes of CPR | | 500 per 1,000 | **235 per 1,000** (75 to 705) |  1. Yates, Andrew R, Sutton, Robert M, Reeder, Ron W, Meert, Kathleen L, Berger, John T, Fernandez, Richard, Wessel, David, Newth, Christopher J, Carcillo, Joseph A, McQuillen, Patrick S, Harrison, Rick E, Moler, Frank W, Pollack, Murray M, Carpenter, Todd C, Notterman, Daniel A, Dean, J Michael, Nadkarni, Vinay M, Berg, Robert A. Survival and Cardiopulmonary Resuscitation Hemodynamics Following Cardiac Arrest in Children With Surgical Compared to Medical Heart Disease..Pediatric critical care medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies; 2019. 2. Secondary analysis of a multi-center prospective cohort  | **Outcomes** | **Anticipated absolute effects\* (95% CI)** | | **Relative effect (95% CI)** | **№ of participants (studies)** | **Certainty of the evidence (GRADE)** | **Comments** | | --- | --- | --- | --- | --- | --- | --- | | **Risk with no blood pressure target** | **Risk with a systolic blood pressure of 60 for infants < 1 and 80 for children >=1** | | Survival to hospital discharge (SHD) | Study population | | **RR 1.12** (0.95 to 1.32) | 577 (2 non-randomised studies)1,2 | ⨁◯◯◯ Very lowa | Showed no difference between exposure to a SBP of ≥60 mmHg for infants <1 and ≥80 mmHg for children ≥1 for the first 10 minutes of CPR | | 507 per 1,000 | **568 per 1,000** (482 to 670) | | Survival with favorable neurological outcome (PCPC 1-3 or no change) (FNO) | Study population | | **RR 1.0** (0.7 to 1.4) | 164 (1 non-randomised study)2 | ⨁◯◯◯ Very lowb | Showed no difference between exposure to a SBP of ≥60 mmHg for infants <1 and ≥80 mmHg for children ≥1 for the first 10 minutes of CPR | | 0 per 1,000 | **0 per 1,000** (0 to 0) | | Functional status scale increase by 3 or increase by 2 in single domain (in survivors) (FSS) | Study population | | **RR 0.70** (0.40 to 1.24) | 77 (1 non-randomised study)3 | ⨁◯◯◯ Very lowc | No difference between the median diastolic blood pressures between subjects with new substantive morbidity and those without | | 489 per 1,000 | **342 per 1,000** (196 to 606) |  1. Berg, Robert A., Morgan, Ryan W., Reeder, Ron W., Ahmed, Tageldin, Bell, Michael J., Bishop, Robert, Bochkoris, Matthew, Burns, Candice, Carcillo, Joseph A., Carpenter, Todd C., Dean, J. Michael, Diddle, J. Wesley, Federman, Myke, Fernandez, Richard, Fink, Ericka L., Franzon, Deborah, Frazier, Aisha H., Friess, Stuart H., Graham, Kathryn, Hall, Mark, Hehir, David A., Horvat, Christopher M., Huard, Leanna L., Maa, Tensing, Manga, Arushi, McQuillen, Patrick S., Meert, Kathleen L., Mourani, Peter M., Nadkarni, Vinay M., Naim, Maryam Y., Notterman, Daniel, Palmer, Chella A., Pollack, Murray M., Sapru, Anil, Schneiter, Carleen, Sharron, Matthew P., Srivastava, Neeraj, Tabbutt, Sarah, Tilford, Bradley, Viteri, Shirley, Wessel, David, Wolfe, Heather A., Yates, Andrew R., Zuppa, Athena F., Sutton, Robert M.. Diastolic Blood Pressure Threshold During Pediatric Cardiopulmonary Resuscitation and Survival Outcomes: A Multicenter Validation Study\*.Critical Care Medicine; 01/2023. 2. Berg, Robert A, Sutton, Robert M, Reeder, Ron W, Berger, John T, Newth, Christopher J, Carcillo, Joseph A, McQuillen, Patrick S, Meert, Kathleen L, Yates, Andrew R, Harrison, Rick E, Moler, Frank W, Pollack, Murray M, Carpenter, Todd C, Wessel, David L, Jenkins, Tammara L, Notterman, Daniel A, Holubkov, Richard, Tamburro, Robert F, Dean, J Michael, Nadkarni, Vinay M. Association Between Diastolic Blood Pressure During Pediatric In-Hospital Cardiopulmonary Resuscitation and Survival..Circulation; 2018. 3. Wolfe, Heather A, Sutton, Robert M, Reeder, Ron W, Meert, Kathleen L, Pollack, Murray M, Yates, Andrew R, Berger, John T, Newth, Christopher J, Carcillo, Joseph A, McQuillen, Patrick S, Harrison, Rick E, Moler, Frank W, Carpenter, Todd C, Notterman, Daniel A, Holubkov, Richard, Dean, J Michael, Nadkarni, Vinay M, Berg, Robert A. Functional outcomes among survivors of pediatric in-hospital cardiac arrest are associated with baseline neurologic and functional status, but not with diastolic blood pressure during CPR..Resuscitation; 2019. 4. Two secondary analyses of prospective cohorts 5. Secondary analysis of a single cohort 6. Secondary analysis of a single cohort with 77 subjects included      | **Outcomes** | **Anticipated absolute effects\* (95% CI)** | | **Relative effect (95% CI)** | **№ of participants (studies)** | **Certainty of the evidence (GRADE)** | **Comments** | | --- | --- | --- | --- | --- | --- | --- | | **Risk with no blood pressure monitoring** | **Risk with the use of blood pressure monitoring** | | Return of spontaneous circulation (ROSC) | Study population | | **OR 0.93** (0.79 to 1.10) | (1 non-randomised study)1 | ⨁◯◯◯ Very lowa | Showed no difference between exposure to reported use of invasive blood pressure monitoring of CPR quality | | 0 per 1,000 | **0 per 1,000** (0 to 0) | | Survival to 24 hours (24hS) | Study population | | **OR 1.02** (0.84 to 1.22) | (1 non-randomised study)1 | ⨁◯◯◯ Very lowa | Showed no difference between exposure to reported use of invasive blood pressure monitoring of CPR quality | | 0 per 1,000 | **0 per 1,000** (0 to 0) | | Survival to hospital discharge (SHD) | Study population | | **OR 0.97** (0.81 to 1.16) | (1 non-randomised study)1 | ⨁◯◯◯ Very lowa | Showed no difference between exposure to reported use of invasive blood pressure monitoring of CPR quality | | 0 per 1,000 | **0 per 1,000** (0 to 0) | | Survival with favorable neurological outcome (PCP 1-2 or no worsening) (FNO1-2) | Study population | | **OR 0.91** (0.72 to 1.17) | (1 non-randomised study)1 | ⨁◯◯◯ Very lowa | Showed no difference between exposure to reported use of invasive blood pressure monitoring of CPR quality | | 0 per 1,000 | **0 per 1,000** (0 to 0) |  1. Kienzle, Martha F, Morgan, Ryan W, Alvey, Jessica S, Reeder, Ron, Berg, Robert A, Nadkarni, Vinay, Topjian, Alexis A, Lasa, Javier J, Raymond, Tia T, Sutton, Robert M. Clinician-reported physiologic monitoring of cardiopulmonary resuscitation quality during pediatric in-hospital cardiac arrest: A propensity-weighted cohort study..Resuscitation; 2023. 2. Single registry study | The diastolic blood pressure cutoffs of 25 mmHg for infants under 1 and 30 mmHg for children 1 - 18 years were derived from Berg 2018. |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial ○ Small ○ Moderate ○ Large ○ Varies ● Don't know | None of the studies examined undesirable effects of the treatment. There are risks and complications from invasive arterial monitoring, such as infection and bleeding, and all subjects enrolled in these studies had invasive monitoring in place prior to an in-hospital cardiac arrest. | It was felt by the task force that the evidence applied only to children with invasive blood pressure monitoring in place at the time of in-hospital cardiac arrest, particularly given the challenges and risks associated with initiation of invasive monitoring during arrest. |
| 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 | Five studies were included in the systematic review. (1, 2, 3, 4, 5) All five were observational cohort studies, with all being secondary analyses.  **Diastolic and systolic blood pressure**  Berg 2023 was a secondary analysis of a prospective multicenter cohort study (ICU-RESUScitation, Sutton 2022). Berg 2018 and Wolfe 2019 were secondary analyses of the PICqCPR cohort, but examined different outcomes. The studies were performed at large academic pediatric hospitals in the United States, which limits generalizability but is representative of the population of in-hospital cardiac arrests in highly resourced settings.  The pooled aRR for favorable neurological outcome (FNO) showed a modest benefit (aRR 1.37), but this predominantly came from Berg 2018, with Berg 2023 showing no difference in FNO. Furthermore, using the same cohort as Berg 2018, Wolfe et al. found no difference in new substantive morbidity.  **Presence of monitoring**  The intervention of clinician-reported use of diastolic blood pressure to monitor CPR performance intra-arrest was reported in only one study. (4) The study was large, with 2,886 patients, but relied on clinician-reported use of monitoring (collected post-hoc) and was limited to institutions enrolled in the American Heart Association Get With the Guidelines Registry. The heterogeneity of subjects required propensity score matching. |  |
| 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 | The ILCOR P-COSCA initiative developed a core outcome set specific for pediatric cardiac arrest studies. The P-COSCA outcomes of return of spontaneous circulation, survival to discharge, and survival with favorable neurological outcome were chosen as critical, highly-valued outcomes for this review. |  |
| 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 | **Diastolic blood pressure**  Overall, the benefit of targeting a diastolic blood pressure of 25 mmHg for infants ≤1 and 30 mmHg for children 1 to 18 years, for the first 10 minutes of cardiac arrest for subjects with invasive blood pressure monitoring in place at the time of arrest, is associated with better outcomes when compared to a different diastolic blood pressure. Acknowledging the very low certainty of evidence, the currently available data support higher rates of ROSC, SHD, and FNO for subjects with the intervention.  **Systolic blood pressure**  Overall, there was no significant difference in outcomes in subjects with systolic blood pressures of 60 mmHg (infants <1) or 80 mmHg (children 1-18 years).  **Presence of monitoring**  Overall, there was no difference in outcomes for subjects who had clinician-reported use of diastolic blood pressure monitoring.  **Overall**  Given the benefits of studies examining diastolic blood pressure, the balance of effects favors targeting diastolic blood pressures in infants and children with invasive BP monitoring in place at the time of arrest. | Studies only included subjects with invasive monitoring in place at the time of arrest, and the task force considered it important to highlight the applicability of the evidence to only those with invasive blood pressure monitoring in place at the time of cardiac arrest.    The task force also acknowledged that the presence of invasive blood pressure monitoring is challenging in resource-limited settings, and that no studies were found examining the use of other methods of blood pressure monitoring, including non-invasive monitoring. |
| Acceptability Is the intervention acceptable to key stakeholders? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ● Yes ○ Varies ○ Don't know | No specific studies examining the acceptability of targeting a specific blood pressure using invasive monitoring were found. But, in settings where invasive monitoring is available and in place at the time of arrest, it is likely acceptable to continue monitoring blood pressures during arrest. |  |
| Feasibility Is the intervention feasible to implement? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know | For patients with invasive monitoring in place at the time of arrest, it is feasible to monitor the blood pressure during the arrest. However, it is likely not feasible to initiate invasive monitoring intra-arrest, and no studies examined this. The task force acknowledged that some settings may not have the resources for invasive blood pressure monitoring. |  |

# Summary of judgements

|  | **Judgement** | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 |
| **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 targeting an intra-arrest diastolic blood pressure of ≥25mmHg for infants <1 year and ≥30mmHg for children 1 to 18 years with invasive blood pressure monitoring in place at the time of in-hospital cardiac arrest (weak recommendation, very low certainty of evidence). |
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| Justification |
| The task force considered that in high-resource settings, invasive arterial blood pressure monitoring may be present at the time of in-hospital cardiac arrest, and that current targets have been suggested through individual studies and expert consensus. The ILCOR pediatric life support task force undertook a systematic review of the evidence.  The review found no randomized controlled studies comparing two blood pressure targets during pediatric in-hospital cardiac arrest. The available evidence consisted solely of observational data demonstrating the effect of exposure to various targets on critically important outcomes.  The consensus of the task force was that for the specific population examined in the studies (ie, infants and children with invasive monitoring in place at the time of in-hospital cardiac arrest), that the evidence from a pooled sample size of 577 was adequate to make a recommendation for diastolic blood pressure targets of 25 mmHg for infants <1 and 30 mmHg for children 1-18 years, understanding that adolescents are under-represented in the studies. Pooled estimates showed better ROSC, SHD, and FNO, but the task force recognized that the FNO outcome was driven primarily by a single study (Berg 2018), and two other individual studies looking at different populations or definitions of FNO, found no difference.  The same studies demonstrated no difference when systolic blood pressures were targeted, so the task force recommended solely diastolic targets. Mean arterial pressure was not examined. A single study examining the clinician-reported presence of arterial monitoring at the time of in-hospital cardiac arrest showed no difference in outcomes (Kienzle 2023), however, we felt that its indirectness was outweighed by the specific targets in other studies (Berg 2018, Berg 2023). |

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| Subgroup considerations |
| Specific etiologies of arrest and their association with outcomes were not examined given the small number of patients in each subgroup. The subgroup of children heart disease was examined, with children with surgical heart disease having better outcomes but medical disease having no difference in outcomes, with significant limitations given the size of the cohorts. |

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| Implementation considerations |
| Studies only included subjects with invasive monitoring in place at the time of arrest, and the task force considered it important to highlight the applicability of the evidence to only those with invasive blood pressure monitoring in place at the time of cardiac arrest.  The task force also acknowledged that the presence of invasive blood pressure monitoring is challenging in resource-limited settings, and that no studies were found examining the use of other methods of blood pressure monitoring, including non-invasive monitoring. |

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| Monitoring and evaluation |
| See below |

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| Research priorities |
| There are no interventional, randomized controlled trials comparing the benefits or harms of specific blood pressure targets during arrest  There are no studies examining the use of non-invasive methods to measure blood pressure during arrest  There are no studies examining whether different blood pressure targets would be more appropriate for adolescents  There are no studies examining the utility of initiating invasive blood pressure monitoring intra-arrest |

# References Summary

1. Berg, Robert A., Morgan, Ryan W., Reeder, Ron W., Ahmed, Tageldin, Bell, Michael J., Bishop, Robert, Bochkoris, Matthew, Burns, Candice, Carcillo, Joseph A., Carpenter, Todd C., Dean, J. Michael, Diddle, J. Wesley, Federman, Myke, Fernandez, Richard, Fink, Ericka L., Franzon, Deborah, Frazier, Aisha H., Friess, Stuart H., Graham, Kathryn, Hall, Mark, Hehir, David A., Horvat, Christopher M., Huard, Leanna L., Maa, Tensing, Manga, Arushi, McQuillen, Patrick S., Meert, Kathleen L., Mourani, Peter M., Nadkarni, Vinay M., Naim, Maryam Y., Notterman, Daniel, Palmer, Chella A., Pollack, Murray M., Sapru, Anil, Schneiter, Carleen, Sharron, Matthew P., Srivastava, Neeraj, Tabbutt, Sarah, Tilford, Bradley, Viteri, Shirley, Wessel, David, Wolfe, Heather A., Yates, Andrew R., Zuppa, Athena F., Sutton, Robert M.. Diastolic Blood Pressure Threshold During Pediatric Cardiopulmonary Resuscitation and Survival Outcomes: A Multicenter Validation Study\*.Critical Care Medicine; 01/2023.

2. Berg, Robert A, Sutton, Robert M, Reeder, Ron W, Berger, John T, Newth, Christopher J, Carcillo, Joseph A, McQuillen, Patrick S, Meert, Kathleen L, Yates, Andrew R, Harrison, Rick E, Moler, Frank W, Pollack, Murray M, Carpenter, Todd C, Wessel, David L, Jenkins, Tammara L, Notterman, Daniel A, Holubkov, Richard, Tamburro, Robert F, Dean, J Michael, Nadkarni, Vinay M. Association Between Diastolic Blood Pressure During Pediatric In-Hospital Cardiopulmonary Resuscitation and Survival..Circulation; 2018.

3. Kienzle, Martha F, Morgan, Ryan W, Alvey, Jessica S, Reeder, Ron, Berg, Robert A, Nadkarni, Vinay, Topjian, Alexis A, Lasa, Javier J, Raymond, Tia T, Sutton, Robert M. Clinician-reported physiologic monitoring of cardiopulmonary resuscitation quality during pediatric in-hospital cardiac arrest: A propensity-weighted cohort study..Resuscitation; 2023.

4. Wolfe, Heather A, Sutton, Robert M, Reeder, Ron W, Meert, Kathleen L, Pollack, Murray M, Yates, Andrew R, Berger, John T, Newth, Christopher J, Carcillo, Joseph A, McQuillen, Patrick S, Harrison, Rick E, Moler, Frank W, Carpenter, Todd C, Notterman, Daniel A, Holubkov, Richard, Dean, J Michael, Nadkarni, Vinay M, Berg, Robert A. Functional outcomes among survivors of pediatric in-hospital cardiac arrest are associated with baseline neurologic and functional status, but not with diastolic blood pressure during CPR..Resuscitation; 2019.

5. Yates, Andrew R, Sutton, Robert M, Reeder, Ron W, Meert, Kathleen L, Berger, John T, Fernandez, Richard, Wessel, David, Newth, Christopher J, Carcillo, Joseph A, McQuillen, Patrick S, Harrison, Rick E, Moler, Frank W, Pollack, Murray M, Carpenter, Todd C, Notterman, Daniel A, Dean, J Michael, Nadkarni, Vinay M, Berg, Robert A. Survival and Cardiopulmonary Resuscitation Hemodynamics Following Cardiac Arrest in Children With Surgical Compared to Medical Heart Disease..Pediatric critical care medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies; 2019.