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| Question | |
| **Should presence vs. absence of N20 waves on somatosensory evoked potential recordings be used for predicting favorable neurodevelopmental outcomes in children after cardiac arrest?** | |
| **Population:** | Children (<18 years) who achieve a return of spontaneous or mechanical circulation (ROC) after resuscitation from in-hospital cardiac arrest (IHCA) and out-of-hospital (OHCA), from any cause. |
| **Intervention:** | Presence of N20 waves on somatosensory evoked potential recordings |
| **Comparison:** | Absence of N20 waves on somatosensory evoked potential recordings |
| **Main outcomes:** | Prediction of survival with good neurological outcome: defined as a Pediatric Cerebral Performance Category (PCPC) score of 1, 2 or 3, or Vineland Adaptive Behavioural scale-II ≥ 70. PCPC score ranges 1 (normal), 2 (mild disability), 3 (moderate disability), 4 (severe disability), 5 (coma), and 6 (brain death). We will also separately report studies defining good neurological outcomes with other assessment tools, or as a PCPC score 1 or 2, or change in PCPC score from baseline ≤2. |
| **Study DESIGN** | Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion. Unpublished studies (e.g., conference abstracts, trial protocols\*) and animal studies were excluded. We selected studies where the sensitivity and false-positive rate (FPR) of the prognostic (index) test are reported and a 2s2 contingency table could be created. |
| **TIMEFRAME** | All years and all languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded. Literature search updated to Feb 17th, 2022. |

# 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 | Cardiac arrest is uncommon in children; however, has a low rate of survival and high chance of neurological injury. Most of these deaths occur because of withdrawal of life-sustaining treatment (WLST) based on prediction of unfavorable neurological outcome. Prognostication is of utmost importance because inappropriate WLST can be avoided in those likely to survive with good neurological outcomes. Prediction of favourable neurodevelopmental outcome is a key skill for clinicians to guide appropriate treatment and realistic expectation with parents and/or legal guardians. |  |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial ○ Small ● Moderate ○ Large ○ Varies ○ Don't know | Somatosensory evoked potential (SSEPs), evaluating presence or absence of N20 wave, were reported in only one study, with a small sample size (n=9) reporting good neurological outcome (PCPC 1 to 3) at 3 timepoints (24, 48 and 72 hours) [McDevitt 2019]. Clinicians were blinded to test results and the SSEP assessor was blinded to outcome. The predicted sensitivity was 100% at 24 and 48 hours and 83% at 72 hours, with a very low FPR 0% at all time points. |  |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large ○ Moderate ○ Small ● Trivial ○ Varies ○ Don't know | The false positive rate was very low (0%) making the presence of N20 wave highly specific (100%) for prediction of good neurodevelopmental outcomes in comatose children after cardiac 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 | Given the small sample size of the single included study, certainty of evidence would be considered low. The precision of the results was low with wide confidence intervals: Sensitivity 1.00 [0.48, 1.00] at 24 and 48 hours with sensitivity 0.83 [0.36, 1.00] at 72 hours; False positive rate 0.00 [0.00, 0.71] at 24 and 72 hours with FPR 0.00 [0.00, 0.60] at 48 hours.  The findings were strengthened by the fact that clinicians were blinded to test results and SSEP assessor to outcome. |  |
| 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 | Neurological outcome is a critical outcome after cardiac arrest (P-COSCA: Topjian, et al Circulation 2020; 142). However, tools and definitions to measure good neurological outcome in our studies were the PCPC 1 to 2 and 1 to 3, or <1 change in PCPC and the VABS II >70. Change from baseline neurodevelopmental status may be more important than the neurodevelopmental level, especially in infants and children with pre-existing neurological impairment.  We defined good neurological outcome prediction as imprecise when the false positive rate (FPR) was above 30%. However, there is no universal consensus on what the acceptable limits for imprecision should be in prediction for infants and children after cardiac arrest.  A low false positive rate means that a low proportion of patients, predicted to have a good outcome will have a falsely optimistic prediction (test predicted a good outcome, but patient went on to have a bad outcome). The task force felt that when focused on accuracy of predicting a good outcome - a low false positive rate (e.g. <30%) is more desirable to avoid falsely optimistic prediction than a high sensitivity. The cut off of 30% FPR (equivalent to 70% specificity) was chosen as the consequences of false optimism were felt by the task force to be less critical than false pessimism. False optimism may result in continued life sustaining therapy in a patient who will eventually have a poor outcome. This will involve increased resources and treatment; however, may also allow more time for further prognostic evaluation. Also, reasons for not achieving a very low false positive rate may be non-neurological causes of poor outcome or death, not attributable to the index test assessment.  A high sensitivity means the majority of patients, who have a good outcome, tested positive and therefore a corresponding low proportion will have a falsely pessimistic prediction (test predicted a poor outcome, but patient went on to have a good outcome). When considering the accuracy of predicting a poor outcome (compared to predicting a good outcome), then a low rate of falsely pessimistic predictions is very important. Our cut off threshold for considering precise sensitivity was therefore higher (>95%), as the consequences of inaccurate poor outcome prediction (e.g. false pessimism) may lead to a decision to limit or withdraw life sustaining therapies in a patient who could have a good neurological outcome. |  |
| 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 | The presence of the N20 wave on somatosensory evoked potentials at 24 and 48 hours post cardiac arrest was 100% sensitive and 100% specific for prediction of good neurological outcomes in children post-cardiac arrest. However, this is from a single study and therefore the balance of effects neither favors for or against the use of presence of N20 waves for prediction of good neurological outcomes in this population. |  |
| 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 | We did not include any specific studies assessing costs of performing somatosensory evoked potentials in critically ill children for neuroprognostication. However, specific equipment and skills are required for performing continuous EEG monitoring in critically ill children and these may not be available in many settings. |  |
| 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 | We did not identify any studies specifically assessing costs of performing somatosensory evoked potentials and/or screening for the presence of N20 wave. |  |
| 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 | We did not identify any studies addressing cost-effectiveness of identifying N20 waves or performing somatosensory evoked potential recordings in children after cardiac arrest. |  |
| 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 | The specific equipment and skills needed to obtain somatosensory evoked potential recordings in critically ill children post cardiac arrest may not be available everywhere and every time. This can create a problem in terms of equity. |  |
| Acceptability Is the intervention acceptable to key stakeholders? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know | We have not identified any research that assessed acceptability of presence of N20 waves as a predictor of outcomes or that of somatosensory evoked potentials. However, acceptability is likely. |  |
| Feasibility Is the intervention feasible to implement? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know | Feasibility was not specifically addressed in any of the studies included in this review. Evaluating for the presence of N20 waves on somatosensory evoked potential recordings for prognostication purposes requires specific equipment and the expertise to interpret the tracing. This may not be feasible everywhere or during all times of the day. |  |

# 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** | Large | Moderate | Small | **Trivial** |  | 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 |
| We can neither suggest for the use of presence of N20 wave in the first 72 hours after return of circulation for the prediction of favorable neurodevelopmental outcomes in children after cardiac arrest (weak recommendation, very low certainty of evidence) |
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| Justification |
| **Overall justification**  One study evaluated the utility of 'presence of N20 wave' in somatosensory evoked potentials as a predictor of good neurodevelopmental outcomes in comatose critically ill children after cardiac arrest [McDevitt 2019 30]. This study reported a 100% sensitivity at 24 and 48 hours with a 0% false positive rate. At the 72-hour time point, this study reported a 83% sensitivity with 0% false positive rate.  **Detailed justification**  *Desirable Effects*  100% sensitivity at 24- and 48-hour time points83% sensitivity at 72-hour time point  *Undesirable Effects*  100% specificity at all 3-time points0% false positive rate at all 3 time points  *Certainty of evidence*  Single study with a small number of subjects and low precision - Low certainty of evidence  *Resources required*  Specialized equipment and expertise are required for the conduct and interpretation of somatosensory evoked potentials in critically ill children  *Equity*  Resources required for SSEP recording and interpretation may not be available in many centers, especially in resource-limited settings. |

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| Subgroup considerations |
| None |

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| Implementation considerations |
| Performance and interpretation of SSEPs in the pediatric critical care environment requires resources and these may not be uniformly available even in resource-rich settings. |

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| Monitoring and evaluation |
| None |

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| Research priorities |
| Large multicenter studies are required to evaluate the sensitivity and false positive rate of positive N20 wave on SSEPs during the first 72 hours post cardiac arrest in critically ill children with higher precision. |

# References Summary