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| QUESTION | |
| **Continuous amplitude-integrated EEG (aEEG) or reduced montage EEG for prediction of good neurological outcome in adults with cardiac arrest**  **(Subsection of Prognostication ETD)** | |
| **POPULATION:** | Adults who are comatose after resuscitation from cardiac arrest (either in-hospital or out-of-hospital), regardless of target temperature management. |
| **INTERVENTION:** | Amplitude integrated EEG (aEEG) or original EEG using reduced electrode montages assessed within 72 hours after cardiac arrest. |
| **COMPARISON:** | *None.* |
| **MAIN OUTCOMES:** | Prediction of good neurological outcome defined as Cerebral Performance Categories (CPC) on hospital discharge or 6 months after cardiac arrest |
| **STUDY DESIGN:** | Prognostic accuracy studies where the 2 x 2 contingency table (i.e., the number of true/false negatives and positives for prediction of good outcome) was reported, or where those variables could be calculated from reported data. are eligible for inclusion. Unpublished studies, reviews, case reports, case series, studies including less than 10 patients, letters, editorials, conference abstracts, and studies published in abstract form were excluded. |
| **TIMEFRAME:** | An ILCOR review from 2013 and an update from 2020 presented the evidence of predictors of poor neurological outcome after cardiac arrest. More recently, several studies identifying predictors of good neurological outcome after cardiac arrest have been published, therefore an ILCOR evidence review for predictors of good neurological outcome after cardiac arrest is necessary.  The most recent search of this systematic review evidence update on neuroprognostication was launched in October 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 | Neurologic injury is the most common cause of death in patients with post cardiac arrest syndrome. Most of these deaths occur due to withdrawal of life-sustaining treatment (WLST) based on the prediction of poor neurological outcome. Neurological prognostication after cardiac arrest is of utmost importance to avoid futile treatments for unsalvageable patients but also to minimize the risk of falsely pessimistic prediction and self-fulfilling prophecy. |  |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| JUDGEMENT | RESEARCH EVIDENCE | ADDITIONAL CONSIDERATIONS |
| ○ Trivial ● Small  ○ Moderate ○ Large ○ Varies ○ Don't know | Five studies [Wennevirta, 2009; Jang, 2019; Oh, 2013; Rundgren, 2010; Eertmans, 2019] investigated the predictive value of a **continuous normal-voltage background** defined from quantitative trend analysis using amplitude-integrated EEG (**aEEG**) [Jang, 2019; Oh, 2013] or original **EEG with reduced electrode montages** [Rundgren, 2010; Wennewirta, 2009] at a time ranging from 6 to 72 h after ROSC.  Two studies [Rundgren, 2010; Wennewirta, 2009] assessed reduced-montage EEG at two time-windows (within 24h and between 24 and 48h after ROSC) and favorable EEG pattern predicted good outcome at **earlier time window with specificity 56–96% (sensitivities 53–67%) and at later time-window with specificity of 67–79% (sensitivity 95%)**.  Two studies [Jang, 2019; Oh, 2013] investigated **aEEG within 72h after ROSC** and specificity to predict good outcome **on hospital discharge** [Oh, 2013] was **96% (sensitivity 57%)** and **at 6 months** [Jang, 2019] **85% (sensitivity 100%)**.  One study [Eertmans, 2019] analyzed the original EEG tracing of a bispectral index (BIS) monitor recorded between 6 and 48 h from ROSC from four frontotemporal channels. **A slow diffuse theta and/or delta activity,** as opposed to epileptiform, burst-suppression, or suppression (<5 μV), predicted good neurological outcome with **79% specificity at all time points, with 55%-86% sensitivity.** | aEEG results report voltage and continuity, but do not directly enable a morphological assessment of the original EEG signals making the identification of superimposed activity difficult unless the original EEG channels are also displayed. In one study [Oh, 2013] original EEG was reviewed to exclude epileptical discharges. |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| JUDGEMENT | RESEARCH EVIDENCE | ADDITIONAL CONSIDERATIONS |
| ○ Large ○ Moderate ○ Small ○ Trivial ○ Varies  ○ Don't know | None known. | A falsely optimistic prediction in a patient with poor neurological outcome may potentially lead to the delivery of futile care. |
| 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 about favorable aEEG or reduced-montage EEG is very low because of bias (mainly due to lack of blinding) and imprecision. | Strengths of aEEG include bedside investigation, wide availability, and non-invasiveness. aEEG provides a real-time investigation of electrical brain activity. aEEG enables non-s-specialists to intepret EEG |
| 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 | Most studies define good outcome as CPC scores 1–2 |  |
| 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 main disadvantage of aEEG is the limited access to the raw EEG’s morphology. |
| 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. However, specific equipment is required for assessing aEEG. |  |
| 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 aEEGs. |  |
| 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 aEEGs. |  |
| 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 assess aEEGs are not available everywhere. 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 aEEGs. 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 | The equipment and skills required for their assessment may represent an obstacle for their implementation. | Intepretation of aEEG does not require a specialist (compared to full montage EEG) |

# 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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| Recommendations |
| We suggest against the use of other EEG metrics, including reduced montage or amplitude integrated EEG, BIS, or EEG-derived indices, to predict good outcome in patients who are comatose after cardiac arrest. |
| Justification |
| In recommending against using amplitude-integrated EEG, the panel considered that these techniques do not allow or allow only a limited morphological assessment of the original EEG signal. Moreover, the evidence was limited to few studies. |
| Subgroup considerations |
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| Implementation considerations |

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| Monitoring and evaluation |
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| Research priorities |
| Studies are needed to confirm the consistency of aEEG patterns with those identified by experts on full-montage EEG.  The evidence on aEEG is limited to a few studies, and further studies are needed to ensure the reproducibility of the results. |

References:

Eertmans W, Genbrugge C, Haesen J, et al. (2019) The prognostic value of simplified EEG in out-of-hospital cardiac arrest patients. Neurocrit Care 30:139–148

Jang J, Oh SH, Nam Y, et al. BS (2019) Prognostic value of phase information of 2D T2\*-weighted gradi- ent echo brain imaging in cardiac arrest survivors: A preliminary study. Resuscitation 140:142–149

Oh SH, Park KN, Kim YM, et al. (2013) The prognostic value of continuous amplitude-integrated electroencephalogram applied immediately after return of spontaneous circulation in therapeutic hypothermia-treated cardiac arrest patients. Resuscitation 84:200–205

Rundgren M, Westhall E, Cronberg T, et al. (2010) Continu- ous amplitude-integrated electroencephalogram predicts outcome in hypothermia-treated cardiac arrest patients. Crit Care Med 38:1838–1844

Wennervirta JE, Ermes MJ, Tiainen SM, et al.P (2009) Hypothermia-treated cardiac arrest patients with good neurological outcome differ early in quantitative variables of EEG suppression and epileptiform activity. Crit Care Med 37:2427–2435