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| Question | |
| **Should Double Sequential Defibrillation vs. Standard defibrillation be used for Adult cardiac arrest patients with a shockable (VF/pVT) cardiac arrest rhythm?** | |
| **Population:** | Adult cardiac arrest patients with a shockable (VF/pVT) cardiac arrest rhythm |
| **Intervention:** | Double (dual) Sequential Defibrillation (DSED) |
| **Comparison:** | Standard defibrillation |
| **Main outcomes:** | Good Neurological Outcome at Discharge; Survival to Hospital Discharge; Survival to Hospital Admission; Return of Spontaneous Circulation; Termination of VF; |
| **Setting:** | Any Setting |
| **Perspective:** |  |
| **Background:** |  |
| **Conflict of interests:** |  |

# 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 | Survival from sudden cardiac arrest is low. Patients who present in an initial cardiac rhythm of ventricular fibrillation (VF) have a higher rate of good outcome. Approximately 20% of VF patients, however, will remain in VF despite standard resuscitation interventions. Patients in refractory VF have significantly lower rates of survival than patients who respond to standard resuscitation treatments. |  |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial ○ Small ○ Moderate ●  Large ○ Varies ○ Don't know | Improvement in survival to discharge and neurologic outcome is substantial. |  |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large ○ Moderate ○ Small ○ Trivial ○ Varies ● Don't know | It is not currently known if there are undesirable effects of double sequential defibrillation. Excess defibrillation energy may cause myocardial stunning and prevent return of organised rhythm post-defibrillation [Crampton 1980 167]. This was not seen in the current trial. | Damage to defibrillators from DSED has been raised as a concern. The trial was designed so that defibrillations were done in rapid sequence and not simultaneously, and no damage to defibrillators was reported. |
| 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 around the evidence for DSED compared to standard defibrillation is low. The new randomized trial is the first of its kind, and shows a benefit from DSED compared with standard defibrillation (SD). The certainty of evidence was downgraded for concern for risk of bias due to the unavoidable lack of blinding on the part of the treating paramedics, and because of the cluster randomization, with a paramedic service being aware of the treatment group at the time of enrolment and treatment. Evidence was also downgraded for imprecision as the optimal information size, based on the author’s own sample size calculations, was not met due to the trial being terminated early. | Sensitivity analyses showed some variability in results. |
| 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 | There is little uncertainty around the value that people put on the main outcome of neurological survival and/or survival to hospital discharge. |  |
| 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 | Although the certainty of evidence is low, the existing evidence suggests a beneficial effect with DSED compared with SD on all included outcomes. |  |
| 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 | No research examined costs associated with the intervention. | There are most likely costs associated with double dispatching multiple units in order to perform DSED or having two defibrillators available. The extent of the costs associated with this intervention will vary from service to service. In some systems it is already standard for two ambulances (and thus two defibrillators) to be dispatched to every cardiac arrest, but this is not the case in all systems. In the in-hospital setting there is also considerable variation in the number and location of defibrillators present. |
| 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 research examined the resource requirements for the intervention | There are costs associated with the intervention as it requires multiple defibrillators to perform. The resource requirements to carry out the intervention will vary across different healthcare systems. |
| 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 | Not known. No included studies |  |
| 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 | Implementation of DSED could be challenging in settings with lower resources, including rural areas, due to the cost of having two defibrillators available for use. |  |
| Acceptability Is the intervention acceptable to key stakeholders? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ●  Probably yes ○ Yes ○ Varies ○ Don't know | Stakeholders are likely to accept the benefit vs risk. If effective, the benefit is high, while the associated risks would be low. |  |
| Feasibility Is the intervention feasible to implement? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know | There is no research examining the feasibility of this intervention. It is likely that the feasibility will be dependent on the setting. | Feasibility will depend on dispatching procedures, availability of units with defibrillators and training of personnel.  Feasibility may also depend on the setting, rural vs. urban vs. remote settings.  May also depend on low vs high resource settings. |

# 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 suggest that a double sequential defibrillation strategy (weak recommendation, low certainty of evidence) or a vector change defibrillation strategy (weak recommendation, very low certainty of evidence) may be considered for adults with cardiac arrest who remain in ventricular fibrillation or pulseless ventricular tachycardia after 3 or more consecutive shocks.  If a double sequential defibrillation strategy is utilized, we suggest an approach similar to that in the available trial, with a single operator activating the defibrillators in sequence. (good practice statement) |
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| Justification |
| Existing data provides low certainty evidence of improved ROSC, VF termination, survival to discharge and favorable neurologic outcome (mRS 0-2) with DSED compared with SD for refractory VF. These data also provide low certainty evidence for improvement in VF termination and survival to discharge with VC compared with SD. Benefits from VC compared with SD on ROSC and favorable neurologic outcome at hospital discharge did not reach statistical significance. However, it is not possible to conclude with the data available whether DSED is superior to VC for this patient population. |

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| Subgroup considerations |
| None |

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| Implementation considerations |
| Implementation of DSED would require training of frontline staff as well as ensuring that there were defibrillators that were available to provide the intervention. Implementation of a VC strategy would require training, but would not necessarily require additional defibrillators. |

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| Monitoring and evaluation |
| It is important to monitor the intervention, not just to determine effectiveness but to track any adverse events such as harm to the patient, defibrillator damage, the increase in resource utilization etc. |

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| Research priorities |
| -Comparison of the effectiveness of DSED and VC in this patient population  -Optimal timing of either of these defibrillation strategies  -Whether pad placement with SD affects efficacy |

**Reference**

Crampton R. Accepted, controversial, and speculative aspects of ventricular defibrillation. Progress in Cardiovascular Diseases. Volume 23, Issue 3, 1980, 167-186