Are two shocks better than one? Aotearoa New Zealand emergency medical services implement a new defibrillation strategy: implications for around nine patients per week

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Aotearoa New Zealand emergency medical services (EMS) began routinely using new external defibrillation strategies for the treatment of refractory ventricular fibrillation (VF) and pulseless ventricular tachycardia (VT) from January 2024. These strategies are vector change (VC) defibrillation and double sequential external defibrillation (DSED). DSED provides rapid sequential shocks using two defibrillators with the pads attached in two different vectors, one in an anterior-lateral and the other in an anterior-posterior position. Around 20% of patients with ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT) do not respond to three or more single defibrillation attempts (i.e., are in refractory VF/VT) and have lower survival rates than those who respond to standard (single defibrillation every two minutes) resuscitation approaches.[1] Consideration of DSED and VC defibrillation (switching defibrillation pads from anterior-lateral to an anterior–posterior position) has been suggested for these patients in the 2023 update of the International Consensus on Cardiopulmonary Resuscitation (ILCOR) and Emergency Cardiovascular Care Science with Treatment Recommendations.[2]

Though the task force noted that DSED was already in use by some EMS, ILCOR recommended against the routine use of DSED in 2020 on the basis that there was a lack of high-quality evidence to support its use.[1] In the updated review, one additional randomised controlled trial was identified that utilised DSED and VC defibrillation strategies,[2,3] leading to an update in guidelines while acknowledging that this was a weak recommendation with low certainty of evidence.[1,2] The cluster-randomised trial was undertaken in Canada with a total of 405 patients randomised to one of three strategies: standard defibrillation with the pads in the usual anterior-lateral position, DSED or VC. Refractory VT/VF was defined as three consecutive shocks being delivered by paramedics or participating fire services, and the primary outcome of the trial was survival to hospital discharge. The trial showed a convincing survival benefit of DSED (31/143 [21.7%], RR 2.21 [1.33–3.67]) and VC (38/125 [30.4%], RR 1.71 [1.01–2.88]) over standard defibrillation 18/135 (13.3%). Limitations in this study are also described in an accompanying editorial to this trial.[4] Post-resuscitation care was not described for trial participants and could vary significantly between groups, and the trial was terminated early, with the power analysis indicating that 930 patients were needed but only 405 were analysed. As well as those recruited for the trial, this included 152 patients from an internal pilot study that had subtly different inclusion criteria to the main trial and did not include patients with pulseless VT, shocks administered by fire personnel or additional EMS services to determine refractory VF, or resuscitations started by non-participating EMS agencies.[4,5]

In Aotearoa New Zealand, EMS work under standing orders called the Clinical Procedures and Guidelines (CPGs).[6] The CPGs are developed by the National Ambulance Sector Clinical Working Group, who have considered this study in depth alongside the ILCOR guidelines and incorporated DSED and VC into the CPGs to become routine practice from January 2024.[6] Prior to being able to use this protocol in practice, EMS personnel must have undertaken face-to-face education, simulation and online training in the performance of DSED and VC. When undertaking DSED, a single operator activates the defibrillators in sequence, with one hand moving from the first defibrillator to the second. The CPGs stipulate that if VF/VT

Table 1: Number of patients from 1 July 2020 to 30 June 2023 that would have met the criteria for DSED or VC and the current rate of survival.

Total n=1,390	**N/N (%)**
Return of spontaneous circulation (ROSC) on hospital handover	
YES	359/1,390 (26%)
Survival to 30 days	
Survived	198/1,390 (14%)

persists beyond three shocks then VC/DSED is to be administered. If one manual defibrillator is present, then VC is administered; if two are present, then DSED is administered. Outside of Canada, Aotearoa New Zealand is the first country to implement these resuscitation treatments as routine protocol in cardiac arrest. As the technique is new to Aotearoa New Zealand and at the forefront of current defibrillation strategies, patient outcomes and implementation are being carefully monitored through transmission of defibrillator recordings for clinical review.

Though the balance of evidence suggests this new strategy may have survival benefits for some patients, one of the key factors that will be monitored during clinical review of DSED/VC cases is any potential impact on no-flow/pauses in cardio-pulmonary resuscitation (CPR) that may occur when co-ordinating the switching of defibrillation pads into the anterior-posterior position for DSED or VC. It is well established that pauses in compressions during CPR have a significant impact on patient survival, and this was one of the key considerations when Aotearoa New Zealand EMS implemented high performance CPR in 2019.[7–9] In addition, key changes over the years in resuscitation guidelines relating to defibrillation strategies have evolved in response to reducing the hands-off chest/no-flow time. In particular, this includes the shift post-2010 from three stacked shocks to the delivery of a single shock, with CPR initiated as soon as possible post-shock.[10,11]

Data from the Aotearoa New Zealand Paramedic care Collection (ANZPaCC), the Aotearoa New Zealand database derived from EMS electronic patient report forms (ePRFs), indicates that Aotearoa New Zealand EMS attended 1,390 patients over a 3-year period (1 July 2020 to 30 June 2023) who would have met the criteria for VC/DSED—approximately nine patients a week (Table 1).

As emphasised in the ILCOR guidelines, evidence for these new external defibrillation strategies is still emerging, and implementation in Aotearoa New Zealand is a key opportunity to understand how they could translate from a controlled research setting to the real world. Our existing survival statistics align closely with the findings of the Cheskes et al. study, revealing a 14% survival rate through standard defibrillation.[3] We are keenly observing whether the adoption of this new strategy can emulate the enhanced survival rates observed in their trial. However, implementing and monitoring this new protocol presents a challenge, as it effectively transforms into a before-and-after observational study that inherently carries limitations, such as observational bias and confounding factors. Considering the findings of the Cheskes et al. study and the recommendations from ILCOR, we concluded that there was a lack of equipoise, making it unethical to randomise patients to "standard care" in this scenario. Furthermore, due to the relatively small number of survivors annually (less than 100) at a national level, a step-wise cluster introduction would not have had sufficient power to detect outcome differences unless carried out over an extended period (several years).

While we are closely reviewing efficacy of this new treatment strategy, we maintain a low threshold to default to previous practice if harm becomes evident.

In conclusion, Aotearoa New Zealand is the first country outside Canada to routinely implement DSED, and this could affect the care of up to nine patients a week.

COMPETING INTERESTS
All of the authors are employees of Hato Hone St John or Wellington Free Ambulance.

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REFERENCES
1. Nolan JP, Maconochie I, Soar J, et al. Executive summary: 2020 international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. Circulation. 2020;142(16_suppl_1):S2-S27. doi: 10.1161/CIR.0000000000000890.
2. Berg KM, Bray JE, Ng KC, et al. 2023 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. Circulation. 2023;148(24):e187-e280. doi: 10.1161/CIR.0000000000001179.
3. Cheskes S, Verbeek PR, Drennan IR, et al. Defibrillation strategies for refractory ventricular fibrillation. N Engl J Med. 2022;387(21):1947-56. doi: 10.1056/NEJMoa2207304.
4. Sasson C, Haukoos J. Defibrillation after Cardiac Arrest—Is It Time to Change Practice? N Engl J Med. 2022;387(21):1995-6. doi: 10.1056/NEJMe2213562.
5. Drennan IR, Dorian P, McLeod S, et al. DOuble SEquential External Defibrillation for Refractory Ventricular Fibrillation (DOSE VF): study protocol for a randomized controlled trial. Trials. 2020;21(1):977. doi: 10.1186/s13063-020-04904-z.
6. National Ambulance Sector Clinical Working Group. Emergency Ambulance Service Clinical Procedures and Guidelines, Version: 1.0.4.1 [Internet]. NZ: National Ambulance Sector Working Group; 2023 [cited 2023 Nov]. Available from: https://cpg.stjohn.org.nz/tabs/guidelines?_ga=2.229533532.1908072009.1674680333-1630428122.1628726924
7. Deakin CD, Koster RW. Chest compression pauses during defibrillation attempts. Curr Opin Crit Care. 2016;22(3):206-11. doi: 10.1097/MCC.0000000000000310.
8. Bobrow BJ, Clark LL, Ewy GA, et al. Minimally interrupted cardiac resuscitation by emergency medical services for out-of-hospital cardiac arrest. Jama. 2008;299(10):1158-65. doi: 10.1001/jama.299.10.1158.
9. New Zealand Guidelines Group. The Aotearoa New Zealand Model of High Performance CPR [video on the Internet]. Hato Hone St John, Wellington Free Ambulance, Auckland University of Technology (AUT), Fire & Emergency New Zealand. Auckland (NZ): AUT Paramedicine; 2019 [cited 2023 Nov]. Available from: https://youtu.be/7L45-AsO4bA.
10. Rea TD, Helbock M, Perry S, et al. Increasing use of cardiopulmonary resuscitation during out-of-hospital ventricular fibrillation arrest: survival implications of guideline changes. Circulation. 2006;114(25):2760-5. doi: 10.1161/CIRCULATIONAHA.106.654715.
11. Nolan JP, Hazinski MF, Billi JE, et al. Part 1: executive summary: 2010 international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. Resuscitation. 2010;81 Suppl 1(1):e1-e25. doi: 10.1016/j.resuscitation.2010.08.002.