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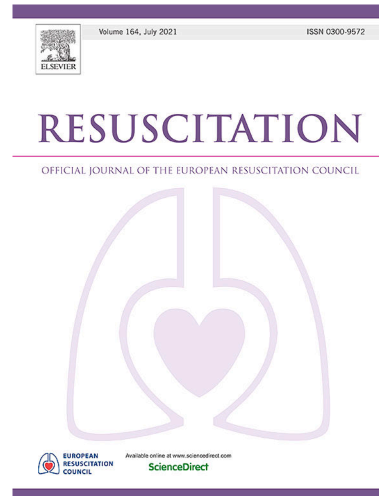

Original paper

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Implementation of Double Sequential Defibrillation (DSD): An Aotearoa New Zealand observational study

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Introduction

Refractory ventricular fibrillation (VF) and refractory pulseless ventricular tachycardia (VT) remain among the most challenging presentations in out-of-hospital cardiac arrest (OHCA), with survival rates significantly lower than those for patients who respond to initial defibrillation attempts. Approximately 10–25% of OHCA cases are refractory to three or more standard defibrillation attempts[1], prompting interest in alternative defibrillation strategies such as vector change (VC) and double sequential defibrillation (DSD). DSD involves delivering rapid sequential shocks using two defibrillators with pads placed in both anterior-lateral and anterior-posterior positions, aiming to engage multiple myocardial vectors and overcome high defibrillation thresholds[2].

The most robust evidence to date comes from the DOSE-VF trial, a cluster-randomised crossover study conducted across six Canadian paramedic services[2]. This trial demonstrated significantly improved survival to hospital discharge with DSD (30.4%) and VC (21.7%) compared to standard defibrillation (13.3%), with DSD also associated with better neurologic outcomes[2]. Despite its promising findings, the trial was terminated early and had limitations including sample size and crossover effects, leading to cautious interpretation of its results.

Building on this evidence, additional trials are underway, including the DOUBLE-D study in Sweden[3], the STRAT-DEFI in Denmark[4] and the DUALDEFIB trial in Norway[5]. These studies reflect a growing international interest in refining defibrillation strategies for shock-refractory cardiac arrest.

The 2023 update to the International Liaison Committee on Resuscitation (ILCOR) guidelines recommended "*We suggest that a DSED strategy (weak recommendation, low-certainty evidence) or a VC defibrillation strategy (weak recommendation, very low–certainty evidence) may be considered for adults with cardiac arrest who remain in VF or pulseless ventricular tachycardia after ≥3 consecutive shocks.*"[6]. In October 2023, Aotearoa New Zealand became the first country outside Canada to implement prehospital DSD and VC defibrillation as routine practice for refractory VF/VT[7]. Emergency medical services (EMS) personnel underwent comprehensive training prior to implementation, and the strategy is now applied when VF/VT persists beyond three shocks[8]. Given the novelty of this approach and its potential impact on approximately nine patients per week nationally[8], this study aimed to evaluate the real-world application, uptake, and outcomes of DSD post-implementation in Aotearoa New Zealand.

Methods

Study design

This national retrospective cohort study examined the implementation of Double-Sequential-Defibrillation (DSD) in Aotearoa New Zealand, a country with a population of 5.1 million and a land area of 264,920 km²[9, 10]. The study comprised two periods: 1 April 2022–30 September 2023 (eighteen-month pre-period) and 1 January 2024–30 June 2025 (eighteen-month post-period). DSD training commenced in October 2023, with full implementation by 1 January 2024[8]. DSD administration followed the National Emergency Ambulance Service Clinical Procedures and Guidelines[7].

Aotearoa New Zealand, Paramedic Care Collection (ANZPaCC)

All variables were extracted from ANZPaCC, which contains routinely collected clinical data for patients attended by EMS nationwide, excluding air transport cases. ANZPaCC also integrates linked data elements such as mortality and ethnicity from Health New Zealand Te Whatu Ora[11]. Further detail on variable definitions is available in the Ambulance Care Standard and Te Whatu Ora data dictionaries. [12-14].

Inclusion and exclusion criteria

Eligible cases included adults aged ≥16 years who experienced an out-of-hospital cardiac arrest (OHCA) of presumed cardiac aetiology and received more than three defibrillation attempts during prehospital resuscitation. In the post-period, patients were categorised into:

1. **NDSD** – DSD not administered, and
2. **DSD** – DSD administered.

DSD cases were further stratified by the number of EMS defibrillations before DSD initiation:

- **Early-DSD:** ≤3 EMS shocks prior to DSD initiation
- **Late-DSD:** >3 EMS shocks prior to DSD initiation.

Case Identification

Cases were identified using keywords ("dsd", "dsed", "sequential") within free-text clinical documentation. An independent reviewer verified each case to confirm DSD use and correct defibrillation counts.

Demographic, Event and System variables

Demographic variables included sex, age, ethnicity (classified using the Health New Zealand Te Whatu Ora prioritisation framework), and socioeconomic deprivation using NZDep2018 and NZDep2023 based on residential meshblock[14-16]. Event variables included incident location and rurality, classified with the Geographic Classification for Health (GCH2018)[17].

System variables included response time (minutes from call pickup to EMS arrival on scene), time on scene, transport time, arrest witnessed status (yes/no), bystander CPR, number of defibrillations delivered prior to EMS arrival (pre-EMS), and number of defibrillations delivered by EMS personnel. Pre-EMS shocks included bystander AED use and shocks delivered by Fire and Emergency New Zealand, who respond alongside ambulances to OHCA.

Time between first and last shock was calculated for EMS-defibrillations. For DSD cases, manual record review verified defibrillation counts. Outcomes included Return of Spontaneous Circulation (ROSC) on hospital handover and 30-day survival.

Statistical analysis

Variables were described as totals and percentages of total numbers. A Pearson Chi-Squared test was used to compare nominal values. Continuous variables (age, time to scene and transport time) were compared using the Mann–Whitney U Test. Adjusted odds ratios (aORs) and 95% confidence intervals (95% CIs) were calculated from multivariable logistic regression models for outcome variables. For descriptive analyses, missing data were managed using pairwise case-available analysis. This approach allows the exclusion of specific variables with missing values while retaining available data for other variables with complete information. The regression analyses used common prognostic factors in a forced entry model with listwise exclusion, where cases with any missing data across the variables included in the model were excluded entirely. The models were adjusted for sex, age, ethnicity (Māori vs non-Māori), rurality, witnessed status, and defibrillation prior to EMS arrival. A supplementary analysis excluding cases with pre-EMS defibrillation was adjusted for the same variables except defibrillation prior to EMS arrival. Analyses firstly compared pre-period and post-period, then compared NDSD patients with DSD and early-DSD with late-DSD. Data analysis was performed using IBM SPSS Statistics for Windows, version 31 (IBM Corp., Armonk, N.Y., USA). A p-value <0.05 was considered statistically significant.

Results

Between 1 April 2022 and 30 September 2023 (pre-period), 663 patients met inclusion criteria (Figure 1). During the post-period (1 January 2024 to 30 June 2025), 738 patients met the same criteria. Of these, 421 did not receive DSD, while 317 did. Of those that received DSD, 100 received early-DSD and 217 received late-DSD (Figure 1).

Pre-period vs post-period analysis

Patient demographics and event characteristics

There were no significant differences in demographic characteristics between the pre- and post-periods. Median age was similar, with a higher proportion of males, non-Māori ethnicity, arrests occurring at home, in urban settings, and among patients from the most socioeconomically deprived areas (all $p>0.05$; Table 1).

System response

Most system response measures (time on scene, transport time, witnessed status, bystander CPR, and time between first and last EMS shock) did not differ significantly between periods (p>0.05). EMS time to scene was slightly longer in the pre-period (9 vs 8 minutes; p=0.005), and pre-EMS defibrillation was more common pre-period (25.0% vs 18.3%; p=0.002). Total shocks per case were lower in the pre-period (median 7 vs 8; p=0.004) (Table 1).

Outcomes and logistic regression

There were no significant differences in ROSC (25.0% vs 28.0%; p=0.203) or 30-day survival (13.4% vs 15.5%; p=0.263). Adjusted analyses showed no association between period and ROSC or survival (p>0.15) (Table 1, Figure 2).

Post-period subgroup analysis NDSD vs DSD

Patient demographics

There was a lower proportion of male patients in the NDSD subgroup (78.4%) compared to the DSD subgroup (90.2%), p<0.001 (Table 2). The median age was older in the NDSD subgroup than in the DSD subgroup (66 vs. 64 years), p=0.049. (Table 2). Patient demographic characteristics of ethnicity and socioeconomic deprivation were not significantly different between NDSD and DSD, p>0.05 (Table 2).

System response characteristics

Compared with the NDSD subgroup, DSD cases occurred more often in urban settings (72.3% vs 81.6%, p=0.004). Median EMS response time (8 minutes) and transport time (19 vs 18 minutes, p=0.363) were similar between groups. Time on scene was longer for DSD cases (104 vs 89 minutes, p=0.001). EMS-witnessed arrests were less common in the DSD subgroup (4.4% vs 12.4%, p=0.001), while pre-EMS defibrillation was more frequent (23.7% vs 14.3%, p=0.001). DSD patients received more total shocks (median 13 vs 6, p<0.001) and had a longer time between first and last EMS shock (23 vs 16 minutes, p<0.001).

Median shock-count per DSD segment

Early-DSD patients received fewer pre-DSD shocks than late-DSD patients (median(IQR), 3(2-3) vs 6(4-7), p<0.001) and fewer total shocks (median(IQR) 9(7-14) vs 14(10-19), p<0.001).

Outcomes: NDSD vs DSD

ROSC was higher in the NDSD subgroup (33.0% vs 21.5%, p=0.001). Thirty-day survival was also greater in NDSD patients (18.7% vs 11.4%, p=0.007)(Table 2).

Logistic regression analysis

Compared with NDSD, DSD was associated with lower odds of ROSC (aOR 0.59 [0.41–0.85], p=0.01) and 30-day survival (aOR 0.56 [0.35–0.88], p=0.01)(Figure 3).

Early-DSD showed no significant association with ROSC (aOR 1.05 [0.62–1.77], p=0.87) or survival (aOR 1.05 [0.56–1.99], p=0.88)(Figure 3).

Late-DSD was associated with lower odds of ROSC (aOR 0.46 [0.30–0.71], p<0.001) and survival (aOR 0.41 [0.23–0.72], p=0.002)(Figure 3).

Supplementary analysis of cases excluding those with pre-EMS defibrillation

Exclusion of cases receiving defibrillation prior to EMS arrival did not materially alter the findings, which were consistent with results from analyses including EMS-defibrillated cases. Supplementary Table S1.

Discussion

This retrospective study evaluated clinical outcomes and DSD use in patients receiving >3 EMS defibrillations before and after DSD was introduced to EMS practice guidelines for OHCA in Aotearoa New Zealand. Few differences in patient or EMS response characteristics were observed between the pre- and post-periods, aside from slower median response time, more pre-EMS defibrillation, and fewer total shocks in the pre-period. DSD was associated with male sex, younger age, urban location, and bystander intervention. DSD patients had longer on-scene and resuscitation times. Adjusted analyses showed DSD (vs. NDSD) was associated with lower odds of ROSC on handover and 30-day survival, particularly for those receiving late DSD.

DSD is a new intervention strategy for refractory VF/VT, with the first randomised trial employing its use published in 2022 and indicating a large relative risk 2.21 (1.33–3.67) adjusted relative risk for survival to hospital discharge compared to standard defibrillation[2]. In the DOSE-VF trial, survival in the control group was nearly identical to the 13.4% observed in our pre-period baseline. In contrast, survival in the DOSE-VF intervention group was 30.4%, higher than the 15.5% observed in our post-period group[2]. Whilst our findings contrast with this randomised trial, a recent systematic review and meta-analysis indicated that the pooled data from five smaller observational cohort studies also demonstrated no survival benefit of DSD over standard defibrillation (RR, 0.91; 95% CI, 0.46–1.78)[18]. It could be noted that, although 30-day survival may be influenced by variation in post-resuscitation hospital care, similar rates of pre-hospital ROSC suggest that such differences are unlikely to have attenuated any DSD effect.

In our study, we included patients who had received greater than 3 defibrillations by EMS and were potentially eligible to receive DSD. However, DSD was only implemented in less than half of the included cases (43%). Current evidence and Aotearoa New Zealand guidelines indicate that DSD is most effective for patients in refractory, rather than recurrent, VF or VT[7, 19]. Most patients receiving three standard shocks have recurrent VF (83% of per-protocol patients in DOSE-VF[19], 95% in the ARREST observational study[20]). The distinction between these patients is ill-defined in international guidelines and can be difficult to determine when analysing intra-arrest rhythms, yet may have a significant impact on patient outcomes and therefore the potential success of DSD[21, 22]. A secondary analysis of the DOSE-VF trial indicated that DSD was superior for survival for patients with shock-refractory VF but not for patients with recurrent VF[19, 20]. Apparent 'missed' or delayed DSD in our subgroup could reflect clinical decision-making based on patient factors not captured within our datasets, including a possible preference for DSD when there was greater confidence that the patient was in a refractory state. We were unable to differentiate between patients with refractory vs recurrent VF in our study.

Notable differences were observed between the NDSD and DSD subgroups across demographic characteristics, event factors, system response variables, and outcomes. These variations suggest the possibility of underlying differences in prognosis. Despite this, after adjustment for the patient and incident characteristics available in the dataset, outcomes continued to favour the NDSD subgroup, with higher rates of return of spontaneous circulation and 30-day survival. Importantly, several potentially influential factors such as comorbidities, estimated patient weight, presence of community responders, and timing of the first pre-EMS shock are not captured in the ANZPaCC database. The absence of these variables may mask plausible unmeasured confounders.

Although regression analysis adjusted for several key confounders, some factors such as variation in shock phases (e.g., the number of shocks delivered pre-DSD, during DSD, and post-DSD) could not be incorporated into the model. The association of late-DSD with poorer survival may suggest harm from delayed DSD or highlight the benefit of earlier defibrillation, as survival declines sharply with each shock[21]. Compared to the Cheskes study (3.9 mean standard shocks), over half of our DSD patients were in the late-DSD subgroup, receiving more than four EMS-administered shocks before DSD began[19]. It is also unknown whether there is a potential impact on the length of pauses in compression in patients with

NDSD vs DSD, noting that in simulation, it has been previously shown that there were no differences found between time to place pads for DSD vs NDSD[23].

Implications for practice

The greatest gains in survival from OHCA are likely to come from upstream, community-based actions rather than downstream refinements such as DSD. Most patients benefit far more from early recognition, bystander CPR, rapid lay rescuer defibrillation, and high-quality EMS CPR than from advanced interventions applied after prolonged downtime, and efforts to shorten time to first shock through wider AED dissemination and emerging personal defibrillator technologies are particularly promising. Focusing on the dissemination, implementation, and evaluation of these proven early interventions offers a strong and hopeful pathway to improving survival, while continued and enthusiastic research into DSD remains important as an innovative and promising technology for patients with refractory shockable rhythms who may benefit from advanced defibrillation strategies.

Limitations

This observational study is subject to bias and confounding. Differences in shock-phase distribution could not be adjusted for due to collinearity with the intervention. Only 43% of eligible patients received DSD, indicating additional unmeasured factors influenced its application. This large proportion of non-receipt of the intervention is likely to have reduced the effective contrast between exposure groups and therefore statistical power, particularly for outcomes of ROSC and survival. Patients receiving early DSD may also have benefited from greater early resourcing, potentially affecting outcomes independent of the intervention. Adjustment for refractory versus recurrent VF was not possible because defibrillator data were not routinely transmitted into the patient record. DSD exposure was determined by free-text review rather than provider report, and although independently verified, any resulting misclassification may have reduced observed differences between treatment groups. The quality of EMS CPR is known to influence outcomes after OHCA, however the limited information available on CPR quality in this observational study means that variation in CPR performance could have attenuated the observed effect of DSD. We did not have access to precise time-to-intervention data; surrogate measures such as number of shocks were not used to assess timing due to substantial confounding and resuscitation time bias.

Conclusions

This study did not demonstrate a survival benefit following DSD implementation. DSD was applied in only 43% of potentially eligible cases, and significant differences in patient demographics, event characteristics, and system response between DSD and NDSD groups may have influenced outcomes, underscoring the complexity of assessing DSD in real-world settings. Delayed application of DSD may further diminish any potential benefit. Future research should focus on the timing of DSD and the factors influencing its application to better understand their impact on patient outcomes.

Ethics Approval

This study has been approved by the Northern B Health and Disability Ethics Committee. Reference: Aotearoa New Zealand, Paramedic Care Collection (ANZPaCC), 2022 FULL 13415.

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Conflict of interest statement

None.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process.

During the preparation of this work, the author used AI-assisted tools (Microsoft Copilot) to support phrasing and wording refinement. After using these tools, the author reviewed and edited the content as needed and takes full responsibility for the final content of the published article.

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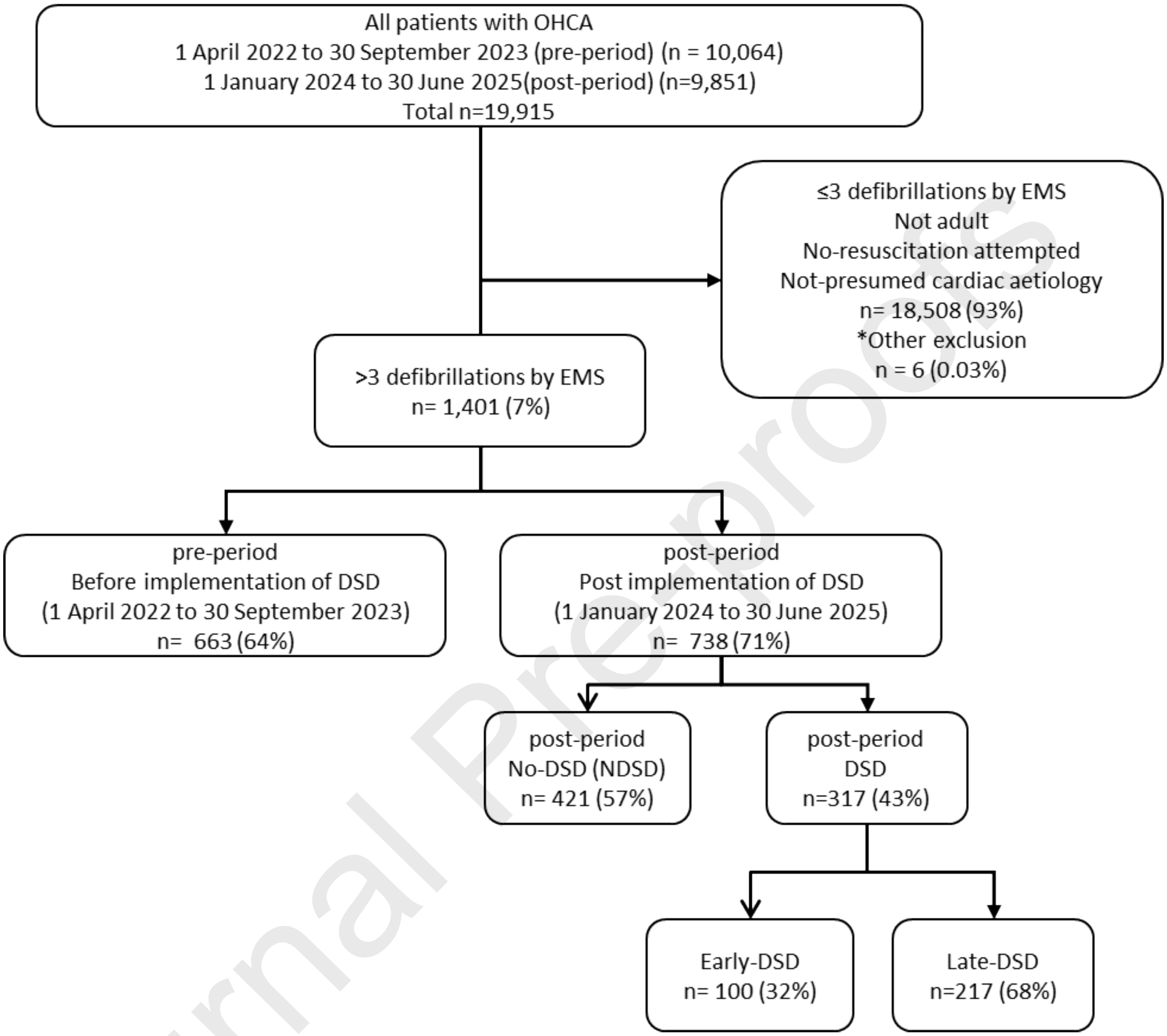
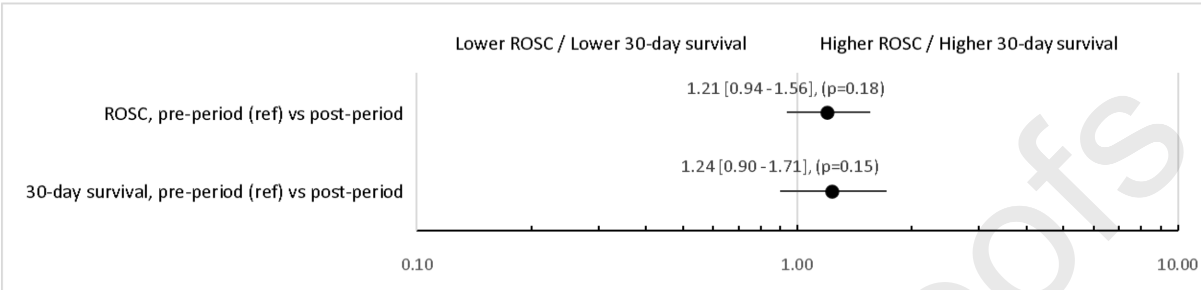
Figure 1. Included cases



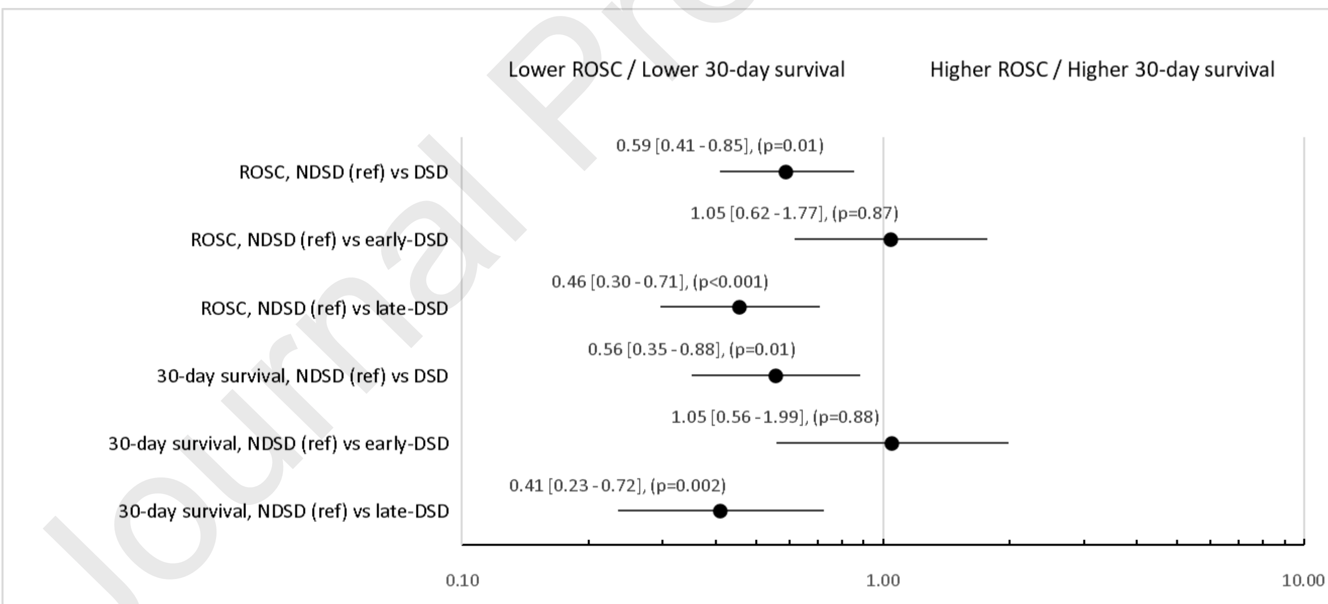
OHCA, out-of-hospital cardiac arrest; DSD, Double sequential defibrillation; EMS, emergency medical services, *Excluded: DSD delivered in pre-period (n=5), unknown DSD status in post period (n=1).

Figure 2: Multivariable logistic regression of pre-period and post-period showing the association between return of spontaneous circulation (ROSC) on handover; and 30-day survival.



ROSC, return of spontaneous circulation;
Forest plot – adjusted for Sex, Age, Ethnicity (Māori/non-Māori), Rurality, Witnessed status and Defibrillation prior to EMS arrival. Illustrates the association between Survival or ROSC and being in the pre-period or post-period. OR and [CI] represent adjusted odds ratios and confidence intervals, respectively. p-Interaction indicates the p-value for the interaction term.

Figure 3: Multivariable logistic regression of post-period sub-groups (NDSD, DSD, early-DSD and late-DSD) showing the association between return of spontaneous circulation (ROSC) on handover; and 30-day survival.



DSD, Double sequential defibrillation; NDSD, no-DSD; ROSC, return of spontaneous circulation; early-DSD (≤3PreDSD defibrillations), late-DSD (>3PreDSD defibrillations).
Forest plot – adjusted for Sex, Age, Ethnicity (Māori/non-Māori), Rurality, Witnessed status and Defibrillation prior to emergency medical services (EMS) arrival. OR and [CI] represent adjusted odds ratios and confidence intervals, respectively. p-Interaction indicates the p-value for the interaction term.

Table 1: Pre vs Post Frequency and demographics of included cases.

		Total Cases	Pre-period	Post-period	P-value
		n (%)	n (%)	n (%)	
Total Cases		1401	663 (47%)	738 (53%)	
Patient demographics and event characteristics					
Sex	Female	236 (16.9%)	114 (17.2%)	122 (16.5%)	0.731
	Male	1164 (83.1%)	548 (82.8%)	616 (83.5%)	
Age in years	Median (IQR)	65 (55-74)	65 (55-75)	66 (56-74)	0.901
Ethnicity	Māori	318 (23.1%)	156 (24.0%)	162 (22.3%)	0.433
	non-Māori	1059 (76.9%)	493 (76.0%)	566 (77.7%)	
NZDep18 Quintile (pre-)	Quintile 1	226 (16.7%)	112 (17.6%)	114 (16.0%)	0.721
NZDep23 Quintile (post-)	Quintile 2	215 (15.9%)	107 (16.8%)	108 (15.1%)	
	Quintile 3	228 (16.9%)	103 (16.1%)	125 (17.5%)	
	Quintile 4	263 (19.5%)	126 (19.7%)	137 (19.2%)	
	Quintile 5	419 (31.0%)	190 (29.8%)	229 (32.1%)	
Location	Healthcare Facility[a]	14 (1.0%)	5 (0.8%)	9 (1.2%)	0.503
	Home	981 (70.0%)	472 (71.2%)	509 (69.0%)	
	Public and Other	406 (29.0%)	186 (28.1%)	220 (29.8%)	
Rurality	Rural	315 (23.3%)	147 (22.9%)	168 (23.7%)	0.707
	Urban	1036 (76.7%)	496 (77.1%)	540 (76.3%)	
System response					
EMS Time to scene (min)	median, (IQR)	9 (7-12)	9 (7-12)	8 (6-11)	0.005
EMS Time on scene (min)	median, (IQR)	97 (63-135)	96 (63-133)	97 (62-136)	0.714
Transport time (min)	median, (IQR)	17 (9-30)	15 (7-28)	19 (9-30)	0.063
Witnessed status	Bystander	900 (64.2%)	436 (65.8%)	464 (62.9%)	0.484
	EMS	117 (8.4%)	51 (7.7%)	66 (8.9%)	
	NO	384 (27.4%)	176 (26.5%)	208 (28.2%)	
CPR prior to EMS arrival	NO	225 (17.7%)	99 (16.3%)	126 (19.0%)	0.209
(Excludes EMS witnessed)	YES	1045 (82.3%)	508 (83.7%)	537 (81.0%)	
Defibrillation prior to EMS arrival	NO	1100 (78.5%)	497 (75.0%)	603 (81.7%)	0.002
	YES	301 (21.5%)	166 (25.0%)	135 (18.3%)	
Total number of defibrillations per case	median, (IQR)	8 (5-11)	7 (5-10)	8 (5-13)	0.004
Time between first and last EMS defibrillation	Median, (IQR)	19 (12-29)	19 (12-28)	19 (12-29)	0.706
Outcome					
ROSC on handover	NO	1028 (73.4%)	497 (75.0%)	531 (72.0%)	0.203
	YES	373 (26.6%)	166 (25.0%)	207 (28.0%)	

30-Day Survival	NO	1190 (85.5%)	569 (86.6%)	621 (84.5%)	0.263
	YES	202 (14.5%)	88 (13.4%)	114 (15.5%)	

CPR, cardiopulmonary resuscitation; ROSC, return of spontaneous circulation; EMS, emergency medical services
$p < 0.05$ is significant; χ2 test for nominal values; Mann–Whitney U-test for continuous values.
[a] Healthcare facility refers to non-hospital treatment localities such as a general practice clinic.

Table 2: Post-period Frequency and demographics of included cases.

		Post-period (total)	No-DSD (NDSD)	DSD	Chi-square P-value
		n (%)	n (%)	n (%)	
Total Cases		738	421 (57%)	317 (43%)	
Patient demographics and event characteristics					
Sex	Female	122 (16.5%)	91 (21.6%)	31 (9.8%)	<0.001
	Male	616 (83.5%)	330 (78.4%)	286 (90.2%)	
Age in years	Median (IQR)	66 (56-74)	66 (58-75)	64 (54-74)	0.049
Ethnicity	Māori	162 (22.3%)	91 (21.8%)	71 (22.8%)	0.747
	non-Māori	566 (77.7%)	326 (78.2%)	240 (77.2%)	
NZDEP Quintile	Quintile 1	114 (16.0%)	64 (15.6%)	50 (16.6%)	0.738
	Quintile 2	108 (15.1%)	66 (16.1%)	42 (13.9%)	
	Quintile 3	125 (17.5%)	69 (16.8%)	56 (18.5%)	
	Quintile 4	137 (19.2%)	84 (20.4%)	53 (17.5%)	
	Quintile 5	229 (32.1%)	128 (31.1%)	101 (33.4%)	
Location	Healthcare Facility	9 (1.2%)	5 (1.2%)	4 (1.3%)	0.228
	Home	509 (69.0%)	301 (71.5%)	208 (65.6%)	
	Public and Other	220 (29.8%)	115 (27.3%)	105 (33.1%)	
Rurality	Rural	168 (23.7%)	112 (27.7%)	56 (18.4%)	0.004
	Urban	540 (76.3%)	292 (72.3%)	248 (81.6%)	
System response					
Response time (min)	median, (IQR)	8 (6-11)	8 (7-11)	8 (6-11)	0.300
EMS Time on scene (min)	median, (IQR)	97 (62-136)	89 (59-131)	104 (70-145)	0.001
Transport time (min)	median, (IQR)	19 (9-30)	19 (11-31)	18 (9-27)	0.363
Witnessed status	Bystander	464 (62.9%)	250 (59.4%)	214 (67.5%)	0.001
	EMS	66 (8.9%)	52 (12.4%)	14 (4.4%)	
	NO	208 (28.2%)	119 (28.3%)	89 (28.1%)	
CPR prior to EMS arrival	NO	126 (19.0%)	69 (19.0%)	57 (19.1%)	0.972
(Excludes EMS Witnessed)	YES	537 (81.0%)	295 (81.0%)	242 (80.9%)	
Defibrillation prior to EMS arrival	NO	603 (81.7%)	361 (85.7%)	242 (76.3%)	0.001
	YES	135 (18.3%)	60 (14.3%)	75 (23.7%)	
Total number of defibrillations	median, (IQR)	8 (5-13)	6 (5-8)	13 (9-18)	<0.001
Time between first and last EMS defibrillation	Median, (IQR)	19 (12-29)	16 (10-26)	23 (15-32)	<0.001
Outcome					
ROSC on handover	NO	531 (72.0%)	282 (67.0%)	249 (78.5%)	0.001
	YES	207 (28.0%)	139 (33.0%)	68 (21.5%)	

30-Day Survival	NO	621 (84.5%)	340 (81.3%)	281 (88.6%)	0.007
	YES	114 (15.5%)	78 (18.7%)	36 (11.4%)	

DSD, Double sequential defibrillation; CPR, cardiopulmonary resuscitation; ROSC, return of spontaneous circulation; EMS, emergency medical services

*$p < 0.05$ is significant; $\chi 2$ test for nominal values; Mann–Whitney U-test for continuous values.

[a] Healthcare facility refers to non-hospital treatment localities such as a general practice clinic.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.