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DATABASE ANALYSIS

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Outcomes of Targeted Temperature Management for In-Hospital and Out-Of-Hospital Cardiac Arrest: A Matched Case-Control Study Using the National Database of Taiwan Network of Targeted Temperature Management for Cardiac Arrest (TIMECARD) Registry

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

BCDEF 1,2 **Yu-san Chien**
B 3 **Min-Shan Tsai**
A 3 **Chien-Hua Huang**
AB 4 **Chih-Hung Lai**
A 5 **Wei-Chun Huang**
AB 6 **Lung Chan**
ADF 1,2 **Li-Kuo Kuo**

1 Department of Critical Care, Mackay Memorial Hospital, Taipei, Taiwan
2 Department of Medicine, Mackay Medical College, New Taipei, Taiwan
3 Department of Emergency Medicine, National Taiwan University Medical College and Hospital, Taipei, Taiwan
4 Cardiovascular Center, Taichung Veterans General Hospital, Taichung, Taiwan
5 Department of Critical Care Medicine, Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan
6 Department of Neurology, Taipei Medical University, Shuang-Ho Hospital, New Taipei, Taiwan

Corresponding Author: Li-Kuo Kuo, e-mail: lmn4093@gmail.com

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Background: This study aimed to compare outcomes of targeted temperature management (TTM) for patients with in-hospital and out-of-hospital cardiac arrest using the national database of TaIwan network of targeted temperature ManagEment for CARDiac arrest (TIMECARD) registry.

Material/Methods: A retrospective, matched, case-control study was conducted. Patients with in-hospital cardiac arrest (IHCA) treated with TTM after the return of spontaneous circulation (ROSC) were selected as the case group and controls were defined as the same number of patients with out-of-hospital cardiac arrest (OHCA), matched for sex, age, Charlson comorbidity index, and cerebral performance category. Neurological outcome and survival at hospital discharge were the primary outcome measures.

Results: Data of 103 patients with IHCA and matched controls with OHCA were analyzed. Patients with IHCA were more likely to experience witnessed arrest and bystander cardiopulmonary resuscitation (CPR). The duration from collapse to the beginning of CPR, CPR time, and the duration from ROSC to initiation of TTM were shorter in the IHCA group but their initial arterial blood pressure after ROSC was lower. Overall, 88% of patients survived to completion of TTM and 43% survived to hospital discharge. Hospital survival (42.7% vs 42.7%, P=1.00) and favorable neurological outcome at discharge (19.4% vs 12.7%, P=0.25) did not differ between the 2 groups.

Conclusions: The findings from the national TIMECARD registry showed that clinical outcomes following TTM for patients with IHCA were not significantly different from OHCA when baseline factors were matched.

Keywords: **Hypothermia, Induced • Out-of-Hospital Cardiac Arrest • Post-Cardiac Arrest Syndrome**

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Background

In-hospital cardiac arrest (IHCA) is a highly morbid event with an incidence of 1.51 to 3.25 events per 1000 admissions reported in the literature [1,2]. Less than 20% of patients who were successfully resuscitated after IHCA survived to discharge [1-3] and half of the survivors died within 1 year [4]. Unlike patients who experienced out-of-hospital cardiac arrest (OHCA), IHCA patients tend to present with more pre-existing comorbidities and higher disease severity at the time of cardiac arrest [5,6]. Around 80% of them had a non-shockable initial rhythm [7,8]. They are also more likely to experience witnessed collapse, bystander cardiopulmonary resuscitation (CPR), and have medical professionals as first responders who have access to tools and medications not readily available to OHCA responders [5,9]. Compared with OHCA, the rate of regain spontaneous circulation (ROSC) among IHCA patients was higher, ranging between 42% and 66% [1-3], and their duration of resuscitation was shorter [10]. Given the aforementioned differences, whether treatments proved to improve outcomes of OHCA would be equally effective in IHCA patients requires more investigation.

Targeted temperature management (TTM) is a complex therapeutic intervention designed to induce and maintain body temperature at mild hypothermia for a certain period of time [11]. TTM exerts its neuroprotective effects through multiple mechanisms, including reduction of brain metabolism, attenuation of reactive oxygen species formation, attenuation of immune response during reperfusion, and blockage of apoptosis. It has been used in critically ill patients, such as post-cardiac arrest survivors, patients with traumatic brain injury, and hypoxic encephalopathy in newborns [11,12], but it has also been linked to complications such as secondary infections, ventilator-associated pneumonia, sepsis, coagulopathy, and electrolytes imbalance, especially in those with pre-existing conditions [13,14]. TTM gradually has become standard of care for post-cardiac arrest patients after 2 landmark studies were published in 2002. Researchers found that when survivors of OHCA whose initial rhythm was shockable (ventricular fibrillation or pulseless ventricular tachycardia) were treated with a targeted temperature of 32-34°C, the active temperature control reduced mortality and increased the rate of favorable neurological outcomes [15,16]. Similar benefits were also demonstrated in subsequent studies focusing on OHCA patients who had non-shockable initial rhythm [7,17,18]. In terms of what temperature should be targeted at, Nielsen et al found that for OHCA survivors who remained unconscious, the clinical outcomes of hypothermia at 33°C was not superior to a target at 36°C [19], while a recent trial published in 2019 including 581 comatose cardiac arrest survivors with non-shockable initial rhythm (27.4% of the patients had IHCA) showed that a moderate hypothermia at 33°C led to a better neurologic outcome at 90 days compared with a normothermia group [20].

Based on currently available evidence, the International Liaison Committee on Resuscitation and the American Heart Association [21,22] suggested considering use of TTM, targeting a constant temperature between 32°C and 36°C, in patients who remain comatose after resuscitation from either OHCA or IHCA with any initial rhythm.

The recommendation remains weak for IHCA survivors due to lack of good-quality evidence. So far, no randomized controlled trial has been published that investigated the effects of TTM on IHCA survivors. A few retrospective observational analyses showed only 2-13% of IHCA patients received TTM after regaining spontaneous circulation (ROSC) [23-25], and of those, only about 40% of them had achieved the targeted temperature [6,23]. Of the 5 studies comparing clinical outcomes of IHCA patients treated with TTM versus usual care, 2 were inconclusive (no benefits identified) [26,27], 1 showed that TTM was associated with a favorable neurologic outcome [25], and the other 2 showed that TTM was associated with a lower likelihood of hospital discharge and a worsened neurologic survival [24,28]. Among them, the largest retrospective study focusing on IHCA patients was published in 2013 [28], using data from the Get With The Guideline-Resuscitation Registry. The results indicated potentially harmful effects of therapeutic hypothermia in INCA survivors. However, only 6% of the 26 183 IHCA patients were treated with TTM, which raised the concern of selection bias, and over 75% of the data regarding body temperature in both groups were missing. The results of this study were not considered powerful enough to change the recommendation in guidelines [29]. On the other hand, when comparing IHCA and OHCA patients treated with TTM, 2 retrospective studies published in 2016 showed no differences in short- and long-term survival rates or neurologic outcomes, indicating the benefits of TTM for both groups might be similar [6,30].

Th e present study was conducted to test the hypothesis that benefits of targeted temperature control for patients with IHCA would be similar to those with OHCA when baseline characteristics and comorbidities are controlled, using the national database of Taiwan network of targeted temperature ManagEment for CARDiac arrest (TIMECARD) registry [31].

Material and Methods

This study was approved by the Institutional Review Board (IRB) of Taipei Mackay Memorial Hospital (IRB number: 18MMHIS047), and the requirement for informed consent was waived.

Study Design and Patient Enrollment

This multicenter, retrospective, case-controlled study was conducted in Taiwan using data collected from the Taiwan

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network of targeted temperature ManagEment for CARDiac arrest (TIMECARD) registry. Ten tertiary medical centers participated in this program. Patients over 20 years of age who experienced cardiac arrest and received TTM after successful resuscitation between January 2014 and August 2019 were enrolled. TTM referred to strict temperature control using different cooling devices to target the core body temperature to between 33°C and 36°C following the return of spontaneous circulation (ROSC) after a cardiac arrest, regardless of initial rhythm. TTM protocols and sedation/analgesics/muscle-relaxant protocols varied from hospital to hospital but were accepted by the national academic societies and adhere to international guidelines. Individual patient-level data, delinked with private information, including baseline features, pre-existing comorbidities, location of cardiac arrest, resuscitation characteristics, TTM settings, and possible related complications, clinical course, and outcomes, were recorded using an online case report system [31]. Neurological outcomes were recorded using Glasgow-Pittsburgh cerebral performance category (CPC) scores. A CPC score of 1 or 2 was considered to indicate a favorable neurological outcome, and a CPC score of 3 to 5 was considered to be a poor neurological outcome [16]. Data from electrophysiology studies, including somatic sensory evoked potential and electroencephalogram, and biomarkers of blood or CSF were not available in this registry. The Charlson comorbidity index (CCI) was used to categorize the burden of comorbidities for each patient [32,33]; the index assigns a weight for each comorbid disease, and the score is the total of assigned weights.

All adult cardiac arrest survivors (aged ≥20 years) treated with TTM in the registry were eligible for the present study. Traumatic cardiac arrest was excluded. Study patients were then selected and classified into 2 groups: the case group included patients who experienced IHCA and the control group included those who experienced OHCA, with a 1: 1 ratio matched for age (within 5 years), sex, Charlson comorbidity index (within 2 points), and pre-arrest CPC score (in the same group of performance; good performance defined as 1 or 2 and bad performance defined as a score ≥3) manually. Clinical course, resuscitation, and TTM-related characteristics and outcomes in cases and controls were compared. A shockable rhythm was defined as pulseless ventricular tachycardia or ventricular fibrillation at the beginning of resuscitation. Neurological outcome and survival at hospital discharge were the primary outcome measures.

Statistical Analysis

Results are expressed as n (%) for categorical variables. Descriptive statistics were reported as mean±standard deviation (SD) or median and interquartile range for continuous variables. The groups were compared using the *t* test for numerical data and Pearson's chi-squared test or Fisher's exact test for categorical data, as appropriate.

Logistic regression models were used to explore independent risk factors for in-hospital mortality and patients' neurological outcomes. Univariate analyses were performed separately for each risk factor to ascertain the odds ratio and 95% confidence interval. All biologically plausible variables with *P* value of <0.10 in the univariate analysis were considered for inclusion in the logistic regression model during the multivariate analysis. A backward selection process was used. All data were processed using IBM SPSS Statistics software (version 20.0; IBM Corp., Armonk, NY, USA). Differences were considered to have reached the significance level with a two-tailed *P*<0.05.

Results

During the study period, a total of 580 adult cardiac arrest survivors treated with TTM were registered in the TIMECARD database and 67 of them with traumatic cardiac arrest were excluded. Data from the remaining 513 cases were retrospectively extracted from the registry. Among them, 103 of the 110 patients with IHCA were selected as the case group and the same number of patients with OHCA, matched for age, sex, pre-arrest CCI, and pre-arrest CPC, were selected as the control group. Seven IHCA survivors were not included due to lack of matched controls. Sixty percent of the IHCA patients were resuscitated in either the emergency department (ED) or intensive care unit (ICU) and 34.0% in the ordinary ward. Other locations where IHCA occurred included the hemodialysis room, cardiac catheterization lab, and out-patient clinic.

Baseline characteristics and pre-existing conditions of patients are shown in **Table 1**. Half of the patients in both groups had a CCI ≥5 (49.5% vs 50.5%, *P*=1.000). Despite the matching process, patients with IHCA were more likely to have chronic kidney disease (36.9% vs 24.3%, *P*=0.049) and less likely to have cerebrovascular accident (8.7% vs 21.4%, *P*=0.018).

Resuscitation-associated parameters and characteristics after ROSC are displayed in **Table 2**. Patients with IHCA were more likely to experience witnessed collapse (95.2% vs 73.8%, *P*=0.000), bystander CPR (85.4% vs 58.3%, *P*=0.000), and a shorter duration from collapse to initiation of CPR (1.5±5.6 vs 10±12 min, *P*=0.000). No significant differences were found between groups in initial rhythm, presumed cardiac collapse, use of medications, and use of extracorporeal membrane oxygenation during resuscitation. Patients with IHCA had a shorter CPR duration (16.6±16.8 vs 25.8±17.4 min, *P*=0.000), but their arterial blood pressure was lower (mean: 88.3±32.1 vs 101.1±34.0 mmHg, *P*=0.006) and body temperature was higher (36.4±1.3 vs 35.9±1.6°C, *P*=0.008) at ROSC. They were also

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Table 1. Baseline characteristics and pre-existing comorbidities of patients with IHCA and OHCA receiving targeted temperature.

	IHCA	N=103	OHCA	N=103	P value
Male, N (%)	67	65.0%	67	65.0%	1.000
Age, median (IQR)	71.5	22.9	70.1	23.0	0.874
Pre-arrest CPC, median (IQR)	1	1	1	1	0.580
Pre-arrest comorbidities					
Diabetes mellitus, N (%)	53	51.5%	46	44.7%	0.329
Hypertension, N (%)	61	59.2%	63	61.2%	0.776
Coronary artery disease, N (%)	25	24.3%	33	32.0%	0.215
Heart failure, N (%)	31	30.1%	27	26.2%	0.535
Arrhythmia, N (%)	18	17.5%	10	9.7%	0.154
Chronic lung disease, N (%)	13	12.6%	17	16.5%	0.429
Chronic kidney disease, N (%)	38	36.9%	25	24.3%	0.049
End-stage renal disease, N (%)	17	16.5%	12	11.7%	0.317
Liver cirrhosis, N (%)	3	2.9%	3	2.9%	1.000
Cerebrovascular disease, N (%)	9	8.7%	22	21.4%	0.018
Hyperlipidemia, N (%)	23	22.3%	20	19.4%	0.607
Active malignancy, N (%)	24	23.3%	18	17.5%	0.299
Pre-arrest Charlson comorbidity index, median (IQR)	4	3	5	3	0.830
0-2, N (%)	17	16.5%	17	16.5%	1.000
3-4, N (%)	35	34.0%	34	33.0%	1.000
≥5, N (%)	51	49.5%	52	50.5%	1.000

IHCA – in-hospital cardiac arrest; OHCA – out-of-hospital cardiac arrest; CPC – cerebral performance category; IQR – interquartile range.

less likely to receive a brain computed tomography examination (68.0% vs 86.4%, *P*=0.002).

Table 3 shows the comparison of TTM-related variables and clinical outcomes between patients experiencing IHCA vs those experiencing OHCA. Both groups started temperature control 5 hours after ROSC (4.99±4.38 vs 5.35±3.73, *P*=0.526). Most patients in both groups were treated with non-invasive surface cooling devices, including Arctic Sun™ (48.5% vs 44.7%, *P*=0.576) and a traditional ice blanket (37.9% vs 46.6%, *P*=0.204). Four patients in the IHCA group did not reach the targeted temperature. The incidence of possible TTM-related complications was similar in patients experiencing IHCA and those experiencing OHCA. Hypokalemia (51.5% vs 60.2%, *P*=0.822), new infection (49.5% vs 44.5%, *P*=0.485), and new arrhythmia (40.8% vs 44.7%, *P*=0.573) were the 3 most common complications in both groups. Overall, 88% of patients had survived to completion of TTM. Survival to discharge (42.7% vs 42.7%, *P*=1.000) and favorable neurologic outcome (19.4% vs 12.7%, *P*=0.246) at hospital discharge did not differ between the case and control groups, but survivors among patients with IHCA had longer ICU length of stay than patients with OHCA (25.8±18.4 vs 19.5±14.2 days, *P*=0.048).

The results of univariate analysis for predictors of survival to discharge are shown in **Table 4A**. Pre-arrest CPC, pre-arrest CCI, initial shockable rhythm, CPR duration ≥20 minutes, heart rate and systolic blood pressure at ROSC, and new arrhythmia during TTM were significant in a multivariate logistic regression analysis and the data were well fitted by the model (*P*=0.972 by the Hosmer-Lemeshow test). Predictors of good neurologic outcome at hospital discharge are listed in **Table 4B**. New seizure occurring during TTM, best motor function at ROSC ≥3, and use of epinephrine during resuscitation remained significant in multivariate analysis (*P*=0.923 by the Hosmer-Lemeshow test). No single variable could independently predict both survival and good neurologic outcome at hospital discharge.

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Table 2. Resuscitation-associated parameters and characteristics after return of spontaneous circulation of IHCA and OHCA patients receiving targeted temperature management.

	IHCA	N=103	OHCA	N=103	P value
During resuscitation					
Time to initiation of CPR (min), mean (SD)	1.5	5.6	10.0	12.0	0.000
Witnessed collapse, N (%)	98	95.2%	76	73.8%	0.000
Bystander CPR, N (%)	88	85.4%	60	58.3%	0.000
Initial shockable rhythm, N (%)	28	27.2%	31	30.1%	0.644
Presumed cardiac collapse, N (%)	46	44.7%	53	51.5%	0.329
Use of epinephrine, N (%)	97	94.2%	89	86.4%	0.098
Dose of epinephrine, mg, mean (SD)	4.5	4.8	3.5	3.1	0.076
Use of anti-arrhythmia, N (%)	17	16.5%	15	14.6%	0.700
Use of $NaHCO_3$, N (%)	33	32%	33	32%	1.000
Use of calcium, N (%)	14	13.6%	8	7.8%	0.259
Use of ECMO, N (%)	12	11.7%	8	7.8%	0.481
ROSC					
CPR duration (min), mean (SD)	16.6	16.8	25.8	17.4	0.000
Heart rate (bpm), mean (SD)	107.2	27.9	106.0	30.3	0.756
SBP (mmHg), mean (SD)	124.1	27.9	140.7	44.7	0.011
DBP (mmHg), mean (SD)	70.4	26.9	81.4	32.2	0.009
MAP (mmHg), mean (SD)	88.3	32.1	101.1	34.0	0.006
BT (°C), mean (SD)	36.4	1.3	35.9	1.6	0.008
Best motor, mean (SD)	1.4	0.9	1.4	1.0	0.667
Brain CT, N (%)	70	68.0%	89	86.4%	0.002
Coronary angiography, N (%)	22	21.4%	33	32.0%	0.083

IHCA – in-hospital cardiac arrest; OHCA – out-of-hospital cardiac arrest; SD – standard deviation; ECMO – extracorporeal membrane oxygenation; ROSC – return of spontaneous circulation; CPR – cardiopulmonary resuscitation; SBP – systolic blood pressure; DBP – diastolic blood pressure; MAP – mean arterial pressure; BT – body temperature; CT – computed tomography.

Discussion

In this case-control study, we used data from the national TIMECARD registry to compare the clinical outcomes of TTM following in-hospital and out-of-hospital cardiac arrest. After matching baseline characteristics, pre-existing comorbidities, and pre-arrest neurologic performance, we found no significant differences in in-hospital survival and neurologic performance at discharge between IHCA and OHCA survivors, indicating that the benefits of TTM are similar in these 2 groups.

Since current guidelines of post-cardiac arrest care for patients experiencing IHCA are mostly based on study results derived from the OHCA population [22], our findings, in line with 2 similar previous studies [6,10], could be used to support the recommendations that suggest use of TTM following in-hospital cardiac arrest [21,22].

However, there are still notable differences in resuscitation-related variables between our case group and control group despite matching (**Table 2**). IHCA survivors had a shorter time from collapse to initiation of CPR (no-flow time), more witnessed collapse, more bystander CPR, a shorter CPR duration (low-flow time), and a lower blood pressure immediately after resuscitation. Some of these factors were associated with a better clinical outcome after cardiac arrest, and a recent met-analysis showed that bystander CPR contributed to higher survival following OHCA [34]. Duration of resuscitation in patients with IHCA was associated with 30-day survival among those who had ROSC in a Swedish cohort [35]. In another retrospective survey, CPR duration of <20 minutes was found to be an independent predictor for hospital discharge [1]. In contrast, a lower mean arterial blood pressure and a higher heart rate after ROSC were associated with increased in-hospital mortality and worse neurologic performance at discharge [36]. The detrimental effect of lower initial blood pressure might

Table 3. Comparison of targeted temperature management related variables and clinical outcomes between patients with IHCA and OHCA.

		IHCA	(N=103)	OHCA	(N=103)	P value
Time from ROSC to TTM (hours), mean (SD)		4.99	4.38	5.35	3.73	0.526
Targeted temperature (°C)		33.12	0.48	33.18	0.51	0.402
Reach targeted temperature (%)		99	96%	103	100%	0.840
Cold saline induction (%)		50	48.54%	62	60.19%	0.093
Maintenance mode	Arctic sun (%)	50	48.54%	46	44.66%	0.576
	Intravenous cooling catheter (%)	4	3.88%	3	2.91%	0.700
	Traditional ice blanket (%)	39	37.86%	48	46.60%	0.204
Complication	New bleeding (%)	22	21.36%	30	29.13%	0.199
	New arrhythmia (%)	42	40.78%	46	44.66%	0.573
	New infection (%)	51	49.51%	46	44.66%	0.485
	New seizure (%)	28	27.18%	34	33.01%	0.362
	Hypokalemia (%)	53	51.46%	62	60.19%	0.207
	Hypoglycemia (%)	10	9.71%	12	11.65%	0.822
Survival to completion of TTM (%)		90	87.38%	92	89.32%	0.664
Survival to ICU discharge (%)		54	52.4%	55	53.4%	0.889
CPC at ICU discharge, mean (SD)		2.9	1.2	3.0	1.2	0.682
ICU stay among survivors (days), mean (SD)		25.8	18.4	19.5	14.2	0.048
Survival to hospital discharge (%)		44	42.7%	44	42.7%	1.000
CPC at hospital discharge, mean (SD)		2.5	1.3	2.7	1.2	0.593
CPC ≤2 at ICU discharge (%)		20	19.4%	19	18.5%	0.605
CPC ≤2 at hospital discharge (%)		20	19.4%	14	12.7%	0.246
Hospital stay among survivors (days), mean (SD)		46.2	30.7	48.3	34.0	0.770

IHCA – in-hospital cardiac arrest; OHCA – out-of-hospital cardiac arrest; TTM – targeted temperature management; GCS – Glasgow Coma Scale; CPC – cerebral performance category.

be compensated for by a better resuscitation profile in IHCA patients, but this correlation needs further research to verify.

A survey in 2016 showed 59% of IHCA occurred in ICUs and those who arrested in the ICU were more likely to have preexisting hypoperfusion, renal and hepatic insufficiency, metabolic abnormalities, and sepsis [37]. Because hypothermia itself can inhibit the cellular immune response, cause cardiac arrhythmia, decrease cardiac output, and suppress renal and cerebral function, it is reasonable to assume that IHCA survivors might be more susceptible to TTM-related complications and therefore have worse clinical outcomes. Our study showed that the incidence of major complications related to TTM were similar in patients experiencing IHCA and those experiencing OHCA if their baseline conditions were matched (**Table 3**), but we were unable to determine whether the severity and frequency of each documented complication contributed to patients' survival or neurologic performance.

Our study has some limitations. First, since this study was conducted using data from the national TIMECARD registry, it was subject to the limitations of any retrospective analysis. Associations between variables could be identified but causal relationship could not be established. Second, a selection bias might have occurred. Patients with expected favorable outcomes were more likely to be treated with TTM to optimize the prognosis. In addition, we do not have data on patients who did not receive TTM. Third, our study measured end-points only at the time of hospital discharge, although long-term functional outcomes may be a more robust measurement of any treatment effect on patients recovering from cardiac arrest. Finally, during the 5-year study period, the intensive care for post-cardiac arrest syndrome might have evolved.

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Table 4A. Predictors of survival to hospital discharge among patients receiving targeted temperature control in this cohort.

	Single-variate analysis				Multivariate analysis			
	OR	95% CI		*P* value	OR	95% CI		*P* value
Pre-arrest CPC	0.776	0.643	0.936	0.008	0.546	0.342	0.871	0.011
Pre-arrest CCI	0.933	0.882	0.987	0.016	0.503	0.267	0.945	0.033
Initial shockable rhythm	1.626	1.166	2.268	0.004	3.145	1.484	6.667	0.003
Use of epinephrine during CPR	0.691	0.516	0.926	0.013				
Use of $NaHCO_3$ during CPR	0.500	0.300	0.834	0.008				
Use of calcium during CPR	0.375	0.147	0.958	0.040				
CPR duration ≥20 minutes	0.536	0.344	0.835	0.006	0.495	0.260	0.943	0.033
HR at ROSC ≥100 bpm	0.671	0.467	0.964	0.031	0.512	0.267	0.981	0.044
SBP at ROSC ≤120 mmHg	0.400	0.254	0.630	0.000	0.424	0.231	0.777	0.006
BT at ROSC ≤36°C	0.621	0.410	0.941	0.025				
Time from ROSC to initiation of TTM ≥8 hours	0.391	0.181	0.846	0.017				
Targeted temperature, °C	0.991	0.983	0.999	0.036				
Time to normothermia during rewarm phase of TTM, hours	0.989	0.978	1.000	0.049				
New arrhythmia during TTM	0.492	0.315	0.767	0.002	0.503	0.267	0.945	0.033

OR – odds ratio; CPC – cerebral performance category; CCI – Charlson comorbidity index; CPR – cardiopulmonary resuscitation; HR – heart rate; SBP – systolic blood pressure; BT – body temperature; TTM – targeted temperature management.

Table 4B. Predictors of good neurological outcome at hospital discharge among patients receiving targeted temperature control.

	Single-variate analysis				Multivariate analysis			
	OR	95% CI		*P* value	OR	95% CI		*P* value
Pre-arrest CPC	0.705	0.511	0.972	0.033	0.270	0.070	1.043	0.058
Use of epinephrine during resuscitation	0.604	0.381	0.958	0.032	0.032	0.002	0.435	0.010
Best motor function at ROSC	12.000	1.560	92.287	0.017	11.765	2.203	62.500	0.004
Time from ROSC to initiation of TTM, hours	0.917	0.845	0.996	0.039				
Time from ROSC to initiation of TTM ≥6 hours	0.400	0.155	1.031	0.058				
Time to normothermia during rewarm phase of TTM, hours	0.975	0.954	0.996	0.022				
Time to return normothermia ≥25 hours	0.308	0.100	0.944	0.039	0.231	0.049	1.087	0.064
New seizure during TTM	0.148	0.052	0.423	0.000	0.086	0.020	0.370	0.001

CPC – cerebral performance category; ROSC – return of spontaneous circulation.

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Conclusions

The findings from the national TIMECARD registry showed that clinical outcomes of TTM for patients with in-hospital cardiac arrest were not significantly different from those with out-of-hospital cardiac arrest when baseline factors were matched.

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Conflict of Interest

None.

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