

# **THERAPEUTIC HYPOTHERMIA GUIDELINES FOR OUT-OF-HOSPITAL CARDIAC ARREST AND CLINICAL PRACTICE**

**Keywords:** hypothermia, cardiac arrest, intensive care

## **Abstract**

Background: Out of hospital cardiac arrest is associated with a high rate of mortality, and poor neurological outcomes. Favourable neuro-protective effects are associated with induced hypothermia and international recommendations exist for therapeutic hypothermia. .

Objective: This study reviews current practice for therapeutic hypothermia for out of hospital cardiac arrest patients within one ICU. It aims to identify and improve adherence to the practice guidelines.

Setting: This project was conducted in an adult ICU which admits 2,000 patients yearly.

Methods: A retrospective chart audit was used to document current practice for a 12 month period.

Results: Of the sample of 33 patients, four patients (12%) were at the goal temperature of 32.5 - 33.5 °C, in the target time of two hours. Nearly half (n=17) were not cooled at all. The length of time the patient was in the ICU prior to active cooling commencing varied from <1 hour (n=15, 45%) to > 3 hours (n=5, 15%). Twenty-four percent (n=9) were cooled for the recommended length of time. There were medical orders stating a target temperature in nearly half of the cases (n=18), however, only 27% (n=9) were consistent with the guidelines.

Interventions: A number of strategies have been initiated. They aim to improve communication and ready access to the required materials.

Conclusions: The audit indicated that less than a third of the patients experienced therapeutic induced hypothermia and only 12% were at goal temperature within the required two hours. Strategies to improve guideline implementation have been initiated.

## **Introduction**

Out of hospital cardiac arrest is associated with a high rate of mortality, and for those patients who survive, poor neurological outcomes are common<sup>1</sup>. Studies have shown therapeutic hypothermia to be an effective intervention to improve neurological outcomes and survival after cardiac arrest from ventricular fibrillation<sup>2</sup>. The International Liaison Committee on Resuscitation (ILCOR) recommends therapeutic hypothermia to a temperature of 32 °C to 34 °C for all unconscious adult patients is commenced as soon as possible after return of circulation. This temperature should be maintained for 12 to 24 hours for these patients<sup>3</sup>.

This study reviews current clinical practice for therapeutic hypothermia in survivors of out of hospital cardiac arrest (OOHCA) within one Intensive Care Unit (ICU). The ICU has clinical guidelines based on international standards but adherence and implementation of the guidelines for patients post OOHCA are unknown. The aim of the project was to identify adherence to the practice guidelines as well as to identify any barriers impeding guideline implementation. Adherence to the international standards and clinical guidelines is essential for best practice and to promote optimal neurological outcomes for this group of patients.

## **Literature review**

In industrialised countries OOHCA is a relatively common occurrence with an annual incidence of 36 to 128 per 100,000 people<sup>4</sup>. Of particular significance with this condition is the high mortality rate which is between 65% and 95%<sup>4</sup>. When cardiac arrest occurs, cerebral perfusion is halted causing a cascade of events that result in cell death. Even with the return of spontaneous circulation (ROSC) damage to the tissues continues to occur due to an acceleration of free oxygen radicals causing poor neurological outcomes in many survivors of OOHCA<sup>5</sup>. Inducing hypothermia as a therapeutic intervention aims at reducing cerebral metabolism and providing neuro-protection, ultimately improving functional recovery and quality of life<sup>1</sup>.

The concept of inducing hypothermia for its therapeutic benefits has been documented since the early 19<sup>th</sup> Century when the “Russian method of Resuscitation” was described as covering a patient with snow hoping for ROSC after a cardiac arrest<sup>6, p 1,335</sup>. Therapeutic hypothermia has been used as a treatment modality in traumatic head injury, bacterial meningitis, and acute encephalitis and is routinely used in operating theatres to reduce cellular demand<sup>5</sup>.

A Cochrane review of hypothermia for neuro-protection in adults after cardiopulmonary resuscitation reported on five studies, two of which are landmark randomised control trials (RCT) which indicated favourable neuro-protective effects associated with inducing hypothermia post OOHCA<sup>2</sup>. One of these RCTs conducted in Australia over a 33 month period with a sample of 77 patients (43 hypothermia; 34 normothermia) demonstrated a significant difference in outcomes, with 49% of the intervention group being discharged to home or a rehabilitation facility compared with 26% of the control group<sup>7</sup>. The second study was a multi centred RCT conducted over 58 months by the Hypothermia after Cardiac Arrest Study Group<sup>8</sup>. In total 275 patients were enrolled, 137 assigned to the hypothermia group and 138 to the normothermia group. At six months 55% of the patients in the hypothermia group demonstrated a neurological outcome as measured by the cerebral performance category of one (good recovery) or two (moderate disability) compared to 39% in the normothermia group, representing a reduced risk in the intervention group. Six month mortality was also improved, with 41% in the intervention group compared with 55% in the normothermia group<sup>8</sup>. The ILCOR reviewed the evidence and in 2003 recommended inducing hypothermia of 32 to 34 °C for 12 to 24 hours in unconscious adult patients post OOHCA with an initial rhythm of ventricular fibrillation. The Australian Resuscitation Council endorsed these guidelines in 2006<sup>3,9</sup>.

Confidence in induced hypothermia has peaked and waned through the decades due to the potential for complications such as clinically significant arrhythmias, pneumonia, sepsis and bleeding<sup>2</sup>. A survey (n = 265) conducted in 2005 of emergency and critical care physicians and cardiologists in the USA revealed that 87% of respondents had never utilised hypothermia for cardiac arrest<sup>10</sup>. Reasons for not initiating hypothermia included: the perception of a lack of significant data; a belief that current advanced life support guidelines utilising hypothermia did not exist; and difficulty initiating and maintaining hypothermia<sup>10</sup>. Another reason for hesitancy in inducing hypothermia was the associated risk of an increase in clinically significant arrhythmias<sup>8</sup>. However, when the trials were reviewed by Arrich and colleagues the incidence of dangerous or long-lasting arrhythmia was not found to be an adverse event<sup>2</sup>.

Current international resuscitation guidelines recommend inducing therapeutic hypothermia as soon as possible following ROSC<sup>3</sup>. Various cooling modalities are available consisting of body surface cooling with ice, cooling blankets and helmets<sup>11,12</sup>. These methods have shown

to be time consuming in inducing hypothermia with the time to target temperature taking between four and seven hours<sup>12</sup>. An alternative method includes the instillation of intravenous fluid chilled to 4°C which has been reported to be a safe, effective method of cooling<sup>12,13</sup>. An RTC undertaken in Finland infused Ringers solution at 4 °C at a rate of 100ml/hr until a target temp of 33 °C was reached or a maximum fluid volume of 30ml/kg<sup>14</sup>. This study reported no observed adverse events such as increased re-arrest rates or pulmonary oedema associated with the infusion of cold fluid<sup>14</sup>. Patients in the intervention group had significantly reduced temperatures compared to the control group (34.1 °C versus 35.2 °C) with no significant differences noted between the two groups electrolyte results<sup>14</sup>.

In summary, international guidelines recommend induced hypothermia to aid in neurological protection for patients post OOHCA<sup>3</sup>. Methods to safely cool patients are available. The guidelines in use in the study site ICU are based on the international recommendations and have been in place in the ICU for 12 months. However, what is not known is the consistency of clinical practice with the guidelines. This study aimed to assess how current practice conforms to the guidelines and to document the interventions used. Results informed the research team if additional or revised policy implementation was required.

## **Methods**

### Design

A quantitative research design using a cross sectional retrospective chart audit was used and supports the aims and objectives as it permits an accurate description of current documentation of clinical practice. The number of patients admitted with this condition is low, and therefore it would take multiple years to get sufficient data to describe practice. The benefit of retrospective chart audit is that currently available data can be used immediately to improve practice.

### Site

This project was conducted in a 700 bed tertiary referral metropolitan hospital in Australia. The ICU is a 25 bed unit, admitting approximately 2,000 patients per year. Services provided include trauma care, neurological care, respiratory medicine, spinal injury management, and post-operative care of cardiothoracic, liver transplantation and general surgical patients.

## Sample

The sample comprised all patients admitted to the ICU during a 12 month period finishing in October 2009. The focus of the project was on those admitted with an OOHCA from a primary cardiac disease. The following inclusion and exclusion criteria were used to identify the desired sample.

Inclusion criteria were:

- $\geq 18$  years of age
- Admitted to the Emergency Department and the ICU with a diagnosis of OOHCA
- Primary cause of cardiac arrest was due to cardiac co-morbidities

Exclusion criteria were:

- $< 18$  years of age
- Cause of cardiac arrest secondary to an acute cervical spine fracture, asphyxiation, acute trauma or subarachnoid haemorrhage
- Cardiac arrest as an in-patient in the acute setting
- Transfer from another hospital

Patients were initially identified through the clinical information systems with assistance from an emergency department (ED) research nurse and the ICU data manager to ensure all of the correct admission codes formed part of the search strategy. Hard copies of the charts with the identified codes were retrieved and examined using the data collection tool developed for the project.

## Data collection tool

A data collection tool incorporating data related to demographic data, baseline patient temperature in the ED and cooling practices in the ICU was developed. Demographic data included age, gender, and the initial cardiac rhythm at the time of the cardiac arrest. Data collected from the ICU admission included the temperature monitoring method used, length of time the patient was in the ICU prior to active cooling commencement, patient temperatures at specific time intervals, contra-indications to active cooling, length of time active cooling was carried out in the first 24 hours post admission to ICU, documented complications secondary to active cooling, the documentation of medical orders regarding active cooling, and if the medical orders were consistent with the ICU guidelines.

The data were retrieved from the charts by two of the project team members after first checking for inter-rater accuracy. The two team members reviewed the same five charts and compared the collected data. This initial data collection identified minor differences in interpretation of data collection fields, and discussion led to agreement of data collection principles for the remainder of the charts.

### Data analysis

The data were entered into an access database, with all data entries double checked for accuracy. These data were transferred into the statistical program STATA 11 (Statacorp, Texas) for analysis. Data cleaning was performed and involved checks for completeness together with a check of all variables for out of range values. Demographic data were summarised into frequencies and percentages in order to describe the sample. Patient temperatures were noted in set time points and are reported in frequencies. Cooling methods are presented in frequencies. Free text was noted in full and summarised where appropriate.

### Ethics

Ethical approval was received from the hospital and university Human Research Ethics Committees prior to commencement of the project.

### **Results**

Of the patients admitted to the ED over the 12 month project period, 106 patients were identified with a diagnosis of cardiac arrest. From those 106 charts, 42 patients were found to meet the inclusion criteria in the ED. Of these, 33 patients were admitted to the ICU and the following results pertain to these patients who had a median age of 62 years with a range of 32 - 87 years (see Table 1).

Table 1 – Patient demographics and methods used to induce hypothermia

<b>Characteristic</b>	<b>Frequency (%)</b>	
<b>Gender (n=33)</b>		
Male	20	(60.6)
Female	13	(39.4)
<b>Initial rhythm (n=33)</b>		
VT*/VF*	25	(75.8)
Asystole	6	(18.2)
EMD*	1	(3.0)
Other	1	(3.0)
<b>Cooling Methods (n=12)</b>		
Cooling blanket	7	(58.3)
Cooling hat & vest	4	(33.3)
Ice packs	1	(8.3)
Normal Saline 0.9% 4°C	0	(0)

\*VT Ventricular Tachycardia

\*VF Ventricular Fibrillation

\*EMD Electromechanical Dissociation

The majority of patient's temperature's (70%) were measured via a urinary catheter with the next most frequent method being nasopharyngeal thermometer (12%). The length of time the patient was in the ICU prior to active cooling commencing varied from less than one hour (n=15, 45%) to greater than three hours (n=5, 15%) with the highest proportion falling within the one hour period. Length of therapeutic hypothermia during the first 24 hour period also varied with the highest proportion of patients cooled for 6 to 11.9 hours (see Table 2).

Table 2: Length of therapeutic hypothermia during the first 24 hour period

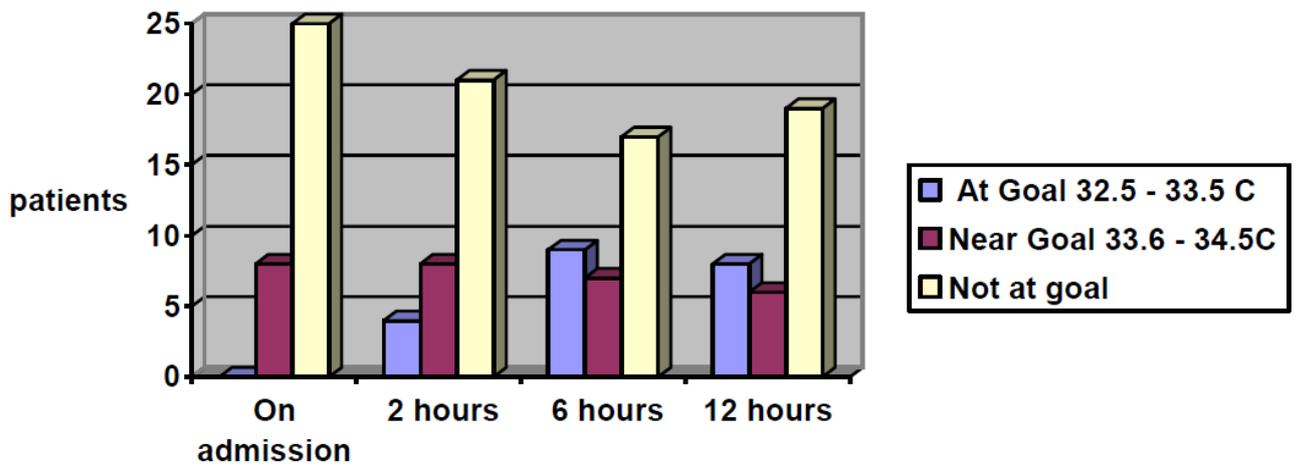
Length of cooling time	Frequency (n = 33) (%)	
<6 hours	6	(18)
6 – 11.9 hours	8	(24)
12 – 18.9 hours	7	(21)
19 – 24 hours	2	(6)
No cooling	6	(18)
Not documented	4	(12)

Although all methods for inducing hypothermia are noted in the unit’s guideline, cold saline was not used and the most frequently utilised method was a cooling blanket. Cooling was used in only 12 cases (see Table 1).

There were medical orders stating a target temperature in more than half of the cases (55%), however, only 27% of these were consistent with the ICU guidelines.

Complications such as bradyarrhythmias (n=4) and shivering (n=2) were documented in six charts (18%), however, only two had cooling ceased. No patients had a chart entry indicating cooling was contra-indicated.

Only four patients (12%) were at goal temperature of 32.5°C - 33.5°C, in the target time of two hours as outlined in the guidelines. Twenty-seven percent of patients were cooled for the recommended length of time of 12 to 24 hours. Over half (51%) were not cooled at all and no notation was made as to why this was the case (see Graph 1).



Graph 1: Documented temperature in the ICU.

## Discussion

The aim of the project was to identify adherence to and issues with, the implementation of practice guidelines designed for OOHCA patients in the site ICU. The guidelines were introduced 12 months prior to the commencement of the project and all staff had ready access to them via a computer terminal at each patient bedside. A retrospective chart audit covering a 12 month period was conducted on all patients presenting to the ED following OOHCA and admitted to ICU.

The audit indicated that less than a third of the patients experienced therapeutic induced hypothermia as recommended by both the site ICU, the Australian Resuscitation Council (ARC) and the ILCOR guidelines and only 12% (n=4) were at goal temperature within the required two hours<sup>3,9</sup>. This suggests that the remaining patients did not experience the required level of neuro-protection which is a primary goal of therapeutic cooling in this patient group<sup>1,2</sup>. The potential complication of clinically significant arrhythmias is frequently the given reason for selecting not to induce hypothermia in these patients<sup>2</sup>. None of the reviewed charts had documentation indicating there were contraindications for the therapy however, it was noted that in some instances, methods to induce hypothermia were ceased at the same time bradycardia was recorded. The lack of a clinical notation limits the ability to draw any conclusions. Notably, in a 2009 Cochrane review of induced hypothermia, the incidence of dangerous or long-lasting arrhythmia was not found to be an adverse event in the reviewed five randomised studies<sup>2</sup>.

The results of the unit’s audit were shared initially with senior nursing and medical staff in the unit who were disappointed by the lack of adherence to the guidelines and were keen to support interventions to improve the care delivered. The care of all ICU patients involves a multidisciplinary approach and well functioning teams have been highlighted to be of prime importance to promote positive patient outcomes<sup>15,16</sup>. Bradley et al found that when interventions have the support of senior management and clinical leaders and a planned process is in place to support changes, there is more likelihood of a successful translation of clinical changes into practice<sup>17</sup>.

With senior staff support a number of strategies were implemented to address the issues, raise awareness and enhance the adherence to the therapeutic hypothermia guidelines (see Table 3). These strategies encompass both communication strategies and practical aspects of ready access to the materials necessary to affect active cooling.

Table 3 – Interventions for practice change

Intervention	Action
1) Cooling blanket placed on bed prior to patient admission	1) Add to Hypothermia Clinical Guidelines
2) Improved patient information system	2) Add changes to patient information system to support clinical practice guidelines
3) Increase staff awareness	3) Include education in unit’s staff publication, update all staff on guidelines and changes to guidelines
4) Ensure adequate Normal Saline 0.9% fluids available at 4 °C	4) Add to daily check list Normal Saline fluids in refrigerator

One change that was made to the guidelines to improve time to cooling was to place a cooling blanket on the bed as part of the bed set up process for admitting a patient post OOHCA. Communication and reinforcement of the guidelines were enhanced by way of regular education sessions with both medical and nursing staff in the unit, during staff meetings and through the monthly unit newsletter where the guidelines and project results

were featured. A Cochrane review of the effect of audit and feedback on professional practice and health care outcomes examined 118 studies and concluded there was a greater effect when there is low baseline adherence and a multipronged approach to the delivery of feedback<sup>18</sup>. Both of these characteristics were present in the current study.

In the area of improved communication strategies, the computerised patient record system has had the addition of a care path to support and prompt clinicians. These prompts centre on the prescription of target temperature, the initiation of therapeutic hypothermia and appropriate documentation on reasons for not cooling. When reminders are programmed into computerised patient charts improved rates of adherence to guidelines have been noted<sup>19</sup>.

An improved procedure for ensuring sufficient cooling agents are readily available has been introduced. For example, ensuring there are adequate intravenous bags of Normal Saline 0.9% fluid being stored at the requisite 4 °C has been added to the regular daily check list in the unit. In the past, one was not assured of locating a cooled bag of fluid thus potentially diminishing the likelihood of staff accessing this fluid. Other forms of cooling devices have been relocated to improve accessibility.

Following the implementation of these strategies it is important to conduct a future audit to gauge their success in improving patient care for OOHCA patients<sup>20</sup>.

### **Limitations**

This study was limited by the inherent issues associated with the methods used. Although chart audits are a convenient and efficient way to gather data, the data collectors are unable to assess if the documentation is a full, accurate and complete record of the events that occurred in relation to what was documented. There was no means to check on the accuracy of the recorded data. Studies have found in a clinical setting, however, that chart audits are a more reliable way to collect data than a method that relies on clinicians' self reports and recall<sup>21</sup>. In the current study, contraindications for implementing or ceasing therapeutic hypothermia may not have been documented and therefore missed thus giving an incomplete picture. The study results are from a single site with a particular context and are therefore only applicable to this site. It may, however, stimulate other ICUs to conduct their own audits on their clinical practice in this area thus improving care more generally across this ICU patient group.

## **Conclusion**

This study examined adherence to therapeutic hypothermia practice guidelines for patients admitted to an ICU following OOHCA. Adherence to the practice guidelines at the site ICU was low. Less than a third of the patients experienced therapeutic induced hypothermia as recommended by the evidence based site guidelines and only 12% (n=4) were at the goal temperature within the required two hours. The study results have been the impetus for change to address the issues impeding guideline implementation. Ultimately it is hoped that the changes to practice introduced as a result of this study lead to increased neurological protection and functioning for patients post OOHCA.

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