



Efficacy of non-pharmacological antishivering interventions in patients undergoing targeted temperature management: findings from a Scoping Review

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ABSTRACT

Targeted temperature management (TTM) is a crucial neuroprotective intervention employed in the Intensive Care Unit (ICU) to enhance the prognosis of patients following cardiac arrest. Shivering, a common side effect of TTM, poses challenges to its neuroprotective benefits. This scoping review aimed to assess available literature on non-pharmacological therapies for shivering in TTM patients, identifying gaps and potential areas for future research. Thirteen relevant studies were analyzed, involving 743 subjects, with a focus on neuroprotective TTM. The review highlighted the inconsistent nature of existing literature on non-pharmacological shivering treatments, emphasizing the need for effective interventions supported by clinical trials. Forced-air blankets emerged as a frequently explored and effective approach. The study provides a foundation for future research on non-pharmacologic therapies, emphasizing the importance of objective shivering assessment and validated measurement tools.

FUTURE IMPROVEMENTS:

This scoping review was conducted in 2022 and never published; the authors send it to the EDUCATIONAL section of *Dissertation Nursing* as it is currently outdated and should be updated with new evidence.

KEYWORDS: ICU, Targeted temperature management, Hypothermia shivering critical care, Nurses, Nursing

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Efficacia degli interventi non farmacologici anti-brivido nei pazienti sottoposti a gestione mirata della temperatura: risultati di una Scoping Review

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ABSTRACT

La gestione mirata della temperatura (TTM) è un intervento neuroprotettivo cruciale impiegato nelle unità di terapia intensiva (ICU) per migliorare la prognosi dei pazienti dopo un arresto cardiaco. Il brivido, un effetto collaterale comune della TTM, mette in discussione i suoi benefici neuroprotettivi. Questa scoping review mira a valutare la letteratura disponibile sulle terapie non farmacologiche per il brivido nei pazienti con TTM, identificando le lacune e le potenziali aree di ricerca future. Sono stati analizzati 13 studi sul tema, che hanno coinvolto 743 soggetti, con particolare attenzione alla TTM neuroprotettiva. La revisione ha evidenziato la natura incoerente della letteratura esistente sui trattamenti non farmacologici del brivido, sottolineando la necessità di interventi efficaci supportati da studi clinici. Le coperte ad aria forzata sono emerse come un approccio frequentemente esplorato ed efficace. Lo studio fornisce una base per la ricerca futura sulle terapie non farmacologiche, sottolineando l'importanza di una valutazione oggettiva del brivido e di strumenti di misurazione validati.

MIGLIORAMENTI FUTURI:

La scoping review in oggetto è stata effettuata nel 2022 e mai pubblicata; gli autori la inviano alla sezione EDUCATIONAL di *Dissertation Nursing* in quanto attualmente *obsoleta*: andrebbe aggiornata con nuove evidenze.

KEYWORDS: *Terapia intensiva, Gestione mirata della temperatura, Ipotermia da brivido, Infermieri, Infermieristica*

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BACKGROUND

Target temperature management (TTM) is a neuroprotective therapy employed in the Intensive Care Unit (ICU) to mitigate secondary neurological harm and enhance the prognosis. The temperature is deliberately regulated at a predetermined goal, encompassing therapeutic hypothermia and induced normothermia. Therapeutic hypothermia is a deliberate and regulated lowering of body temperature to a desired range of 32°C to 35.9°C. On the other hand, *induced normothermia*, which is suggested for managing persistent fever that doesn't respond to other treatments, involves maintaining or reducing body temperature between 36°C and 37.4°C (1). In the adult population, TTM is increasingly acknowledged as a crucial component of post-resuscitation treatment, serving as a significant and equally intricate connection in the chain of survival following cardiac arrest (2). In the USA, in 2021 143,018 out of hospital cardiac arrest (OHCA) events were reported, with hospital discharge of 9.1% (3). Currently, TTM is advised for neuroprotection in all cases of cardiac arrest. This treatment involves closely monitoring the patient's core temperature and taking active measures to prevent pyrexia for at least 72 hours by using anti-pyretic drugs, or if this is insufficient, by using a cooling device with a target temperature of 37.5° C (4). Shivering is a common and significant side effect of TTM (5), is a physiological response of the body to a decrease in temperature characterized by the involuntary

oscillation of muscles. Vasoconstriction and shivering elicit a cascade of autonomic and hemodynamic reactions that can have detrimental effects on the patient (6). These responses are accountable for multiple metabolic changes, including heightened oxygen consumption, energy expenditure, and carbon dioxide production. Shivering also induces a decrease in oxygen levels within the brain tissue, resulting in metabolic strain. Hence, if not promptly and appropriately addressed, this occurrence can undermine the neuroprotective advantages of targeted temperature management (1,5). There are pharmaceutical and non-pharmacologic ways to treat shivering. First-line treatments should prioritize non-pharmacologic approaches due to their reduced risks. Deep sedation has actually been linked to longer ventilation times, a higher risk of pneumonia, a delayed patient awakening, a delayed mobilization, and a higher risk of delirium (7). To the best of our knowledge, there is insufficient evidence to support the superiority of any treatment modality for shivering.

The aim of this scoping review was to: (a) assess the features of the literature's available studies on non-pharmacological therapies for shivering in patients receiving TTM; and (b) map out the gaps and areas for expansion in the body of knowledge.

METHODS

A scoping review was conducted using the framework proposed the Johanna Briggs Institute (8). We

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included studies using the Patient, Concept, Context (PCC) framework as: critically ill adults undergoing TTM (P) treated with non-pharmacologic in addition to pharmacologic treatments (C) in ICU, defined as a highly specialized setting in which a critically ill patient is cared for by a multidisciplinary team (C) (9). We decide to include any tipe of publication with no time limits. May 2022 saw the implementation of the first search strategy across a number of worldwide databases, including the Cochrane Library, CENTRAL, CINAHL Plus with full text, PubMed, Scopus, MEDLINE, as well as unpublished material like ClinicalTrials.gov and grey literature databases like Google Scholar. In *Appendix 1*, the search approach is displayed.

RESULTS

Through searching global databases, we were able to find 13 relevant studies. A flowchart provided comprehensive documentation and description of the screening and source selection process is reported in *Appendix 2*. A total of 743 subjects received non-pharmacologic treatment for shivering management; these included 306 (41%) patients undergoing TTM treatment for neuroprotective purposes. We found 12 distinct non-pharmaceutical intervention categorized in: focal, surface and mixed treatments (*Table 1*) and most of research focuses on preemptively treatments (67%).

FOCAL TREATMENTS		SURFACE TREATMENTS		FOCAL AND SURFACE TREATMENTS	
Oesophageal heat exchanger (Steril Water 3l/min Max T 42°C)	n=1	Cotton sheet and cotton blankets	n=3	Radiant heat (1500 W) + heated and humidified inspired gases (39°C).	n=2
Upper and lower extremities warming (n=1 with wadded, quilted cotton wraps / n=1 with polyvinyl chloride-lined boots and mittens at 46°C)	n=2	Forced Air Blankets (n=1 36°C-37°C/ n=4 43°C)	n=5	Heated and humidified inspired gases (39°C or 37°C) + cotton sheet and cotton blankets.	n=1
Hand warming	n=1	Radiant heat (1500 W)	n=2	Head covering (two terry cloth bath towels, face exposed) + cotton-polyester blankets.	n=1
Face warming (n=1 standard face tent with 6–10 L/min of humidified air warmed to 32°C).	n=2			Mechanical ventilation with a humidified heated wire circuit + heated water blankets (39°C).	n=1
				Mechanical ventilation with a heat and moisture exchanger + heated water blankets (39°C).	n=1

Table 1: non-pharmacological treatments of shivering

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6 distinct groups of drugs were identified as being used to treat shivering in addition to non-pharmacological therapies: concentrated solutions, atypical anxiolytics, neuroblockers, sedatives and hypnotics, opioids, and atypical anxiolytics. Methods used to quantify shivering varied widely. The Bedside Shivering Assessment Scale (BSAS) (5) was only used in three investigations (10,11,12) that were completed after 2008. The scale categorizes shivering as nonexistent, mild, moderate, and severe.

DISCUSSION/CONCLUSIONS

In addition to controlling shivering as the primary outcome, finding a non-pharmacologic treatment for shivering that has been shown to be effective in clinical trials is important for reducing risk, reducing complications in treated individuals, and lowering hospital costs. Despite the fact that the phenomena has been researched since 1987, the literature review is highly inconsistent and offers no conclusive information about the best non-pharmacological treatment for shivering. But the procedure using forced air blankets has been explored the most and produced the best outcomes (10, 11, 13). Because a greater portion of the surface gets counter-warmed, this therapy has a favorable effect. The average skin temperature is significantly impacted by this treatment, which also contributes to 20% reduction in shivering at a rate of 1 °C for every 4 °C increase in average skin temperature (10). The healthcare professional decision to employ a specific anti-

shivering technique may be influenced by factors such as device efficacy, availability, safety, cost, and convenience of use.

Actual/Future Perspectives

In keeping with the initial goal, this scoping review may provide a foundation for future research focusing on non-pharmacologic therapies, such as forced-air blanket interventions that treat and prevent shivering in adult patients undergoing TTM for neuroprotective reasons in various ICU settings. Shivering should be objectively assessed and detected as soon as possible using the Bedside Shivering Assessment Scale (1) as an alternative to instrumental measurements, such as indirect calorimetry (5), because this method is affordable and easily repeatable by skilled operators. This will ensure unambiguous and validated measurement.

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APPENDIX 1: Search Strategy

DATABASE	DATE HOUR	SEARCH STRING	RESULTS
PUBMED	May 15, 2022 01:24 pm	((((((((((((return of spontaneous circulation[Title/Abstract]) OR (ROSC[Title/Abstract])) OR (cardiac arrest[MeSH Terms])) OR (cardiac arrest[Title/Abstract])) OR (out of hospital cardiac arrest[MeSH Terms])) OR (out of hospital cardiac arrest[Title/Abstract])) OR (OHCA[Title/Abstract])) OR (in-hospital cardiac arrest[Title/Abstract])) OR (IHCA[Title/Abstract])) AND (targeted temperature management[MeSH Terms])) OR (targeted temperature management[Title/Abstract])) OR (TTM[Title/Abstract])) OR (therapeutic hypothermia[MeSH Terms])) OR (therapeutic hypothermia[Title/Abstract])) OR (TH[Title/Abstract])) AND (((shivering[Title/Abstract]) AND (shivering[MeSH Terms])) OR (nonpharmacological treatment[Title/Abstract]))	104
MEDLINE	May17, 2022 10:34 am	(TI return of spontaneous circulation OR AB return of spontaneous circulation OR MH cardiac arrest OR TI cardiac arrest OR AB cardiac arrest AND MH targeted temperature management OR TI targeted temperature management OR AB targeted temperature management OR MH therapeutic hypothermia OR TI therapeutic hypothermia OR AB therapeutic hypothermia) AND (MH shivering OR TI shivering OR AB shivering AND TI nonpharmacological treatments OR AB nonpharmacological treatments)	57
SCOPUS	May 17, 2022 10:50 am	(TITLE-ABS(return of spontaneous circulation) OR TITLE-ABS-KEY(cardiac arrest) OR TITLE-ABS(out-of-hospital cardiac arrest) OR TITLE-ABS(OHCA) OR TITLE-ABS(in-hospital cardiac arrest) OR TITLE-ABS(IHCA) AND TITLE-ABS-KEY(targeted temperature management) OR TITLE-ABS(TTM) OR TITLE-ABS-KEY(therapeutic hypothermia) OR TITLE-ABS(TH)) AND (TITLE-ABS(shivering) AND TITLE-ABS(shivering management) OR TITLE-ABS(nonpharmacological treatments))	43
CENTRAL	May 17, 2022 11:00	((return of spontaneous circulation):ti,ab,kw OR (cardiac arrest):ti,ab,kw AND (targeted temperature management):ti,ab,kw OR (TTM):ti,ab,kw OR (therapeutic hypothermia):ti,ab,kw) AND ((shivering):ti,ab,kw AND (shivering management):ti,ab,kw OR (nonpharmacological treatments):ti,ab,kw)	Cochrane Reviews 1 Trials 30
CINHALL Plus with full text	May, 20 2022 02:02 pm	(TI return of spontaneous circulation OR AB return of spontaneous circulation OR TI ROSC OR AB ROSC OR MH cardiac arrest OR TI cardiac arrest OR AB cardiac arrest AND TI targeted temperature management OR AB targeted temperature management OR MH therapeutic hypothermia OR TI therapeutic hypothermia OR AB therapeutic hypothermia) AND (MH shivering OR TI shivering OR AB shivering AND TI nonpharmacological treatments OR AB nonpharmacological treatments)	50

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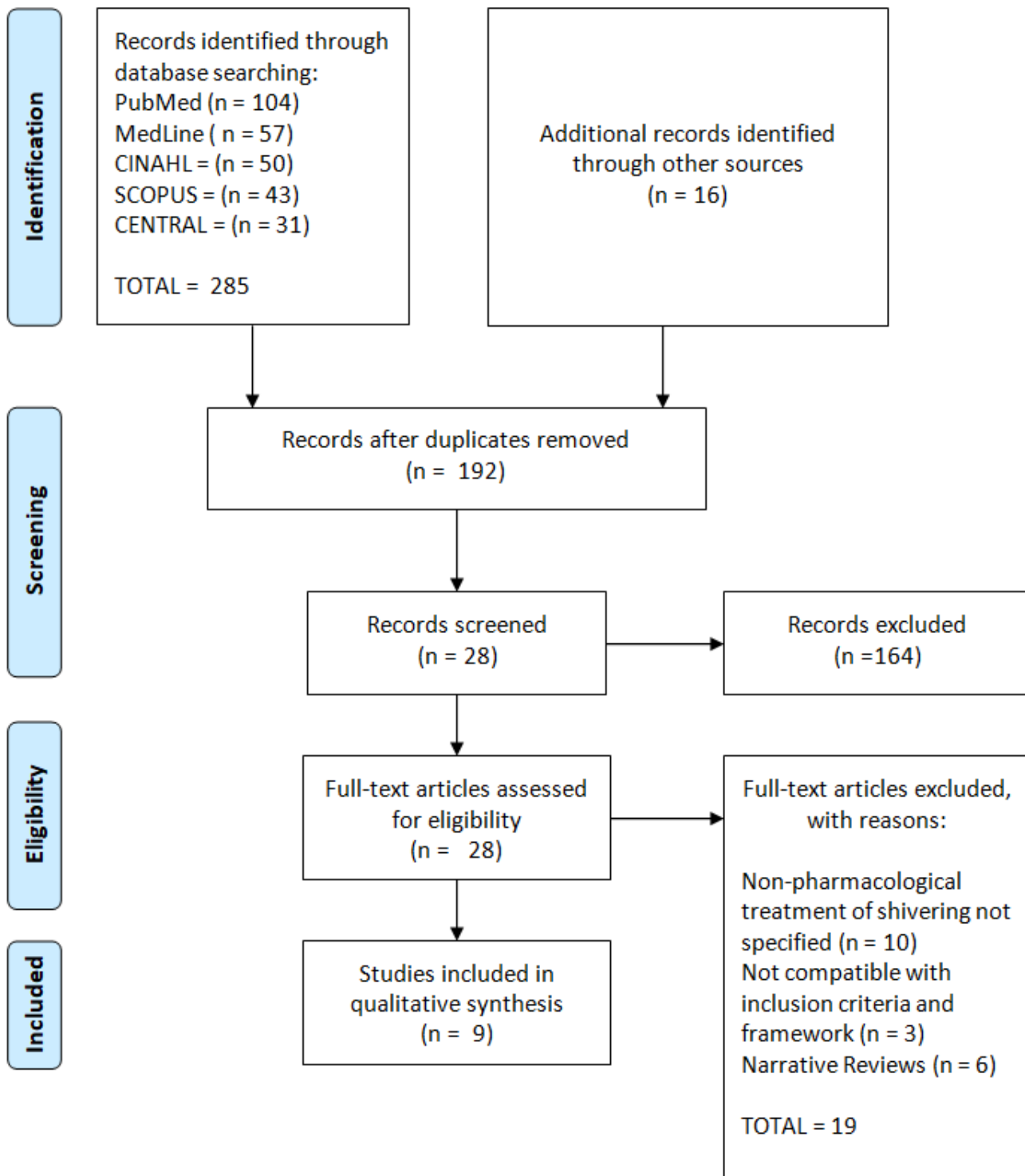
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APPENDIX 2: PRISMA Flow-Diagram



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med* 6(6): e1000097. doi:10.1371/journal.pmed1000097

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