Cool Running Water as a First Aid Treatment for Burn Injuries

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Study objective: The application of 20 minutes of cool running water within 3 hours of a burn injury significantly improves patient burn-related outcomes. To facilitate the integration of 20 minutes of cool running water into clinical practice in the United States, this investigation aimed to determine barriers and facilitators to implementing 20 minutes of cool running water in out-of-hospital emergency medical services (EMS) and in-hospital emergency departments (EDs) and to codesign tailored strategies for its routine use in acute burn first aid.

Methods: Using a sequential mixed-methods design, we identified barriers and facilitators to 20 minutes of cool running water implementation and codesigned strategies to enhance its implementation. EMS and ED clinicians completed an online questionnaire assessing perceived barriers and facilitators, with responses coded using the Consolidated Framework for Implementation Research. Semistructured interviews with a convenience sample of participants further examined determinants and codesigned implementation strategies.

Results: A total of 371 (210 EMS, 161 ED) clinicians participated in the questionnaire, and 22 (14 EMS, 8 ED) participated in interviews. Twelve key determinants were identified across 4 Consolidated Framework for Implementation Research domains. Implementation barriers included a lack of resources, challenges adapting 20 minutes of cool running water to local clinical settings, and the absence of external policies incorporating burn first aid cooling, whereas facilitators included high clinician motivation, strong professional networks, and a supportive clinical culture. Codesigned strategies to enhance 20 minutes of cool running water uptake included portable irrigation equipment, nursing-driven protocols, and policy updates.

Conclusion: Although clinicians appear motivated to implement 20 minutes of cool running water, infrastructure, workflow, and policy challenges hinder widespread adoption. Addressing these barriers through targeted codesigned 20 minutes of cool running water implementation strategies will facilitate integration into EMS and ED settings, improving burn care outcomes. [Ann Emerg Med. 2026;87:90-102.]

Please see page 91 for the Editor's Capsule Summary of this article.

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INTRODUCTION

Background

Current best-practice, evidence-based, first aid for acute thermal burn injuries consists of 20 minutes of cool running water administered within the first 3 hours post-burn. Recommendations from burn care organizations worldwide, including the British Burn Association, Australian and New Zealand Burn Association, and European Burn Association, advocate for 20 minutes of cool running water as a first aid treatment for acute thermal burn injuries.[1-3] Although the optimal water temperature remains undetermined, cool running water is defined in this context as a continuous flow of water from a tap, shower, or hose between 2 °C and 25 °C or 36 °F and 77 °F.[4-6] Adequate cool running water first aid, delivered either consecutively or collectively within the first 3 hours of a burn, significantly decreases the depth of burn wounds in animal models and improves clinical outcomes in adult and pediatric cohort studies.[4,7-15]

Importance

More than 398,000 Americans seek treatment for burn injuries each year.[16] However, 20 minutes of cool running

Editor's Capsule Summary

What is already known on this topic

Best-practice first aid for burn injuries is 20 minutes of cool running water within 3 hours of injury.

What question this study addressed

What are the barriers and facilitators of 20 minutes cool running water in EMS and emergency department (ED) settings?

What this study adds to our knowledge

EMS barriers include increased scene time, environmental exposure, and lack of cool/clean running water. ED barriers include lack of infrastructure, resource intensity, and workflow disruption.

How this is relevant to clinical practice

This study informs how more patients could receive recommended treatment for burns.

water within 3 hours post-burn is absent from United States emergency medical services (EMS), emergency medicine, and burn organizations' first aid guidelines. The American Burn Association recommends at least 5 minutes of running water as an initial first aid treatment.[17] The US Federal Emergency Management Agency advise 3 to 5 minutes of cooling.[18] The National Wildfire Coordinating Group recommends applying cool, clear water over burns, but does not specify the duration.[19] Even with guidelines incorporating some cooling in place, compliance is poor.[20] A 2010 US study of 211 burn patients (95% thermal burns) demonstrated that fewer than 40% of patients used tap water to cool their burns, with more than 25% opting for ice–a method contraindicated due to increased risk of vasoconstriction and hypothermia.[21] Similarly, a 2018 US investigation involving 177 children (0 to 18 years) with acute burns found that 35% of children had their burns irrigated with cold water.[22] However, both studies lacked specification regarding the duration of cooling. Even simple, evidence-based interventions face implementation obstacles due to health care system complexity and diversity. Variability in workflows, clinician training, protocols, resource limitations, and competing priorities hinder best-practice adoption.[23] Even in countries with 20 minutes of cool running water guidelines, only 48% to 72% of acute burn patients receive optimal first aid.[24,25] The translation of scientific evidence into patient care practices is not a problem unique to burn care, but reflects a broader issue in health care, in which proven interventions often face delays or inconsistencies in real-world application.[23]

Aim and Objectives

We aimed to determine barriers and facilitators to the implementation of 20 minutes of cool running water within ED and EMS settings, and codesign tailored implementation strategies to address these barriers and leverage facilitators.

METHODS

Study Design

We used a sequential, mixed-methods, codesign approach, applying the 2009 Consolidated Framework for Implementation Research to identify barriers and facilitators to implementing 20 minutes of cool running water into burn first aid practice.[26,27] Codesign refers to the meaningful involvement of end users, such as clinicians and service providers, in the planning and design of the research, where they contribute in defined and auditable roles to ensure the strategies developed are practical, relevant, and grounded in frontline experience.[26] We developed questionnaires that included both quantitative and qualitative questions to gather data on perceived barriers and facilitators to 20 minutes of cool running water implementation in EMS and ED settings. We then conducted semistructured interviews with clinicians in these settings, guided by data obtained from the questionnaires. This study received ethical approval from the UC Davis Office of Research Institutional Review Board (IRB ID: 18834-5). We adhered to the Consensus-Based Checklist for Reporting of Survey Studies, with the completed checklist provided in Appendix E1 (available at http://www.annemergmed.com).[28]

Outcomes

The primary outcome of this study was identifying barriers and facilitators to implementing 20 minutes of cool running water in ED and EMS settings. The secondary outcome was codesigning tailored implementation strategies. We chose these outcomes to directly address the study's objective of understanding the factors that influence the integration of 20 minutes of cool running water into clinical practice. We aimed to uncover key themes related to organizational, procedural, and individual factors that could either hinder or support adoption. The codesign process with clinicians allowed for the development of strategies that were both contextually appropriate and aligned with the needs and resources of the participating organizations.

Setting and Participants

We engaged EMS clinicians from the Sacramento Fire Department and frontline clinicians from the UC Davis ED. The UC Davis Medical Center in Sacramento, California, is a 646-bed academic medical center and Level 1 trauma center serving 19 counties and more than 5 million residents. The UC Davis Firefighters Burn Institute Regional Burn Center, part of this medical center, is an American Burn Association-verified Center of Excellence, providing specialized care for more than 500 burn patients annually. UC Davis ED participants included physicians, nurses, and technicians involved in the acute treatment of burn patients. The Sacramento Fire Department provides fire protection and emergency medical services to Sacramento and surrounding areas, closely coordinating with local burn centers for patient transfers. Participants from Sacramento Fire Department included officers and non-officers, all serving as firefighter paramedics or firefighter emergency medical technicians (EMTs).

Recruitment and Sampling

Researchers invited clinicians from both organizations to complete the REDCap (Research Electronic Data Capture, Vanderbilt, USA, hosted at Griffith University) questionnaire. REDCap is a secure, web-based software platform designed to support data capture for research studies.[29] Clinical investigators from participating institutions identified potential participants and disseminated questionnaire links through institutional emails. Quick response (QR) codes linked to the REDCap questionnaire were also placed around common staff areas. Participation was voluntary and anonymous. To receive a $5 Amazon gift card (United States dollars) as compensation, participants were required to provide their email addresses to a member of the research team at UC Davis. This helped deliver the gift card and prevent duplicate questionnaire entries. We used purposive and convenience sampling due to recruitment through institutional emails, QR codes, and voluntary participation. Questionnaires were open for 3 months, with UC Davis ED from April to June 2023 and Sacramento Fire Department from March to May 2023. Due to the deidentified nature of data collection, the questionnaire and interview groups were independent, making any potential overlap undetectable. For the interview phase, participants were selected to ensure diversity in role, seniority, experience, and sex.

Measurements

Electronic questionnaires. We developed two 25-item electronic questionnaires using REDCap (one tailored for the ED and one for the Sacramento Fire Department) and piloted them with 5 senior clinicians (TP, JR, KM, SS, NK) to assess the clarity and comprehension of included questions, length and burden to complete, overall flow of included items, branching logic, and alignment with local clinical services and terminology, including the correct terms for professional roles. Questionnaires were then distributed through workplace email to frontline clinicians involved in the management of patients with acute burn injuries across the Sacramento Fire Department and the UC Davis ED. Questionnaires explored contextual factors influencing burn first aid practices across acute care settings and identified barriers and facilitators to implementing 20 minutes of cool running water into routine practice. Participants also rated the perceived difficulty of administering 20 minutes of cool running water in 3 clinical case scenarios using Likert scales. An abridged version appears below, with full questionnaires provided in Appendix E2 and E3 (available at http://www.annemergmed.com).

Example questions:

Prior burns care experience

- *How often has first aid been a part of the out-of-hospital care you/your team have provided to people with burn injuries?* (Options: Always, Sometimes, Rarely, Not yet or Never)
- *Typically, what burn first aid is provided?* (Options: Running water, Still water, Clean dressing, Misted water, Hydrogel dressings, Unknown, Other)

20 minutes of cool running water first aid

- *Prior to hearing about the TIER-ED EFFECT Project, have you heard of 20 minutes of cool running water?* (Options: Yes, No)
- *How acceptable is 20 minutes of cool running water?* (Likert Scale: Completely acceptable, No opinion, Completely unacceptable)

20 minutes of cool running water scenarios: *Please consider the following patient scenarios, and rate the perceived difficulty to provide 20 minutes of cool running water for burns first aid.*

- *A 2-year-old boy with 2% scald burns to arm from spilling hot instant noodles, medically stable* (Options: Very difficult, Difficult, No opinion, Easy, Very easy, Unknown/unsure)

Demographics

- *How many years of experience do you have in emergency/burns care or emergency medical services?* (Free-text response)

Semistructured interviews

We conducted face-to-face, semistructured group interviews with clinicians from Sacramento Fire

Department and the UC Davis ED. Three women researchers trained in qualitative methods facilitated the interviews: a Professor of Nursing and Midwifery (BG – PhD), a Burns Clinical Research Coordinator (MH – PhD), and a Burns Quality Program Coordinator (YS – MPH). Before the interviews, we met with participants to build rapport, explain the study's purpose, outline the researchers' roles, and discuss the potential consequences. We used questionnaire data to develop interview guides that explored barriers and facilitators to 20 minutes of cool running water implementation in more depth, informing the codesign of implementation strategies tailored to each setting. The semistructured interview guide is provided in Appendix E4 (available at http://www.annemergmed.com).

Data Analysis

Electronic questionnaires. We used descriptive statistics to characterize participants' demographics, prior burn experience, frustrations with current initial burn care, and burn first aid treatments and acute dressings used within their institutions. All analyses were conducted using Microsoft Excel 365 (Microsoft Corporation, Redmond, WA).

To identify perceived barriers to administering and implementing 20 minutes of cool running water, 2 researchers (MH, TD) manually coded barrier-specific questionnaire data using deductive qualitative methods guided by the Consolidated Framework for Implementation Research constructs.[27,30] Additional details on the Consolidated Framework for Implementation Research are available in Appendix E5 (available at http://www.annemergmed.com).[31] We mapped barriers and facilitators to ED and EMS settings to develop matched strategies, addressing identified implementation barriers. We used the Expert Recommendations for Implementing Change (ERIC) Barrier Buster V0.53 Matching Tool (https://cfirguide.org/choosing-strategies/) to generate unadapted implementation strategies based on Consolidated Framework for Implementation Research constructs. We also used these Consolidated Framework for Implementation Research -derived barriers to develop our semistructured interview guide with the Consolidated Framework for Implementation Research Interview Guide Tool (https://cfirguide.org/guide/app/). Given the anonymous and voluntary nature of data collection, it was not possible to assess the characteristics of nonresponders or compare them to respondents.

Semistructured interviews

We audio recorded and transcribed all interviews with clinicians from the ED and EMS verbatim. Two researchers (MH, TD) analyzed the transcripts using rapid analysis methods guided by a Consolidated Framework for Implementation Research-based framework.[32] We manually coded themes and relationships, continuing until no new themes emerged and consensus was reached. Interviews confirmed implementation barriers from the questionnaire and supported codesign of context-specific strategies. Clinicians adapted generic strategies to local needs, identifying necessary resources, informing content and distribution channels for educational materials, and defining inclusion and exclusion criteria for integrating 20 minutes of cool running water into burn first aid guidelines and external policies.

RESULTS

Characteristics of Study Subjects

A total of 371 clinicians (210 EMS, 161 ED) completed the questionnaire, and 22 clinicians (14 EMS, 8 ED) were interviewed. We distributed questionnaires to 463 EMS clinicians at Sacramento Fire Department (45.4% response rate) and 250 ED clinicians at UC Davis (64.4% response rate). Though QR codes linked to the questionnaire were shared only in the ED, we cannot confirm that only ED clinicians responded, which may slightly inflate response rates. Participant demographics are detailed in Appendix E6 and E7 (available at http://www.annemergmed.com). The EMS clinicians had a median of 18 years of experience, whereas ED clinicians had 6 years. More than 85% of ED clinicians and 18% of EMS clinicians reported their most recent involvement with burn patients within the last 6 months, with only 1% (ED) and 9% (EMS) stating they had never treated a burn patient. Table 1 presents current first aid practices for acute burn injuries in both the ED and EMS. Missing data were noted for transparency. Figure 1 illustrates clinicians' perceptions of 20 minutes of cool running water, including views on the effort required for implementation and their confidence in adopting it.

A significant portion of ED (65%) and EMS (60%) respondents expressed confidence in using 20 minutes of cool running water as a first aid treatment for acute burn patients. This reflects a readiness for change and adaptability among clinicians. Approximately half of the respondents noted that 20 minutes of cool running water differed from their existing practices, yet fewer than 10% of ED and 11% of EMS respondents felt unconfident in its administration. Table 2 outlines factors that might deter clinicians from applying 20 minutes of cool running water, such as limited access to clean water, long transport and wait times, patient stability, trauma, pediatric patients requiring sedation, staffing availability, physician endorsement, and noncooperative patients. Participants could choose multiple responses.

Table 1. Burn first aid practices.
Survey responses from ED and EMS clinicians on frequency and type of burn first aid provided, dressings used, awareness of the 20 minutes of cool running water guideline and time spent on scene providing first aid.

Variable	ED Count (%) N=161	EMS Count (%) N=210
How often has first aid been a part of the out-of-hospital care you/your team have provided to people with burn injuries?		
Sometimes	63 (39.1)	49 (23.3)
Rarely	42 (26.1)	34 (16.2)
Not yet/Never	34 (21.1)	3 (1.4)
Always	18 (11.2)	104 (49.5)
Missing data	4 (2.5)	20 (9.5)
Typically, what burn first aid is provided?		
Clean dressing (wet or dry)	102 (63.8)	168 (80)
Running water	42 (26.3)	61 (29.1)
Unknown	25 (15.6)	6 (2.9)
Hydrogel dressings	18 (11.3)	7 (3.3)
Still water	10 (6.3)	31 (14.8)
Other	–	25 (11.9)
What dressing (if any) is applied to the wound after injury, cooling, and/or in transit to hospital?		
Dry gauze or similar dressing	80 (49.7)	148 (70.5)
Clean cloth or towel	24 (14.9)	11 (5.2)
Other	22 (13.7)	15 (7.2)
Missing data	16 (9.9)	24 (11.4)
Hydrogel burn dressing (eg, Burnaid)	16 (9.9)	10 (4.7)
Plasticized polyvinylchloride film (eg, saran wrap and cling film)	3 (1.9)	2 (1)
Prior to this research, had you heard of 20 minutes of cool running water?		
No	135 (84.9)	188 (90)
Yes	24 (15.1)	21 (10.1)
How commonly do you and/or your team stay on scene with the patient to provide burn first aid before transfer?*		
Rarely	–	101 (48.1)
Not yet/Never	–	38 (18.1)
Always	–	30 (14.3)
Missing data	–	26 (12.2)
Sometimes	–	15 (7.1)

ED, Emergency department; *EMS*, emergency medical services.
*This question was not asked of ED respondents. EMS participants who responded to the following question "typically, what burn first aid is provided" and indicated "other" as their multiple-choice option were asked to expand on their answers. Other reported burn first aid interventions included pain management; intravenous fluids; occlusive dressings; burn sheet dressings; saline solution soaked dressings; saline solution flushes; oxygen; and rapid transport to an appropriate ED.

Main Results: Determinants of 20 Minutes of Cool Running Water Implementation—Consolidated Framework for Implementation Research Domains and Constructs

These results integrate findings from the questionnaire and semistructured interviews with 22 clinicians. Constructs across 4 Consolidated Framework for Implementation Research domains were identified, as shown in Figure 2 (adapted from Damschroder et al[27]), which illustrates their relationships within the framework. Appendix E8 (available at http://www.annemergmed.com) includes representative quotes organized under the same headings.

Intervention Characteristics

Adaptability. Challenges in adapting 20 minutes of cool running water to current EMS and ED care models were identified as barriers to implementation. In the ED, concerns about the adaptability of 20 minutes of cool running water arose from patients with nonsevere burns facing long wait times due to high patient volumes, often exceeding the 3-hour window for treatment. ED participants emphasized the need for a nursing-driven approach to identify suitable candidates for 20 minutes of cool running water within the waiting room, allowing non-critical burn patients to receive 20 minutes of cool running water and then return to the ED waiting room to await ongoing treatment. A triage nurse protocol was proposed to assess burn patients' suitability for 20 minutes of cool running water, balancing the risk of decompensation. Out-of-hospital, EMS participants reported perceived challenges adapting 20 minutes of cool running water provision in unsafe scenes, structure fires, as well as remote and rural locations with limited access to cool and/or clean running water. Moreover, participants described difficulties adapting 20 minutes of cool running

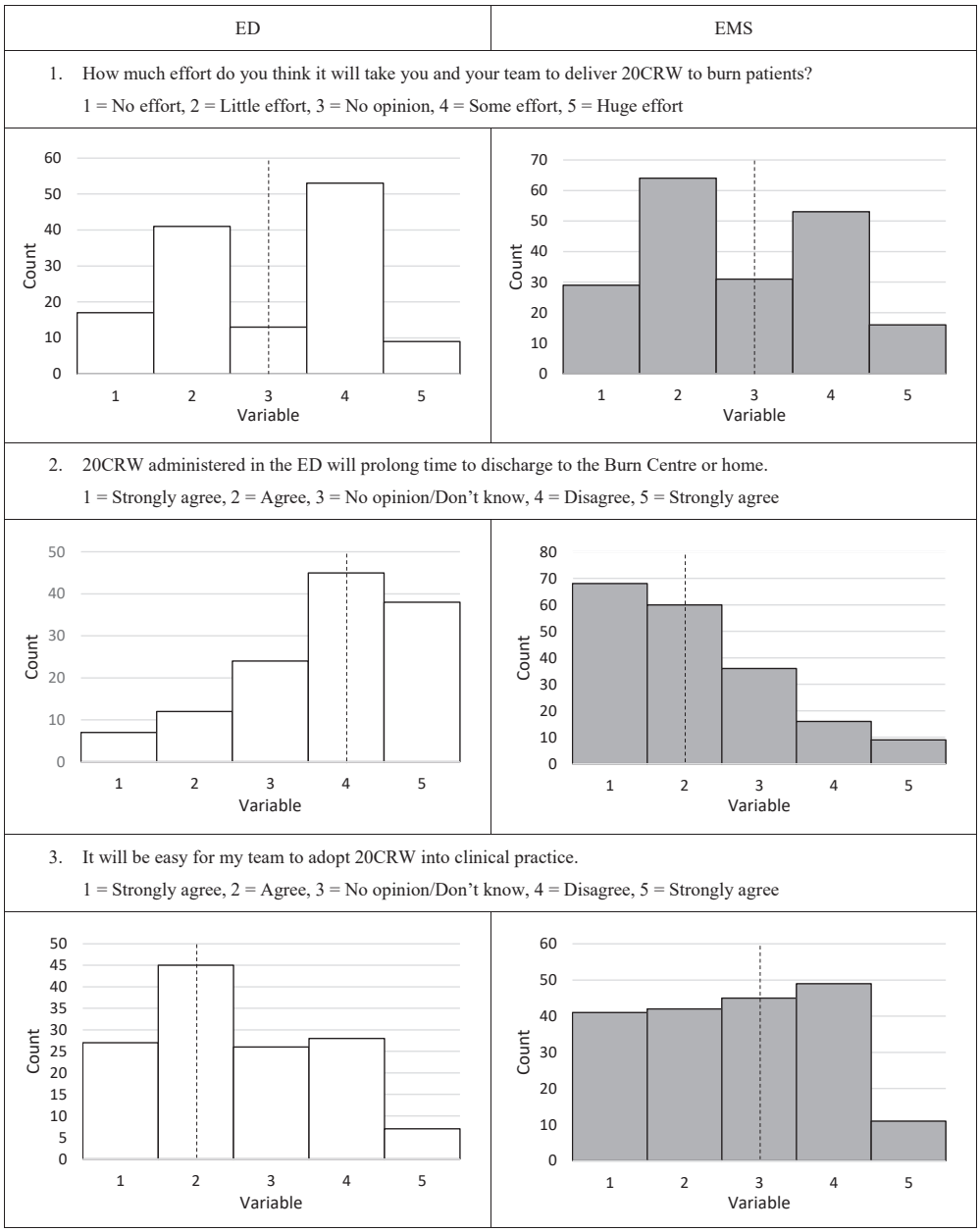

Figure 1. Perceptions of 20 minutes of cool running water among ED and EMS respondents. Six histograms illustrate survey responses, with dashed vertical lines indicating the medians. *20CRW*, 20 minutes cold running water.

water for patients burned in non-residential settings and for vulnerable groups, including those experiencing homelessness, patients injured outside at night in cold temperatures, intoxicated patients, those with substance use disorders, and burn patients with mental health issues affecting compliance and consent to care.

Complexity. This construct was identified as both a positive and negative determinant of clinical implementation. ED and EMS participants viewed 20 minutes of cool running water as a simple intervention, easily initiated by bystanders, patients, and families before EMS arrival, particularly if patients were stable and scenes were safe (ie, nonstructure fires). However, for a small percentage of burn patients, there are practical and logistical challenges in administering 20 minutes of cool running water in the out-of-hospital and ED settings. ED

Table 2. Conditions that may limit the application of 20 minutes of cool running water in burn patients.Survey responses from ED and EMS clinicians identifying patient or workplace factors that would make them less likely to apply 20 minutes of cool running water.

What patient or workplace conditions would make you less likely to apply 20 minutes of cool running water?	ED Count (%)	EMS Count (%)
Suspected airway burns	127 (79.4)	184 (87.6)
Burns involving the face	123 (76.9)	159 (75.7)
Unsafe scenes	111 (69.4)	187 (89.1)
Hypothermia	109 (68.1)	116 (55.2)
Glasgow Coma Scale score < 15	75 (46.9)	107 (51)
Inability to gain intravenous access	68 (42.5)	67 (31.9)
Burns with TBSA ≥10%	53 (33.1)	57 (27.1)
Other	11 (6.9)	6 (2.7)

TBSA, Total body surface area.

participants reported a lack of facilities and resources within the department needed for 20 minutes of cool running water implementation such as showers and sinks, as well as concerns surrounding the resource-intensive process of irrigating a burn wound for 20 minutes. For unstable patients taken to an ED shower for 20 minutes of cool running water, burn wound irrigation might require monitoring from a physician, nurse, or technician during the cooling process, which could potentially disrupt workflow. Participants also expressed reservations about the complexities of implementing 20 minutes of cool running water for nonambulatory patients in the ED. EMS participants reported that remaining on-scene to administer running water for a 20-minute duration might be viewed as disruptive and a deviation from their standard model of care, where it is uncommon for Sacramento Fire Department staff to remain on-scene for prolonged periods of time excluding cardiopulmonary resuscitation.

Relative advantage. This construct was identified as a positive determinant of 20 minutes of cool running water implementation. Compared to current standard practice within the Sacramento Fire Department for the management and transportation of burn patients (ie, applying dry gauze), participants considered 20 minutes of cool running water to be more advantageous, providing immediate burn first aid treatment that positively impacts burn wound progression and clinical outcomes. ED participants reported frustrations with current burn care practices, noting that limited interventions are provided within the ED until the Burn/Surgical Team arrives. The implementation of 20 minutes of cool running water within the ED allows ED clinicians to provide first aid intervention to acute burn patients prior to the arrival of the Burn/Surgical Team.

Evidence strength and quality. Evidence strength and quality was identified as a positive determinant of clinical implementation within this investigation. Both ED and EMS participants indicated that once relevant clinicians, patients, and the public understand the clinical benefits, rationale, and effect of 20 minutes of cool running water on improving burn patient outcomes, this will aid in its implementation and uptake into clinical practice.

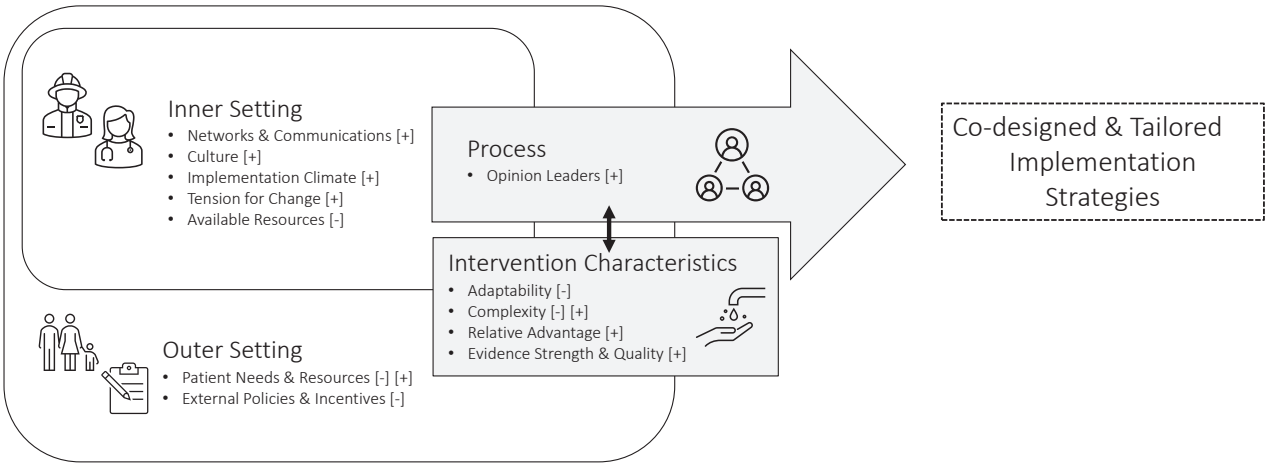

Figure 2. Consolidated Framework for Implementation Research domains and constructs influencing the implementation of 20 minutes of cool running water burn first aid within out-of-hospital and ED settings. Facilitators to 20 minutes of cool running water implementation are denoted with a [+] and barriers limiting 20 minutes of cool running water implementation are depicted as a [–].[27]

Inner Setting

Within this investigation, the inner setting domain describes the teams within the 2 participating stakeholder organizations (ie, UC Davis Health and Sacramento Fire Department).

Networks and communications. This construct was identified as a positive determinant of 20 minutes of cool running water implementation. Within ED and EMS settings, participants reported strong social networks and a multitude of workplace communication platforms that facilitate widespread dissemination of materials. Both organizations described having strong platforms for internal communications, face-to-face and group communications, written and electronic communications, interdepartmental communications, formal meetings, knowledge management systems, and intranet platforms allowing internal private communication and information sharing.

Culture. Consolidated Framework for Implementation Research construct was reported as a positive facilitator to 20 minutes of cool running water implementation within this investigation. ED and EMS participants emphasized the importance of research, continuing professional development, education, and public outreach within their organizations.

Implementation climate. This construct was also reported as a facilitator to 20 minutes of cool running water implementation. Both ED and EMS participants reported high capacities for change within their organizations, and strong support for updating models of care and guidelines to align with current evidence-based practice. However, we acknowledge that there may be some bias in these responses, as participants may perceive their organizations more positively than the reality of implementing change might reflect. In large institutions or fire services, the ease of change reported by participants may contrast with the challenges faced in actual practice, where logistical, institutional, or cultural barriers could impede the adoption of new practices.

Tension for change. Tension for change was identified as a positive facilitator to 20 minutes of cool running water implementation. Participants expressed frustrations with existing burn care practices—feeling limited by current protocols and the lack of cooling guidelines in place. ED clinicians expressed a strong desire to do more for acute burn patients following their arrival to the ED, with respect to providing additional interventions, treatments, administering pain relief, and other acute care measures that could improve patient comfort and outcomes before specialist care begins. The data suggested that participants were eager for 20 minutes of cool running water to be formally included in burn first aid protocols, recognizing its potential to fill this gap and enhance early treatment in both EMS and ED settings.

Available resources. This Consolidated Framework for Implementation Research construct was identified as a barrier to clinical implementation. Participants reported substantial resource limitations required for 20 minutes of cool running water, including a lack of clear inclusion criteria, contraindications, staff time, and limited resources such as sinks, showers, and irrigation equipment. ED participants expressed concern that, without the required infrastructure, each instance of 20 minutes of cool running water provision might necessitate reinventing the processes, thus creating a substantial barrier to sustained use. The lack of adequate sinks in the initial triage area within the ED was noted as a potential challenge to 20 minutes of cool running water implementation. If burn patients need to move to another room for a shower or sink, it is seen as inconvenient and might affect the implementation of 20 minutes of cool running water. Participants also emphasized the importance of having clear evidence-based data and information on the risk of hypothermia, suggesting that providing this information to clinicians would enhance buy-in for the intervention.

Outer Setting

Within this investigation, the outer setting domain describes the participating stakeholder organizations (ie, UC Davis Health and Sacramento Fire Department), as well as broader overarching organizations like the American Burn Association.

External policies and incentives. A lack of burn first aid guidelines and policies that included 20 minutes of cool running water were reported within both ED and EMS settings. Participants emphasized difficulties and challenges with the implementation of a first aid treatment without clear departmental or organizational guidelines that include 20 minutes of cool running water. EMS participants emphasized the need for dispatch to provide burn first aid cooling instructions prior to emergency personnel arriving on-scene. More than 60% of EMS clinicians surveyed believed 20 minutes of cool running water would prolong on-scene time and delay hospital transfer (Figure 1). However, participants noted that if dispatch instructed patients to begin 20 minutes of cool running water while awaiting EMS, it would reduce on-scene time and cooling requirements in the ED. Additionally, dispatch involvement would ensure consistent messaging, reinforce the credibility of 20

minutes of cool running water, and prevent it from being perceived as an improvised intervention, facilitating broader acceptance and integration into burn care protocols.

Patient needs and resources. This construct was identified as both a positive and negative determinant of 20 minutes of cool running water implementation. Barriers included the needs and challenges of pediatric burn patients, as well as concerns around 20 minutes of cool running water inducing hypothermia in patients with large burn injuries. However, public education was seen as a facilitator to 20 minutes of cool running water implementation.

Process

Opinion leaders. This construct was reported as a facilitator to 20 minutes of cool running water implementation. Participants highlighted the crucial role of leaders in driving adoption. EMS participants noted that gaining support from a few key influencers could facilitate wider departmental acceptance. Captains and senior leaders were identified as essential for encouraging compliance and engagement among staff.

Main Results: Codesigned Implementation Strategies

Table 3 presents the complete set of matched, codesigned, and tailored implementation strategies. The table includes initial matched strategies (both generic and nontailored) alongside subsequent tailored strategies, which incorporate data and feedback from semistructured interviews. Please note that these strategies were developed specifically for the local setting, and minor adaptations may be required by others wishing to apply these strategies in different clinical contexts.

LIMITATIONS

Findings from this research should be interpreted with consideration of the following limitations. Firstly, this research was conducted in one specific geographical context—an ED within a burn center and an EMS system in a city with a burn center—limiting the generalizability of the results to other clinical settings, particularly those with different health care systems or environments. EMS personnel in cities without a burn center may have different perspectives, especially on logistics like transport options and destination choices. Secondly, this investigation relied on the perceptions and experiences of a small number of ED and EMS clinicians, which may not fully capture the complexities of implementing 20 minutes of cool running water as a burn first aid treatment. The views of other stakeholders, such as burn patients and their families, were not included in the current investigation. Lastly, although this research developed codesigned and tailored strategies to overcome identified barriers to20 minutes of cool running water implementation, the feasibility and effectiveness of these strategies have not been tested. Future research will evaluate these strategies in real-world settings to determine their effect on 20 minutes of cool running water provision and improvements in burn patient outcomes. Despite these limitations, this research provides valuable insights into perceived barriers and facilitators to 20 minutes of cool running water implementation in ED and EMS settings. Further research is needed to validate these findings in other settings and stakeholder groups.

DISCUSSION

We identified key barriers and facilitators to implementing 20 minutes of cool running water as a first aid intervention for thermal burns in ED and EMS settings. Although clinicians recognized its clinical benefits and ease of use, logistical challenges, resource limitations, and policy gaps hinder 20 minutes of cool running water implementation and widespread adoption. Using a determinant framework, we codeveloped strategies to address these challenges and support broader integration into acute burn care. Participants perceive 20 minutes of cool running water as highly beneficial, recognizing its cost-effectiveness, accessibility, and ease of use compared to current standard practices. To support implementation, tailored strategies included developing educational materials for clinicians, such as frequently asked questions, infographic posters, online and in-person presentations, and email communications. ED and EMS participants codesigned these materials, guiding researchers on content inclusion, preferred formats, and distribution channels.

Both EMS and ED clinicians reported barriers such as resource shortages and unclear patient criteria for 20 minutes of cool running water, along with limited access to irrigation equipment in the ED. To address this, we codesigned exclusion criteria with ED and EMS clinicians (Table 3), and the UC Davis ED has procured bedside equipment to facilitate 20 minutes of cool running water administration. These findings highlight the need for health care organizations to invest in resources for 20 minutes of cool running water implementation. The absence of external policies and standardized protocols incorporating 20 minutes of cool running water into burn first aid and acute management guidelines was a significant barrier to its implementation. At the time of participant

Table 3. Identified barriers, facilitators, matched strategies and tailored implementation strategies.
Barriers and facilitators to 20 minutes of cool running water implementation based on Consolidated Framework for Implementation Research constructs, with matched generic ERIC and tailored 20 minutes of cool running water strategies.

Consolidated Framework for Implementation Research Constructs	Matched (Generic) ERIC Implementation Strategies	Tailored 20 Minutes of Cool Running Water Implementation Strategies
1. Adaptability – Barrier	a. Promote adaptability b. Capture and share local knowledge	• Purchasing of irrigation equipment/portable showers (where output can flow into floor drains) as an additional alternative when the showers and decontamination room are unavailable in the ED. This will facilitate 20 minutes of cool running water to be provided in the resuscitation bay/bedside • Ensure irrigation equipment for bedside 20 minutes of cool running water provision does not flood ED floors with water or create a tripping hazard • Development of a nursing-driven protocol, allowing triage nurses to determine which burn patients are suitable for 20 minutes of cool running water
2. Complexity – Barrier and facilitator	Develop a formal implementation blueprint	Addressing staff concerns regarding scene time when doing education, using cardiopulmonary resuscitation example
3. Relative advantage – Facilitator	Identify and prepare champions	• Develop resources that address staff needs • Provide champions with 20 minutes of cool running water educational materials for distribution and sharing within their organizations
4. Evidence strength and quality – Facilitator	a. Conduct educational meetings b. Develop educational materials c. Distribute educational materials	• Development of two 20 minutes of cool running water frequently asked questions' sheets, tailored for ED and EMS clinicians and based on frequently asked questions that arose during semistructured interviews • Development of 2 tailored 20 minutes of cool running water infographics for circulation through organizational emails and online channel • Distribute educational material on staff training websites and Clinical Resource Centers (eg, hospital wide portals for housing clinical protocols)
5. Patient needs and resources – Barrier and facilitator	a. Conduct local needs assessment b. Involve patients/consumers and family members c. Obtain and use patients/consumers and family feedback	• Obtain feedback from EMS clinicians who have administered 20 minutes of cool running water in the out-of-hospital setting • Obtain feedback from ED clinicians who have administered 20 minutes of cool running water in their ED • Obtain feedback from patients who received 20 minutes of cool running water within the out-of-hospital or ED setting
6. External policies and incentives – Barrier	Conduct local consensus discussions	• Involve and liaise with fire department medical directors, EMS communication center medical directors, ED attendings, attending burn surgeons, executive board members, and American Burn Association board members • Update burn first aid guidelines, protocols, and policies so recommendations are consistent with US professional bodies
7. Networks and communications – Facilitator	a. Organize clinician implementation team meetings b. Promote network weaving	• Provide ongoing training at academic forums • Add 20 minutes of cool running water as an education session topic • Provide ongoing training at ED preshift huddles, triage meetings, and other clinical meetings • Provide ongoing training at Yearly Skills Days for staff – request to have 20 minutes of cool running water education added to this training day • Promote relationship and engagement with EMS communication centers (local 9-1-1 dispatch) to commence burn wound cooling before EMS arrival • Engage California Professional Firefighters • Engage California Medical Assistance Team and Community Emergency Response Team • EMS guidelines – update protocols and policies to include 20 minutes of cool running water

Table 3. Continued.

Consolidated Framework for Implementation Research Constructs	Matched (Generic) ERIC Implementation Strategies	Tailored 20 Minutes of Cool Running Water Implementation Strategies
8. Culture – Facilitator	Identify and prepare champions	• Utilize the strong positive work cultures within the participating ED and EMS organizations • Develop educational resources and training material for ED and EMS champions, facilitating them to continue to provide ongoing education and training on 20 minutes of cool running water
9. Implementation climate – Facilitator	Assess for readiness and identify barriers and facilitators	Identification of ED- and EMS-specific barriers perceived to affect the provision of 20 minutes of cool running water to burn patients Hold an investigator consensus meeting
10. Tension for change – Facilitator	Identify and prepare champions	Identification and engagement with relevant clinicians Identification of 20 minutes of cool running water champions within the ED and EMS
11. Available resources – Barrier	Access new funding	• Development of local ED and EMS burn first aid best-practice guidelines and policies that incorporate 20 minutes of cool running water provision within 3 hours post-burn for thermal injuries • Develop resources that address staff concerns and needs – establish clear patient criteria, exclusions, and contraindications for 20 minutes of cool running water • Patient criteria and exclusions to be presented at project stakeholder meetings for feedback and consensus on contraindications reported during semistructured interviews • Develop clinical decisionmaking flow chart for 20 minutes of cool running water and clear rules around who can administer this and in what situations • Build a 20 minutes of cool running water Order Set and/or add 20 minutes of cool running water to current Burns Order Set in the ED • Within the Order Set – need to create a prompt that states "Stable for 20 minutes of cool running water"
12. Opinion leaders – Facilitator	a. Identify and prepare champions b. Inform local opinion leaders c. Identify early adopters	• Engagement with influential, respected, and experienced experts • Provide opinion leaders with 20 minutes of cool running water educational materials for distribution and sharing within their organizations • Filming and televising news media interviews with influential, respected, and experienced experts discussing 20 minutes of cool running water burn first aid

interviews, Sacramento Fire Department, UC Davis Health, and the American Burn Association did not formally include 20 minutes of cool running water in their guidelines. In response, the UC Davis ED, UC Davis Firefighters Burn Institute Regional Burn Center, Sacramento Fire Department, as well as 9-1-1 dispatch instructions for acute thermal burn patients, have now integrated 20 minutes of cool running water into their burn first aid guidelines. This highlights the importance of establishing consistent burn first aid guidelines, policies, and messaging across EMS, EDs, and relevant stakeholders to ensure the successful implementation of evidence-based practices like 20 minutes of cool running water. Future research will aim to incorporate 20 minutes of cool running water into guidelines at the American Burns Association, Federal Emergency Management Agency, and US Fire Administration.

Previous research conducted in an Australian out-of-hospital setting identified that EMS clinicians can often face barriers to providing 20 minutes of cool running water first aid to burn patients on-scene.[33] Barriers to out-of-hospital burn first aid provision identified within the Australian investigation included environmental challenges such as remote and rural incident locations without access to clean or cool running water, compliance issues and intoxication in adult patients, and managing pain, fear, and distress in pediatric burn patients and their families.[33] The Australian investigation identified facilitators to 20 minutes of cool running water provision, including patients following emergency dispatch instructions and commencing running water cooling prior to EMS arrival on-scene, providing fast and effective analgesia to patients, and having immediate access to clean cool running water.[33] The current US investigation also identified

similar barriers and facilitators to out-of-hospital 20 minutes of cool running water provision.

Successful implementation of 20 minutes of cool running water requires adaptation to local EMS and ED environments, particularly to address complexity and resource constraints. Nursing-driven protocols in the ED and clear dispatch instructions in out-of-hospital settings offer promising solutions. Despite challenges, the perceived advantages of 20 minutes of cool running water suggest its potential as a valuable addition to current burn care practices, ultimately improving outcomes for burn patients. Moving forward, future research should prioritize developing targeted strategies to integrate 20 minutes of cool running water into statewide clinical guidelines and policies, including the American Burn Association. The ultimate goal is to facilitate the translation of this evidence-based intervention into widespread clinical practice across the United States.

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