Research, Society and Development, v. 13, n. 10, e83131047133, 2024
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v13i10.47133

Evolution and challenges in pre-hospital care for burn injury victims in Brazil

Evolução e desafios no atendimento pré-hospitalar para vítimas com lesão por queimaduras no Brasil

Evolución y desafíos en la atención prehospitalaria para víctimas con lesiones por quemaduras en Brasil

Received: 10/03/2024 | Revised: 10/13/2024 | Accepted: 10/14/2024 | Published: 10/18/2024

Anderson dos Santos Barbosa
ORCID: https://orcid.org/0000-0001-5004-9935
AGES Faculty of Medicine, Brazil
E-mail: anderson.s.barbosa@ages.edu.br
Claudio Kelvin Pedrosa Costa
ORCID: https://orcid.org/0000-0003-1823-2021
AGES Faculty of Medicine, Brazil
E-mail: ckmed1507@gmail.com
Eva Tamires de Souza
ORCID: https://orcid.org/0009-0007-1610-6634
AGES Faculty of Medicine, Brazil
E-mail: evatamiresmed20@gmail.com
Leonardo Diego Lins
ORCID: https://orcid.org/0000-0002-7072-0930
AGES Faculty of Medicine, Brazil
E-mail: ldlins@uneb.br
Tâmara Trindade de Carvalho Santos
ORCID: https://orcid.org/0000-0002-2863-1993
AGES Faculty of Medicine, Brazil
E-mail: tamara.carvalho@ages.edu.br
Fabiana Chagas Oliveira de França
ORCID: https://orcid.org/0000-0002-1923-4099
AGES Faculty of Jacobina, Brazil
E-mail: fabiana.franca@ages.edu.br
José Alfredo de Oliveira Alkmin
ORCID: https://orcid.org/0009-0000-2703-6829
AGES Faculty of Medicine, Brazil
E-mail: jose.alkmin@ages.edu.br

Abstract
Burns are severe injuries with a high potential for morbidity and mortality, affecting both the physical and mental health of patients, making them a significant and important issue. Although the Mobile Emergency Care Service (SAMU) was implemented to improve assistance, there are still deficiencies in terms of infrastructure, management, and professional training. The aim of this study was to provide an overview of the evolution of pre-hospital care for burn patients and raise awareness about the challenges faced in assisting these patients. The study, based on a literature review from 2012 to 2024, identified 21 relevant studies that highlight the importance of rapid and effective care in reducing mortality and improving clinical outcomes for patients. However, challenges such as high costs, lack of innovation, and limited continuous training for healthcare professionals still compromise the quality of care. Among the key aspects of pre-hospital care are cooling the burn with cold water, pain management, and quick transfer to specialized centers. The research also emphasizes the importance of standardized protocols and the role of multidisciplinary teams in managing these injuries. Despite advances in hospital treatment, there is a lack of innovations for pre-hospital care, underscoring the need for more studies to improve the initial response to burn victims and long-term quality of life.
Keywords: Pre-hospital assistance; Victims; Burns.

Resumo
As queimaduras são lesões graves, com alto potencial de morbidade e mortalidade, que afetam a saúde física e mental dos pacientes, tornando-o um problema significativo e de grande importância. Embora o Serviço de Atendimento Móvel de Urgência (SAMU) tenha sido implementado para melhorar a assistência, ainda há deficiências em termos de infraestrutura, gestão e capacitação profissional. O objetivo deste trabalho foi fornecer uma visão geral sobre a

evolução e do atendimento pré-hospitalar de pacientes com queimaduras e conscientizar sobre os desafios enfrentados na assistência a esses pacientes. O trabalho, baseado em uma revisão de literatura de 2012 a 2024, identificou 21 estudos relevantes que apontam para a importância de um atendimento rápido e eficaz para reduzir a mortalidade e melhorar os desfechos clínicos dos pacientes. No entanto, desafios como altos custos, falta de inovação e pouca formação contínua dos profissionais de saúde ainda comprometem a qualidade do atendimento. Entre os principais aspectos do cuidado pré-hospitalar estão o resfriamento da lesão com água fria, o controle da dor e a rápida transferência para centros especializados. A pesquisa também destaca a importância de protocolos padronizados e a atuação de equipes multidisciplinares no manejo dessas lesões. Apesar dos avanços em tratamento hospitalar, há uma escassez de inovações para o cuidado pré-hospitalar, enfatizando a necessidade de mais estudos que melhorem a resposta inicial a vítimas de queimaduras e a qualidade de vida a longo prazo.
Palavras-chave: Assistência pré-hospitalar; Vítimas; Queimaduras.

Resumen

Las quemaduras son lesiones graves, con alto potencial de morbilidad y mortalidad, que afectan la salud física y mental de los pacientes, convirtiéndose en un problema significativo y de gran importancia. Aunque el Servicio de Atención Móvil de Urgencias (SAMU) se implementó para mejorar la atención, aún existen deficiencias en términos de infraestructura, gestión y capacitación profesional. El objetivo de este trabajo fue proporcionar una visión general sobre la evolución de la atención prehospitalaria de pacientes con quemaduras y concienciar sobre los desafíos que se enfrentan en la asistencia a estos pacientes. El trabajo, basado en una revisión de la literatura de 2012 a 2024, identificó 21 estudios relevantes que señalan la importancia de una atención rápida y eficaz para reducir la mortalidad y mejorar los resultados clínicos de los pacientes. Sin embargo, desafíos como altos costos, falta de innovación y escasa formación continua de los profesionales de la salud aún comprometen la calidad de la atención. Entre los principales aspectos del cuidado prehospitalario se encuentran el enfriamiento de la lesión con agua fría, el control del dolor y la rápida transferencia a centros especializados. La investigación también destaca la importancia de protocolos estandarizados y la actuación de equipos multidisciplinarios en el manejo de estas lesiones. A pesar de los avances en el tratamiento hospitalario, existe una escasez de innovaciones en la atención prehospitalaria, lo que subraya la necesidad de más estudios que mejoren la respuesta inicial a las víctimas de quemaduras y la calidad de vida a largo plazo.
Palabras clave: Atención prehospitalaria; Víctimas; Quemaduras.

1. Introduction

Burns are injuries resulting from agents (such as thermal, chemical, or electrical energy) capable of producing excessive heat that damages body tissues and leads to cell death, which is generally severe, depending on factors such as the etiological agent, exposure time, depth of the lesion, and the burned body surface (Kara, 2018).

Burn injuries, although they may not seem common, are frequent in emergency and urgent care settings and are often underestimated, even though they are associated with a significant amount of morbidity and mortality. They require full attention because, depending on the severity of the injuries, they trigger an inflammatory response in the immune system, as well as metabolic changes and the possibility of distributive shock, potentially leading the patient to multiple organ failure. Another important point is that these post-trauma patients not only experience negative effects on their physical health but also on their mental health and quality of life (Jeschke et al., 2020).

Burn patients often suffer from severe scarring and a disfigured body image, which generates distorted perceptions of their appearance and even a range of negative societal stigmas. Among the cutaneous sequelae of burns are depigmentation, erythema, hypertrophic scars, keloids, contractures, and scar instability, causing local changes and dysfunction of the surrounding organs and joints (Rodrigues et al., 2019).

Additionally, due to the extent and degree of the burn, significant changes in the normal anatomy of the skin can lead to disfigurement. Thus, burn victims, bearing scars in exposed areas of the body, gain new labels from individuals, families, and society related to their appearance. In this way, there is a direct impact on the mental, physical, and social health of burn victims, emphasizing the importance of pre-hospital care focused on burns, as well as the role of the family as advocates in the patient's recovery process (Oliveira et al., 2023; Rodrigues et al., 2019).

Well-developed pre-hospital care enables burn victims to receive adequate care, favoring the reduction of mortality as

well as psychological and physical morbidity (Outwater et al., 2018). Moreover, proper interventions and the formulation of action plans are essential so that, in case a burn accident cannot be prevented, the injury is treated in a way that minimizes the damage as much as possible (Kara, 2018). Therefore, the aim of this study was to provide an overview of the evolution of pre-hospital care for burn patients, as well as to update information related to proper care and raise awareness of the challenges associated with assisting these patients.

2. Methodology

Scientific methodology is necessary for an article to have reproducible results (Pereira et al., 2018). This section refers to an integrative literrature review (Snyder, 2019; Crossetti, 2012) which consists of a study with a broad approach that does not follow strict protocol, as the data source is not predetermined and is sometimes less comprehensive. This method is used to explore studies produced on the same topic. For this purpose, a search of scientific publications is conducted to gather and summarize the results of these studies. Thus, it is characterized as an important research source, as it cross-references information from various studies, conducted by different academics in different locations, and under different perspectives on the same topic.

The guiding question was developed using the PCC strategy, which highlights the following mnemonic elements: P - Population; C - Concept; and C - Context. Accordingly, the following elements were defined: P = burn victims; C = challenges in burn victim care; and C = pre-hospital care. Based on this, the following research question was formulated: "What are the challenges in care and pre-hospital assistance for burn victims?". The search was conducted in September 2024. A reflective analysis was performed based on the systematic search of studies published between 2012 and 2024, due to the availability and relevance of research within this period. Data were collected through a review of the literature available in major databases, including PUBMED, the Virtual Health Library (VHL), SCIELO (Scientific Electronic Library Online), Google Scholar, MEDLINE, and LILACS (Latin American and Caribbean Health Sciences Literature). The following Health Sciences Descriptors (DeCS) were used: pre-hospital care, burn, and emergency medical service, combined using the Boolean operator AND.

The study included articles published between 2012 and 2024, available for free and in full on the internet, in Portuguese, English, and Spanish, that answered the guiding question, with at least two descriptors in the title and within the proposed time frame. The following exclusion criteria were established: articles that did not address the study's guiding question in the title and abstract, duplicates, those conducted outside Brazilian territory, editorials, articles published beyond the 10-year time frame, and articles written in other languages. In case of disagreement among the authors regarding inclusion and exclusion criteria, a specific discussion on the work in question was conducted until a final consensus was reached.

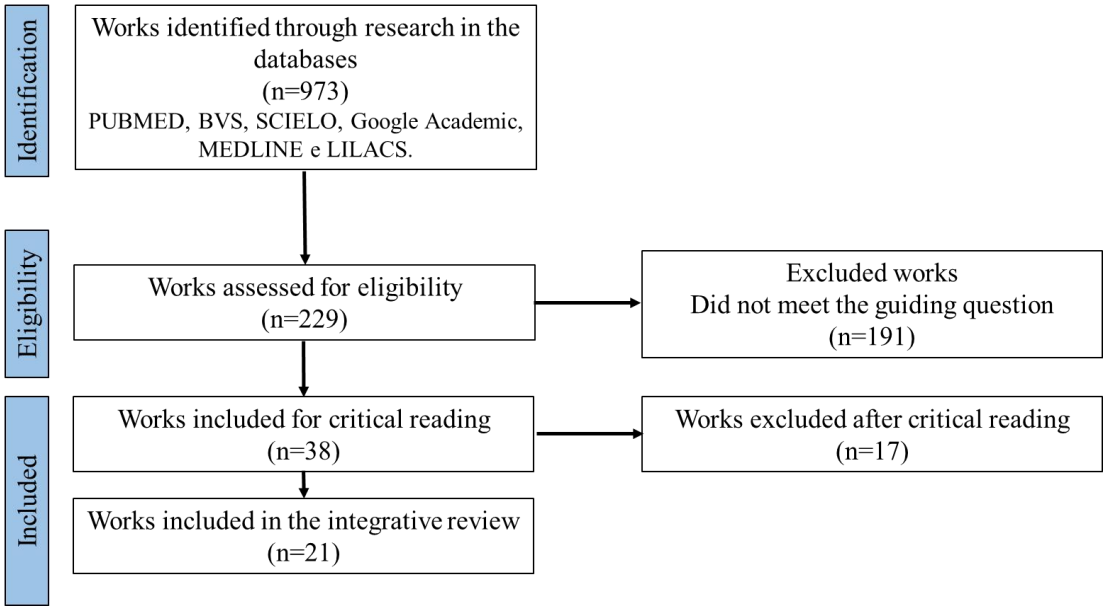
3. Results

From the combination of descriptors, the first stage of the search yielded 973 studies addressing the topic. The second stage, which involved applying advanced search filters related to the inclusion criteria, resulted in 229 articles. In the third stage, the articles were initially evaluated by title and then by abstract, excluding those that did not meet the guiding question of the study. At this stage, 38 articles remained for narrative review. The fourth and final stage involved eliminating duplicates and reviewing the full text of the studies, resulting in 23 articles being excluded. Thus, the final review was composed of 21 articles. The results of the study selection process can be seen in Figure 1.

In the evaluated articles (n = 21), consistency was observed in the findings that demonstrate the benefits of an effective and skillful pre-hospital care (PHC) protocol for burn patients. Most of the studies found indicate that rapid pre-

hospital care has a positive correlation with the reduction of morbidity and mortality, providing better outcomes regarding the patient's well-being. Some of the studies also address essential procedures in the PHC of burn patients.

Figure 1 - Flowchart of the study search and selection process.



Source: Authors.

Other articles highlight the challenges encountered in developing an efficient pre-hospital care protocol for burn victims, especially in developing countries, due to the high costs often required, suggesting alternative ways to mitigate this issue. It is also noted that most studies do not present significant innovations in pre-hospital care for burn victims. For better visualization, a summary was prepared with some of the articles considered for reflection and formulation of the discussion among the authors (Table 1).

Table 1 - Summary with some of the articles considered for reflection and formulation of the discussion among the authors.

AUTHOR/YEAR	OBJECTIVE	CONSIDERATIONS
(Andrade, 2019)	To analyze the available evidence on the immediate treatment of burn victims in the prehospital environment.	The general population does not know how to handle burns or prevent them due to a lack of effective and widely disseminated preventive methods, exacerbated by entrenched popular beliefs.
(Cavalcante et al., 2021)	To describe the appropriate procedures for managing burn patients according to the level of care, severity, and specificities in the treatment.	Proper care for burn victims must follow strict, pre-established protocols, with emphasis on prehospital care based on the type of burn, followed by treatment from a multidisciplinary team, respecting specificities in the care of special populations.
(Clementino et al., 2024)	To analyze the technologies used by the nursing team in the treatment of burn-related skin injuries in patients under intensive care.	The highlighted technologies included the use of specialized dressings, biological agents such as probiotics and cyanobacteria, negative pressure therapies, and enzymes like papain and collagenase. Some technologies, such as nanocrystalline silver, proved effective in infection control.
(Jeschke et al., 2020)	To present an overview and update, while raising awareness about ongoing challenges and stigmas associated with burns.	The response to burns and their treatment is complex, and despite advances in survival, treatment needs to evolve. New technologies should be adopted at all stages of recovery to improve outcomes in the short and long term.

(Josuttis et al., 2024)	To investigate current practices and their potential effects on patient outcomes.	Severely burned patients often received excessive fluids in prehospital care, without benefits in hemodynamic stability or better outcomes. Prehospital intubation, common in these cases, was associated with higher mortality rates. Future research and training should focus on proper fluid use and careful decision-making about intubation.
(Laura et al., 2022)	To investigate whether burn treatment changed globally during the pandemic and how factors such as country income, geographic location, COVID-19 transmission patterns, and burn unit specialization levels influenced resource allocation and access to treatment.	The survey was completed by 234 burn units in 43 countries. During the pandemic, the presence of burn surgeons did not change ($p = 0.06$), while anesthetists and dedicated nursing staff were reduced (<0.01), as well as the ability to manage patients across all age groups ($p = 0.04$). Telemedicine use was implemented ($p < 0.01$), but collaboration between burn centers was not. Burn units in LMICs and LICs were more likely to close, after adjusting for other factors.
(Holbert et al., 2024)	To describe and explore barriers to providing prehospital first aid for burns to Emergency Medical Service (EMS) clinicians.	Our results suggest that when patients do not receive ideal burn first aid on-site, it is not due to a lack of knowledge or awareness of prehospital clinical guidelines for acute burns, but the result of a range of clinical, patient, and environmental factors affecting the provision of prehospital first aid.
(Malta et al., 2020)	To describe the profile of burn victims treated in emergency services and identify associations between the variables investigated.	Burns were more common in adults aged 20 to 39, men, and at home, mainly caused by hot substances. Domestic accidents predominated in children aged 0 to 15, the elderly, and women. Accidents in commerce, services, and industry affected individuals aged 16 to 59. Referrals to other hospitals were more frequent among the elderly, and hospitalizations were more common among children. Among workers, incidents were associated with alcohol use and the workplace. For women, burns were more related to hot substances and domestic accidents.
(Oliveira et al., 2023)	To evaluate the resilience capacity of burn patients at the time of admission and hospital discharge in an emergency hospital in Goiânia.	The relationship between the Support factor and the presence of a partner highlights the importance of family support networks in the rehabilitation of burn patients.
(Outwater et al., 2018)	To describe the initial treatment of burns in Tanzania to suggest ways to optimize initial care.	The main obstacle to proper burn treatment is the lack of knowledge about immediate care. A dual educational approach is recommended: a national mass media campaign should be launched to instruct the population on the correct initial treatment for burns.
(Sgarbossa et al., 2024)	To report the experience of health education on burn prevention and first aid measures for children.	The educational activity using the memory game facilitated interaction between students and children, deepening their understanding of the subject. For medical students, the experience promoted reflection on their role in health promotion, as well as developing communication skills, empathy, and an understanding of the socioeconomic reality of public-school students.
(Silva et al., 2020)	To review how initial care for burn patients should be provided, improve the quality of life of these individuals, and analyze the best and most recent treatments for burns.	In Brazil, statistical data on burn injuries are still scarce. However, such data are essential to understand the magnitude of the problem and identify the most affected populations, as well as the circumstances in which burns occur, to implement prevention programs.
(Silva et al., 2021)	To discuss the multiprofessional approach in treating a severely burned patient in a general Intensive Care Unit (ICU).	Many challenges were faced during this hospitalization, especially the difficulties of managing a severely burned patient in a general ICU. It is hoped that this case will stimulate new research to rethink, modify, improve, and equip the multiprofessional team in caring for burn patients.
(Souto et al., 2020)	To demonstrate recent advances in the use of nanoparticles in wound dressing formulations and tissue engineering for treating burn wound infections.	Nanotechnology has been successful in finding strategies to incorporate antibiotics into nanoparticles for local wound treatment, thus avoiding systemic drug exposure.
(Zdanowski et al., 2019)	To describe ways to reduce the severity of burn injuries in prehospital care.	Educational projects to promote best practices, using products like hydrogel dressings, seem necessary. Medical staff should quickly assess the extent and severity of burns. Additionally, calculated fluid therapy should be implemented, the airway should be protected, and efforts should be made to ensure thermal comfort. Pain assessment and appropriate pharmacological measures for analgesia and sedation must also be performed.

Source: Authors.

4. Discussion

The first pre-hospital care in Brazil was recorded in 1883 with horse-drawn ambulances, following a law approved by the Senate of the Republic that established urgent medical assistance on the streets of Rio de Janeiro (O'Dwyer et al., 2013). Since then, several advances have occurred in pre-hospital care, including the implementation of the Mobile Emergency Care Service (SAMU-192) in 2003, introduced by the National Policy for Urgent Care (PNAU) by the Ministry of Health. This service was created to provide pre-hospital care for accidents, trauma, and various clinical conditions (O'Dwyer et al., 2013).

According to Malta et al. (2020), in an analysis of cases treated in Brazilian capitals, burns were more frequent in adults aged 20 to 39 years (40.7%), men (57.0%), in domestic settings (67.7%), and caused by hot substances (52.0%). Domestic accidents were more common among children aged 0 to 15 years (92.0%) and the elderly (84.4%), with women accounting for 81.6% of these cases. Accidents in commercial, service, and industrial environments affected individuals aged 16 to 59 years (73.6%). Referrals to other hospitals were more frequent for elderly patients, while hospitalizations were more common in individuals aged 0 to 15 years, highlighting the importance of addressing the issue of burn injuries.

Despite progress, the existence of pre-hospital services has been limited in many municipalities due to adverse conditions, such as poor management, lack of infrastructure, and insufficient professional training. These challenges interfere with PNAU's goal to reduce morbidity and mortality by ensuring timely care for patients, including those suffering from burns (Andrade, 2019).

Burn injuries, caused by fire or other agents, are a global health problem, killing approximately 180,000 people annually, with low-income countries, children, and the elderly being the most affected (WHO, 2018). The most common causes of burns include thermal, chemical, electrical, and ionizing factors (Jeschke et al., 2020; Zdanowski et al., 2019). Despite these alarming global statistics, burn injury rates have significantly decreased over time, particularly in developed countries, thanks to the implementation of effective prevention and treatment programs. Outwater et al. (2018) note that 90-95% of burn cases occur in low- and middle-income countries, especially among people from lower socioeconomic classes.

To further reduce burn injuries, it is essential not only to implement awareness campaigns and prevention strategies but also to introduce a culture of self-care among the population. Additionally, healthcare professionals must receive psychosocial support to enhance their capacity to provide care. For burn patients, even when injuries are not fatal, long-lasting physical, functional, psychological, and social consequences can occur (Panayi et al., 2024). These damages are often linked to the healing process, as prolonged healing times lead to more severe sequelae, which must be treated as early as possible to improve the patient's quality of life (Jeschke et al., 2020).

In Brazil, although pre-hospital care for burn patients has advanced, it still exhibits a slow, fragmented process with some flaws that place a significant burden on public resources due to the complexity of care in the pre-, intra-, and post-hospital phases (Andrade, 2019). In 2012, the Brazilian government introduced the "Emergency Burn Treatment Handbook" to guide healthcare professionals and the general public on clinical management and first responses to burn injuries. However, continuous education and qualification for SAMU professionals are still insufficient, given the complexity of such care. Proper protocols and procedures must be regularly updated to ensure optimal care for burn victims (Brasil, 2012).

Key factors that lead to positive outcomes during pre-hospital care for burn patients include (1) initial care provided to burn victims, (2) information sources used by caregivers, (3) reasons for applying (or not applying) specific materials, and (4) the time it takes for victims to reach a healthcare facility. These aspects are crucial to facilitating communication for interventions that will allow proper and immediate initial treatment (Outwater et al., 2018). Studies show that information on burn treatment is often provided by family, friends, and neighbors rather than healthcare professionals, which can negatively affect pre-hospital care outcomes (Outwater et al., 2018).

Moreover, the therapeutic process's effectiveness depends primarily on pre-hospital actions. First aid administered by bystanders at the scene is often ineffective, as improper actions can worsen the patient's condition, potentially leading to secondary infections (Cruz et al., 2021). According to Zdanowski et al., (2019), the most important pre-hospital treatment, depending on the injury's severity and extent, involves applying cold water to cool the burn, prevent further injury, and avoid contamination. Cold water relieves pain, reduces cellular damage, stabilizes vasculature, decreases edema, and improves healing and scarring, thus reducing mortality. However, several factors can increase the risk of burn injuries, including the location and extent of the burn and the causal agent. Burn severity varies from superficial (first-degree) to deep injuries that can affect internal tissues and bones, leading to complications such as Multiple Organ Dysfunction Syndrome (MODS), which can be fatal without immediate, specialized medical care (Cunha et al., 2023; Zdanowski et al., 2019).

Silva et al. (2020) highlight five pillars of care for burn patients: (1) applying dressings that promote re-epithelialization and prevent heat and water loss; (2) controlling potential infections to prevent sepsis; (3) administering fluid replacement if necessary; (4) considering excision of the burned area; and (5) using skin substitutes for reconstruction. Healthcare professionals must quickly assess the burn's extent and severity, initiate fluid therapy, protect the airway, ensure thermal comfort, and manage pain through appropriate analgesics. Additionally, they must coordinate transportation to specialized burn treatment centers (Zdanowski et al., 2019).

There is consensus on the importance of standardized protocols for burn care, considering different approaches for special populations, such as pregnant women and children. Standardized initial treatment protocols can optimize services through organized and planned care, positively impacting patient outcomes. However, there are ongoing controversies regarding medical practices. Excessive fluid administration in pre-hospital settings should be discouraged, as it is not associated with better clinical outcomes (Josuttis et al., 2024).

The importance of a multidisciplinary team in burn patient care is also critical, as it reduces mortality but increases healthcare system demand (Cavalcante et al., 2021). According to Valente et al. (2018), cooling burns with running water at an appropriate temperature should be done immediately for about 20 minutes. However, this ideal duration is often neglected by pre-hospital professionals due to concerns about infection and hypothermia. This practice reduces the need for skin grafts in pediatric and adult patients, improving clinical outcomes (Holbert et al., 2024).

In this context, research on burn injuries continues to evolve. For example, the Federal University of Ceará's Research and Development Center for Medicines has developed a temporary biological dressing made from tilapia skin for superficial burns, though this treatment remains expensive (Maciel et al., 2014). Other studies have focused on managing tissue compliance in burn injuries, such as biomechanical modulation therapy (BMT), which promotes the regeneration of ocular tissues damaged by burns by restoring the limbal stem cell niche (Gouveia & Connon, 2020).

Additionally, researchers are addressing the issue of antibiotic resistance by developing localized antibiotics using nanoparticles, which could improve wound healing and reduce the need for systemic antibiotics (Souto et al., 2020). However, most research focuses on treating burns in intensive care settings, while innovations in pre-hospital care remain scarce, highlighting the need for more studies on this crucial aspect of burn treatment that affects patients' long-term quality of life. During the COVID-19 pandemic, burn care services continued to operate, and telemedicine was implemented for case management. Low income was independently associated with reduced access to burn treatment (Laura et al., 2022).

Our findings show that initial burn care involves more than healthcare professionals' knowledge, encompassing patient-specific factors, burn type, and environmental factors. Emphasizing pain control, first aid, and wound cooling is critical (Holbert et al., 2024). The multidisciplinary team, particularly nurses in pre-hospital risk assessment and doctors managing severe cases, plays a crucial role in patient care (Silva et al., 2021).

5. Conclusion

The analysis of the development of pre-hospital care in Brazil, focusing on burn injuries, reveals both significant advances and persistent challenges. Since the implementation of the Mobile Emergency Care Service (SAMU) in 2003, the country has sought to structure a system that minimizes morbidity and mortality related to emergencies, especially in critical situations such as burns. However, the effectiveness of this care is compromised by factors such as the lack of continuous training for professionals, disorganization in local management, and the shortage of adequate resources.

The presented data indicate that burns continue to be a relevant public health problem, predominantly affecting vulnerable populations such as children and the elderly, and that mortality rates, although declining, remain alarming. This underscores the need for more robust investment in prevention campaigns, self-care education, and psychosocial support, which not only enhance public awareness but also strengthen the capabilities of healthcare professionals involved in care.

Additionally, innovations in burn treatment, while growing, are often limited to the hospital environment, revealing a significant gap in research and the development of effective pre-hospital care practices. The use of emerging technologies, such as localized antibiotics through nanotechnology, highlights the importance of continued research and the application of new knowledge.

Thus, for the care of burn victims in Brazil to become more effective, it is imperative to integrate healthcare teams, continuously update care protocols, and focus on multidisciplinary training. The adoption of evidence-based practices and the development of an agile and coordinated response system will not only improve clinical outcomes but also provide a less traumatic experience for patients and their families, ultimately leading to a real improvement in the quality of life for those suffering from the consequences of burns.

Future research and articles on the topic can explore several areas that require greater attention. First, it is crucial to investigate innovative approaches to improving pre-hospital care for burn victims, considering emerging technologies and evidence-based practices. Studies that examine the impact of continuous training for healthcare professionals, as well as efficient local management models, could help mitigate the current shortcomings. Additionally, it is recommended to expand research focused on implementing educational prevention and self-care campaigns, especially targeting vulnerable groups such as children and the elderly. Another promising line of inquiry would be the analysis of new therapies, such as the use of nanomedicine and treatments outside the hospital environment, integrating these innovations into emergency care. Finally, a multidisciplinary approach, involving both clinical care and psychosocial support, is essential to provide more humane and effective care, reducing the physical and emotional impact on patients.

Conflict of Interest

The authors declare that they do not have any conflict of interest.

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