The Management of Dermal Burn Injuries in Emergency Rooms in Phccs and Role of Health Informatics in Enhancing Treatment Outcomes

Muslem Aqeel Al Hajji [1], Ali Sagar S Alanazi [2], Nayef Yousef A Alharbi [3], Turki Abdullah Aldalaan [4], Eman Kamel Alzayer [5], Mustafa Saleh Aljassas [6], Mohammed Ali Masmali [7], Mohammed Abdrab Alraswl Mubarak [8] , Amna Adnan Ali Al Hashem [9], Saeed Khidhran Alshamrani [10]

[1-] Emergency Physician (Registrar), King Fahad Hospital, Hofuf, Saudi Arabia
[2-] General Practitioner, Dermatology Department, King Saud Medical City, Saudi Arabia
[3-] General Physician, R4 Dermatology, King Fahad Specialist Hospital, Saudi Arabia
[4-] General Practitioner, Alnakheel Medical Center, Family Medicine Department, Saudi Arabia
[5-] General Practitioner, Family Medicine, Hizam Safwa Phc, Saudi Arabia
[6-] Health Informatics Technician, Dammam Medical Complex, Saudi Arabia
[7-] Health Informatics Technician, Dammam Medical Complex, Saudi Arabia
[8-] Health Informatics Technician,Dammam Medical Complex, Saudi Arabia
[9-] Health Services Administration, Bgh (Bqaiq General Hospital), Saudi Arabia
[10-] Health Information Management, Dammam Medical Tower, Saudi Arabia

Abstract:

Dermal burn injuries present a significant challenge in emergency care, particularly within Primary Health Care Centers (PHCCs). Effective management requires a systematic approach that includes rapid assessment, stabilization of the patient, and appropriate treatment protocols. In the emergency room setting, healthcare professionals must prioritize pain management, fluid resuscitation, and wound care to reduce the risk of infection and promote healing. Continuous monitoring of the patient's vital signs and burn severity is critical, as timely interventions can significantly improve outcomes. The integration of guidelines and checklists in PHCCs helps streamline the treatment process and ensures that all staff are informed about best practices in burn care. Health informatics plays a crucial role in enhancing treatment outcomes for dermal burn injuries. By utilizing electronic health records (EHR) and health information systems, clinicians can efficiently document patient data, track treatment progress, and access evidence-based guidelines tailored for burn management. This technology facilitates better communication among healthcare providers and improves the coordination of care, ensuring that patients receive timely and appropriate interventions. Additionally, data analytics can help identify trends in burn incidents and outcomes, informing preventive measures and resource allocation within PHCCs. Overall, the integration of health informatics not only supports better clinical decision-making but also enhances the overall management of burn injuries in emergency settings.

Keywords: Dermal burn injuries, Emergency management, Primary Health Care Centers (PHCCs), Pain management, Fluid resuscitation, Wound care, Infection prevention, Health informatics, Electronic health records (EHR), Treatment outcomes, Clinical decision-making, Data analytics

Introduction:

Burn injuries are a significant public health issue globally, necessitating efficient management strategies, especially within emergency care settings. The treatment of dermal burn injuries is particularly challenging and requires a comprehensive understanding of the injury severity, appropriate clinical interventions, and ongoing patient assessment. Within the context of Primary Health Care Centers (PHCCs), which serve as the first line of defense in the healthcare system, the effective management of burn injuries is crucial not only for immediate patient outcomes but also for long-term recovery and rehabilitation. Moreover, the integration of health informatics—defined as the intersection of information science, computer science, and healthcare—has emerged as a

transformative force in enhancing the quality of care delivered in emergency rooms (ERs) [1].

Burn injuries can result from a variety of sources, including thermal, chemical, and electrical agents, leading to varying degrees of damage to the skin and underlying tissues. The assessment of burn injuries is essential to classify them based on depth—classified as superficial, partial thickness, or full thickness—which directly influences treatment protocols and therapeutic approaches. In PHCCs, where resources may be limited compared to specialized burn facilities, healthcare providers face unique challenges in delivering optimal care for dermal burn injuries. Adhering to international guidelines on burn management, particularly the American Burn Association's recommendations, becomes paramount to ensure that patients receive timely and effective treatment. Furthermore, the challenges of expeditious assessment and intervention in a busy ER setting can significantly impact the clinical outcomes of burn patients [2].

The advent of health informatics technology has the potential to address several challenges faced by emergency rooms in PHCCs when managing dermal burn injuries. Electronic Health Records (EHRs), clinical decision support systems, and telemedicine are just a few examples of informatics tools that can streamline processes, enhance communication, and improve documentation in emergency care. For instance, EHRs facilitate the quick retrieval of patient history, allergies, and previous interventions, thereby enabling healthcare providers to make informed decisions quickly. Clinical decision support systems can provide evidence-based guidelines for burn management tailored to the specifics of the patient's injuries and condition, thus enhancing the consistency and effectiveness of care provided [3].

Additionally, the utilization of mobile health (mHealth) applications can improve patient education and engagement, allowing patients and caregivers to receive real-time guidance on burn care and symptom monitoring after an emergency room visit. Furthermore, health informatics can enhance data collection and analysis, allowing healthcare systems to identify trends, risk factors, and outcomes related to burn injuries, which can subsequently inform future practice improvements and resource allocation in PHCCs [4].

Despite the promising advantages of incorporating health informatics into the management of burn injuries, significant barriers remain. Issues including insufficient training of healthcare providers in informatics tools, lack of standardized protocols across different PHCCs, and concerns about data security may hinder the full realization of informatics benefits. Furthermore, the integration of these technologies needs to be approached with a focus on interoperability and user-friendliness to ensure that they effectively augment clinical workflows rather than complicate them [5].

The research presented in this study aims to explore the current management practices of dermal burn injuries in emergency rooms at PHCCs, highlighting the existing gaps and challenges associated with these practices. Additionally, it will investigate how health informatics tools can be leveraged to enhance treatment outcomes for burn patients by improving access to vital information, fostering better clinical decision-making, and ultimately leading to improved recovery rates. By emphasizing the critical intersection between burn management practices and the role of health informatics, this research endeavors to contribute to improving patient care quality and outcomes in emergency settings [6].

Assessment and Classification of Burn Injuries:

Burn injuries are one of the leading causes of morbidity and mortality worldwide, presenting unique challenges to emergency medical professionals. With their complex etiology and varied presentations, proper evaluation and classification are crucial for effective treatment and management. Understanding the classification of burns, their etiologies, the mechanisms of injury, and the initial assessment protocols can enhance the quality of care administered to burn victims in emergency rooms (ERs) [7].

Classification of Burns

Burn injuries can be categorized based on various criteria, including depth, cause, and surface area affected. A widely accepted classification system is based on the depth of tissue injury, which corresponds to the severity and clinical implications of the burns. Generally, burns are classified into four categories:

1. **First-Degree Burns**: First-degree burns, also known as superficial burns, affect only the outer layer of the skin, known as the epidermis. These burns manifest as redness, minor swelling, and pain. The affected area typically heals within 3 to 6 days without scarring, making them less severe than other forms. Common causes include sunburn and brief exposure to hot liquids [8].
2. **Second-Degree Burns**: Second-degree burns, or partial-thickness burns, extend into the dermis, the second layer of skin. These burns are characterized by blisters, significant swelling, and intense pain. They can be further classified into two subcategories:
    - **Superficial Partial-Thickness Burns**: These extend into the upper part of the dermis. They are moist, red, and blistered, healing in about 1 to 3 weeks, typically without scarring.
    - **Deep Partial-Thickness Burns**: These extend deeper into the dermis, resulting in a dry, white appearance. Healing can take longer, often requiring specialized treatment and may result in scarring and functional impairment [8].
3. **Third-Degree Burns**: Third-degree burns, or full-thickness burns, penetrate through the epidermis and dermis into the underlying tissues. The affected skin often appears leathery, dry, or charred, with a waxy-white or black color. These burns are often painless due to nerve damage and typically necessitate surgical intervention, including skin grafting. Healing can take a long time and may result in significant scarring and dysfunction [9].
4. **Fourth-Degree Burns**: Fourth-degree burns are the most severe type, extending beyond the skin to involve underlying fat, muscle, and bone. These injuries can cause severe dysfunction, may lead to amputation, and frequently require extensive surgical intervention and rehabilitation [9].

Causes and Mechanisms of Burn Injuries

Burn injuries can occur through various mechanisms, with the most common types including thermal, chemical, electrical, and radiation burns. Thermal burns are often caused by contact with flames, scalding hot liquids, or surfaces. Chemical burns arise from contact with corrosive substances, such as acids or alkalis. Electrical burns result from electrical currents passing through the body, potentially causing internal injuries not visible on the skin surface. Lastly, radiation burns, often experienced by individuals undergoing radiation therapy or sun exposure without protection, can also lead to varying degrees of skin damage [10].

Burns necessitate swift and systematic evaluation upon arrival at the emergency room. The initial assessment is vital to determine the burn's severity, its potential complications, and the appropriate treatment. The first step is to conduct a thorough history and physical examination. A focused medical history should include the mechanism of injury, the time elapsed since the burn occurred, pre-existing medical conditions, and medication use. The physical examination should assess the depth, size, and location of the burn [10].

Assessment of Burn Size

The extent of burns can be evaluated using several methods. The "Rule of Nines" is one of the most common methods used for estimating the total body surface area (TBSA) affected by burns in adults. In this system, the body is divided into sections, with each section representing approximately 9% (or multiples thereof) of the TBSA. For example, the head and neck area accounts for approximately 9%, each arm for about 9%, each leg for about 18%, the anterior trunk for 18%, and the posterior trunk for 18%.

In pediatric patients, the Lund and Browder chart provides a more accurate assessment by adjusting the percentage of body surface area based on the child’s age. Accurate assessment of TBSA is crucial because it informs fluid resuscitation protocols and guides treatment plans [11].

Initial Management Strategies

After assessing the extent of the burn injury, emergency medical professionals must implement appropriate management strategies, which may include:

- **Fluid Resuscitation**: Major burns (usually those covering more than 10% TBSA in adults) require aggressive fluid resuscitation to prevent hypovolemic shock. The Parkland formula is commonly used to guide fluid therapy [12].
- **Pain Management**: Adequate pain control is paramount in managing burn victims. Opioids and non-opioid analgesics may be used, factoring in the severity of the burn and individual pain thresholds [12].
- **Wound Care**: Initial wound care may involve cooling the burn site with running water (ideally within the first few hours post-injury), covering the area with sterile, non-adherent dressings, and avoiding ice, which can cause further skin damage.
- **Tetanus Prophylaxis**: Assessing a patient's immunization history is vital since many burn victims may be at risk of tetanus infection. Tetanus prophylaxis may be indicated based on the patient's vaccination status.
- **Referral for Specialty Care**: The decision to admit the patient for inpatient care or refer them to a burn center depends on the severity of the burn, the location, and the likelihood of complications [12].

Challenges in Burn Care

Despite advancements in burn management, several challenges persist, including timely recognition and treatment of complications such as infections, fluid overload, and metabolic dysregulation. Burn injuries often have multi-faceted presentations that can obscure their severity, leading to under triage or delayed treatment.

Furthermore, psychological support is vital, as burn injuries can have serious implications on a patient's mental health, including post-traumatic stress disorder (PTSD) and body image issues. Recognizing the need for psychological support and implementing it as part of the treatment plan in the ER is vital for holistic patient care [13].

Standardized Treatment Protocols for Burn Management in PHCCs:

Burn injuries remain a significant public health concern worldwide, contributing to morbidity and mortality, particularly in low- and middle-income countries. In the Philippines, burn injuries are prevalent due to a combination of environmental factors, social practices, and inadequate access to advanced medical care. Primary Health Care Centers (PHCCs) play a pivotal role in managing a variety of health conditions, including burns, especially considering that many burn incidents occur in settings where immediate access to specialized care is limited. Establishing standardized treatment protocols for burn management in PHCCs is essential to improve patient outcomes, streamline care processes, and enhance the overall system of health delivery [14].

Burn injuries can be categorized based on their severity: first-degree burns, affecting only the epidermis; second-degree burns, involving the epidermis and part of the dermis; and third-degree burns, which damage all layers of the skin and may affect underlying tissues. These injuries result from a variety of sources, including thermal, chemical, electrical, and radiation exposures. The degree of injury often dictates the complexity of treatment, with more severe burns requiring advanced medical interventions [14].

Importance of Standardized Protocols

Standardized treatment protocols for burn management in PHCCs are essential for several reasons:

1. **Consistency in Care**: Standardized protocols promote uniformity in the treatment of burn victims, ensuring that all patients receive the same high-quality care regardless of the healthcare provider or location [15].
2. **Enhanced Communication**: Protocols facilitate clearer communication among healthcare professionals, which is crucial in emergencies where timely responses can significantly affect outcomes.

3. **Improved Patient Outcomes**: Evidence-based protocols incorporate the best available research and clinical guidelines, leading to improved healing rates, reduced infection risks, and overall better recovery experiences for patients.
4. **Resource Optimization**: PHCCs often operate under constrained resources. Standardized protocols help in optimizing the use of available resources, ensuring that critical interventions are prioritized.
5. **Training and Education**: Established protocols serve as valuable tools for training healthcare providers at PHCCs, enhancing their knowledge and skills in burn management practices [15].

Components of Standardized Treatment Protocols

A comprehensive burn management protocol should encompass the following key components:

1. **Initial Assessment**: The first step in treating a burn is to quickly assess the severity of the injury. This includes documenting the burn's cause, the extent of the burn area (measured as a percentage of total body surface area), and the depth of the burn. The patient's medical history, including pre-existing conditions and medications, should also be considered [16].
2. **Immediate Care**: First aid is critical in burn management. Protocols must include guidelines for cooling the burn with running water for at least 20 minutes, removing any constrictive clothing or jewelry, and covering the burn with a clean, dry cloth to prevent infection [16].
3. **Pain Management**: Effective pain relief is paramount in the treatment of burn injuries. Protocols should specify pain assessment tools and appropriate analgesics. A multi-modal approach, including both pharmacologic and non-pharmacologic methods, should be encouraged.
4. **Wound Care**: Treatment of burn wounds involves cleaning, applying appropriate dressings, and potentially using topical antibiotics to prevent infection. Each PHCC should have standardized protocols for wound assessment and management tailored to the type and severity of burns.
5. **Hydration and Nutrition**: Burn injuries can lead to significant fluid loss and nutritional requirements. Protocols should include guidelines for rehydration protocols, which may involve oral or intravenous (IV) fluids based on the severity of the burn. Nutritional support is also vital for promoting healing and preventing malnutrition [16].
6. **Infection Control**: Given the risk of infections in burn injuries, protocols must emphasize strict infection control measures, including proper hand hygiene, use of sterile techniques during dressing changes, and vigilant monitoring for signs of infection [17].
7. **Referral Criteria**: PHCCs often lack advanced resources needed for managing severe burn injuries. Protocols must clearly outline referral criteria, specifying which cases should be transferred to specialized burn care units or hospitals for advanced treatment.
8. **Follow-up Care**: Standardized protocols should include guidelines for follow-up assessments to monitor healing, manage complications, and provide patient education regarding scar management and rehabilitation [17].

Training and Implementation

Successful implementation of standardized treatment protocols requires comprehensive training for healthcare workers in PHCCs. Training programs should be developed to ensure staff members are well-versed in burn assessment, emergency procedures, and ongoing care protocols. Simulation-based training can be particularly effective in preparing providers for real-world scenarios, enhancing both skills and confidence [18].

Furthermore, continuous education and feedback mechanisms should be established to keep healthcare providers updated on best practices and emerging evidence in burn management. Regular

audits and reviews of protocol adherence can help identify areas for improvement, ensuring the protocols remain relevant and effective [18].

Role of Pain Management in Burn Treatment:

Burn injuries are a common occurrence in both developed and developing countries, resulting in significant physical and psychological impacts on affected individuals. They can range from mild first-degree burns, which only affect the outer layer of skin, to severe third-degree burns that penetrate through all layers of skin and can cause severe complications. Pain, being one of the most distressing symptoms associated with burns, requires effective management, especially in the context of primary health care centers (PHCCs), where initial assessment and treatment occur [19].

Burn injuries can be caused by various factors, including thermal (from heat sources), chemical, electrical, or radiation exposure. The classification of burns is typically based on depth, with first-degree (superficial), second-degree (partial thickness), and third-degree (full thickness) categories. Each type of burn presents unique challenges in treatment and pain management, particularly in a primary health care environment where resources may be limited [20].

The implications of burn injuries extend beyond physical pain; they can lead to psychological distress, social isolation, and decreased quality of life. Additionally, there are economic factors at play, such as the cost of medical care and the potential loss of productivity for affected individuals. Given these complexities, effective pain management within primary health care settings is crucial not only for alleviating immediate distress but also for promoting recovery and minimizing long-term psychological effects [20].

Effective pain management is a critical component of burn treatment, as the pain associated with burns can be intense and prolonged. Inadequately managed pain can lead to a range of complications, including chronic pain syndromes, anxiety, depression, and post-traumatic stress disorder (PTSD). Moreover, the experience of pain can significantly hinder rehabilitation and recovery, delaying healing processes and affecting overall health outcomes [20].

In the context of primary health care centers, where many burn patients initially seek treatment, the role of healthcare providers is essential in ensuring that pain is managed appropriately. Pain management should be individualized, reflecting the severity of the burn, the patient's age, underlying health conditions, and personal pain tolerance levels. Recognizing the psychosocial factors surrounding pain is also vital, as individuals may respond differently based on their past experiences and emotional states [21].

Despite the critical need for effective pain relief, several challenges exist in managing burns at primary health care centers. One significant barrier is often the limited availability of resources, including medications, trained personnel, and equipment required for proper assessment and treatment of pain. In some cases, primary healthcare providers may lack access to the full range of analgesics and adjunct medications necessary for comprehensive pain management [21].

Another challenge is the potential underreporting of pain by patients, particularly in cultures where expressing discomfort may be stigmatized or viewed as a sign of weakness. Moreover, healthcare providers may also underestimate patients' pain levels, leading to suboptimal pain management strategies. Addressing these issues requires ongoing training for healthcare personnel and raising awareness about the importance of patient-centered care.

Furthermore, the varying nature of pain in burn victims presents another challenge; pain can be acute during initial injury and treatment phases but may evolve into chronic pain over time. Ensuring a seamless transition in pain management strategies becomes essential, as patients will require different approaches as their healing progresses [22].

To enhance pain management in burn treatment at primary health care centers, several strategies can be implemented. Firstly, education and training of healthcare providers are crucial. Training programs should emphasize the significance of pain assessment and management, equipping providers with practical tools to better evaluate and respond to patients' pain. They should be made aware of both pharmacological and non-pharmacological approaches, as a multimodal strategy often yields the best outcomes [22].

Pharmacological approaches to pain management for burn injuries often involve the use of non-opioid medications, such as acetaminophen and non-steroidal anti-inflammatory drugs (NSAIDs), as well as opioids for more severe pain. Establishing clear protocols for the administration of analgesics can ensure timely and effective pain relief. Moreover, ongoing reassessment of pain levels should be integrated into routine care to accommodate any changes in patients' conditions [22].

In addition to medicinal interventions, non-pharmacological strategies such as cognitive-behavioral therapy (CBT), guided imagery, relaxation techniques, and physical therapy can be effective adjuncts to traditional pain management. These methods can help patients develop coping mechanisms, reduce anxiety, and ultimately improve their overall experience during recovery [23].

Moreover, fostering a supportive and communicative environment is vital. Encouraging patients to openly share their pain experiences can lead to better assessments and more tailored pain management plans. Support groups, counseling, and mental health services should also be considered, as addressing the psychological aspects of pain is integral to holistic treatment [23].

Preventing Infection and Complications in Burn Patients:

Burns are among the most devastating injuries that a person can sustain, inflicting not only physical trauma but also psychological burden and long-term disability. The management of burn patients is a complex process that begins in the emergency room. When individuals arrive with acute burns, particularly severe ones, healthcare professionals must act swiftly and efficiently to prevent further injuries and complications—chief among which are infections [24].

Burns can be classified into three categories: first-degree, which affect only the outer layer of skin; second-degree, which damage both the outer layer and the underlying layer; and third-degree burns, which extend through all layers of skin and may affect underlying tissues. The severity of burns corresponds to the depth of injury, extent of skin loss, and the body surface area affected. Depending on these variables, burns can compromise the integrity of the skin, making patients vulnerable to infections, fluid loss, and metabolic disturbances—factors that can lead to complications such as sepsis, delayed healing, and even death [24].

Infections are a leading cause of morbidity and mortality among burn patients, primarily stemming from the disruption of the skin barrier that normally protects against pathogens. The World Health Organization (WHO) highlights that burn injuries are susceptible to infection, which can result in a longer length of hospital stay and increased healthcare costs. Effective prevention strategies are thus essential, particularly in emergency rooms where interventions can significantly influence outcomes [24].

The first step in preventing infections and complications in burn patients is a thorough initial assessment and triage as they arrive in the emergency room. Rapid evaluation using the "Rule of Nines" allows healthcare providers to estimate the total body surface area affected by burns and determine the severity of the injury. This information is crucial for prioritizing care and identifying patients at heightened risk for infections due to larger burn areas or deeper degrees of injury [25].

In addition to the physical assessment, healthcare providers should screen for concurrent injuries or health conditions that may predispose patients to infection. For instance, individuals with compromised immune systems, such as those with diabetes, alcoholism, or chronic lung disease, may experience more pronounced complications. The Emergency Severity Index (ESI) can assist in categorizing patients' conditions to guide treatment priorities effectively.

Prompt and appropriate wound care is imperative in reducing the risk of infection. Initial management should involve stabilizing the patient, ensuring airway, breathing, and circulation (ABCs) are intact, and avoiding further injury. Once the immediate life-threatening conditions are addressed, attention should turn to wound care. The application of cool, running water to the burn area can reduce pain and temperature and minimize tissue damage. This should be employed for first-degree and superficial second-degree burns; however, it should not be applied for deeper burns that have already undergone thermal injury [25].

Stabilizing burn wounds with sterile dressings is paramount. Caregivers should avoid blanket application of ointments due to potential contamination risks. Should astute judgment indicate the need for wound debridement, especially for second-degree and third-degree burns, this procedure should be performed as soon as feasible to remove necrotic tissues, thereby helping reduce the bacterial load in the wound. The use of hydrotherapy or enzymatic debridement can further enhance the cleanliness of the wound [26].

Once a burn is managed appropriately, systematic approaches to preventing infections become critical. Communication among healthcare workers, adherence to sterile protocols, and consistent hand hygiene are foundational aspects of infection prevention. The use of gloves, masks, and gowns during dressing changes is essential to minimize the risk of pathogen transmission. This is particularly important in emergency settings, where the environment may be overcrowded and the risk of encountering pathogens is higher [26].

Moreover, ensuring reliable access to continuous educational interventions for emergency staff can cultivate a culture of awareness regarding infection control best practices. Training programs should include information on Recognizing signs of infection, using appropriate antiseptics, and following established protocols for the management of burn wounds.

& ## Utilizing Antibiotics Judiciously

The use of antibiotics in burn patients warrants careful consideration. While the routine use of systemic antibiotics is generally not recommended unless there is clinical evidence of infection, the careful selection of appropriate topical antiseptics can help in preventing the onset of infections. Agents such as silver sulfadiazine or mafenide acetate are utilized in many burn cases due to their broad-spectrum antimicrobial activity. However, it is essential to monitor patients for signs of resistance and adjust treatment protocols accordingly [27].

Research indicates that prophylactic antibiotics may be helpful in select high-risk patients, particularly those with extensive burns, severe inhalation injuries, or comorbidities that predispose them to infections. The decision to prescribe antibiotics should involve clinical judgment, considering the potential benefits against the backdrop of adverse side effects and the increasing prevalence of antibiotic resistance [27].

Preventing infections and complications among burn patients does not solely depend on medical interventions; the psychological impact of burns and the subsequent treatment must also be taken into account. Patients may experience anxiety, depression, or post-traumatic stress disorder related to their burn injuries. Providing psychological support, along with educational resources on wound care, self-monitoring for infection signs, and the importance of adherence to follow-up appointments, is essential in empowering burn patients and promoting positive health outcomes.

Education is particularly crucial for caregivers and family members who will assist in postoperative care. Their understanding of infection recognition and the guidelines for care can facilitate timely interventions that prevent minor issues from escalating into significant complications [27].

Health Informatics: Enhancing Treatment and Outcomes:

The domain of health informatics has emerged as a pivotal force in transforming how healthcare is delivered, particularly in specialized fields such as the management of skin burn injuries. Skin burns, resulting from thermal, chemical, or electrical sources, can lead to significant morbidity and mortality, necessitating advanced treatment methodologies and effective patient management strategies. By integrating advanced informatics technologies, healthcare providers can enhance the treatment strategies for burn injuries, improve recovery outcomes, and optimize resource allocation in healthcare settings [28].

Understanding Skin Burn Injuries

Skin burns are classified into different degrees, each aligned with the severity and depth of the injury:

1. **First-Degree Burns**: Affecting only the outer layer of the skin (epidermis), these burns typically result in redness, minor pain, and swelling [28].
2. **Second-Degree Burns**: Involving both the epidermis and the underlying layer of skin (dermis), second-degree burns cause blisters and significant pain, often requiring medical treatment.

3. **Third-Degree Burns**: These burns penetrate through the skin layers, damaging underlying tissues, potentially leading to loss of sensation due to nerve injury. Third-degree burns often necessitate surgical intervention, such as skin grafting.
4. **Fourth-Degree Burns**: Extending beyond the skin into underlying fat, muscle, and bone, fourth-degree burns are catastrophic, typically requiring extensive surgery or amputation [28].

The management of burn injuries is complex, requiring multidisciplinary approaches that involve physical therapy, surgery, occupational therapy, and psychological support. The consequences of inadequate treatment can be severe, leading to complications such as infection, scarring, and significant emotional trauma. In this context, health informatics emerges as an essential framework for enhancing the prevention, treatment, and recovery processes [29].

The Role of Health Informatics in Burn Injury Management

Health informatics encompasses the systematic collection, analysis, and management of health data and information, leveraging technology to enhance patient care and improve outcomes. Within the realm of burn treatment, informatics plays a crucial role in several domains:

1. **Data Collection and Patient Monitoring**: Effective treatment of burn injuries depends significantly on accurate data collection regarding the extent and severity of burns. Electronic Health Records (EHRs) facilitate comprehensive documentation of patient information, including clinical assessments, treatments administered, and patient outcomes. Real-time monitoring systems can track vital signs and other critical parameters, enabling healthcare professionals to respond rapidly to changes in patient conditions [30].
2. **Decision Support Systems**: Informatics tools can aid clinicians in making informed treatment decisions through the use of Clinical Decision Support Systems (CDSS). These systems incorporate evidence-based guidelines and protocols that help healthcare providers determine the optimal course of treatment based on the individual characteristics of patients, the severity of their burn injuries, and associated comorbidities. By offering real-time recommendations, CDSS helps reduce the variability in treatment approaches and ensures adherence to best practices [31].
3. **Telemedicine and Remote Consultations**: Telemedicine has gained significant traction, especially in the wake of the COVID-19 pandemic. For burn victims, telehealth platforms enable specialized care to be delivered remotely. This is particularly beneficial in rural or underserved areas where access to burn specialists may be limited. Through telemedicine, healthcare providers can perform follow-up consultations, monitor healing progress, and provide education on wound care, reducing the need for frequent in-person visits [32].
4. **Patient Engagement and Education**: Health informatics also enhances patient engagement through digital platforms that provide educational resources and self-management tools. By offering access to information on burn care, pain management, and rehabilitation exercises, patients can take an active role in their recovery process. Engagement fosters better adherence to treatment plans and improves overall outcomes [32].
5. **Research and Quality Improvement**: Health informatics serves crucial research purposes, enabling the collection of large volumes of data pertaining to burn treatments and outcomes. This data can be used to perform retrospective studies, identify best practices, and conduct quality improvement initiatives. Through data analytics, healthcare institutions can uncover trends and patterns that inform organizational practices and lead to improved care and resource allocation [32].
6. **Multi-disciplinary Collaboration**: The treatment of burn injuries often requires

input from multiple specialties. Health informatics enables seamless communication and collaboration among healthcare teams. Integrated systems facilitate information sharing about patient status, treatment plans, and progress notes, fostering a coordinated care environment that is essential for achieving positive outcomes [33].

Challenges in Implementing Health Informatics

Despite the immense potential of health informatics, its implementation within burn injury treatment is not without challenges. Firstly, there is a need to ensure that healthcare professionals are adequately trained to use informatics tools effectively. Resistance to change among staff, especially in established healthcare institutions, can hinder the adoption of new technologies [34].

Secondly, data privacy and security remain paramount, particularly concerning sensitive health information. Ensuring compliance with regulatory frameworks such as the Health Insurance Portability and Accountability Act (HIPAA) is essential to maintain patient trust and privacy.

Additionally, disparities in access to technology can create inequities in how burn victims receive care. It is vital that healthcare systems address these disparities to ensure that all patients, regardless of socioeconomic status, benefit from advancements in health informatics [34].

Data Analytics in Burn Management: Trends and Insights:

Burn injuries pose significant challenges to healthcare systems and public health, necessitating advanced strategies to mitigate their impacts. Historically, the management of burn injuries has relied heavily on clinical experience, observational studies, and trial-and-error methodologies. However, with the advent of big data and analytics, there is an emerging paradigm shift in how burn management is approached. Data analytics has opened new avenues for better understanding, predicting, and treating burn injuries, allowing healthcare providers to enhance patient outcomes and optimize resource utilization [35].

Burn injuries can range from mild first-degree burns, affecting only the outer layer of skin, to severe third-degree burns that damage deeper tissues and can lead to significant complications. The management of these injuries encompasses various facets, from immediate first-aid protocols to long-term rehabilitation efforts. Effective burn management is not solely dependent on clinical treatment but also includes psychological support, nutritional care, and pain management strategies. As such, it is a multifaceted domain that can greatly benefit from data-driven approaches [35].

Data analytics in burn management involves the systematic computational analysis of data to extract meaningful insights that can inform clinical decision-making and operational practices. Several types of data are generated throughout the care continuum of burn patients, including demographic information, injury characteristics, treatment protocols, and recovery trajectories. The integration and analysis of this data can lead to significant advancements in understanding burn injuries and their management [36].

Predictive analytics plays a critical role in forecasting patient outcomes based on historical data and statistical methods. For example, machine learning algorithms can analyze vast datasets from burn units to predict complications such as infection rates, healing times, and readmission likelihoods. Hospitals are increasingly using predictive models to optimize resource allocation, ensuring that nursing staff, medical supplies, and equipment are available when needed. By anticipating challenges before they arise, healthcare providers can improve patient care while minimizing costs [37].

Data analytics facilitates the development of evidence-based treatment protocols. By analyzing patient outcomes associated with various treatment modalities, healthcare professionals can identify best practices tailored to specific patient demographics and injury types. Moreover, real-time data collection through electronic health records (EHRs) allows for continuous monitoring of treatment efficacy. This iterative approach supports adaptations to protocols based on emerging data, fostering a culture of continuous improvement [38].

Data analytics empowers patients and healthcare providers alike by improving communication and education. Wearable technology and mobile health applications can collect patient-generated data on post-discharge recovery, including pain levels, mobility, and psychological well-being. This

information can be analyzed to tailor individualized rehabilitation programs, ensure adherence to post-operative care, and even predict potential setbacks. Enhanced engagement leads to improved patient outcomes as individuals assume more active roles in their recovery processes [39].

Several notable trends are shaping the landscape of data analytics in burn management. Understanding these trends is essential for healthcare professionals seeking to leverage data effectively in their practices [40].

Artificial intelligence (AI) and machine learning (ML) technologies are increasingly being integrated into clinical practice. These technologies can analyze complex datasets that would be unmanageable for human analysts. For burn management, AI-enabled tools can assist in predicting burn severity based on early assessments, allowing for timely and appropriate interventions. Companies and healthcare organizations are developing predictive analytics tools that can automatically assess patient data and provide recommendations based on learned patterns from previous patients [41].

The COVID-19 pandemic accelerated the adoption of telemedicine, which remains a trend in burn care. Telehealth platforms enable remote monitoring of burn patients and reduce the need for frequent in-person visits. Consultations conducted through telemedicine also facilitate the collection of data that can be analyzed for treatment effectiveness and patient adherence. Remote monitoring of wound healing and rehabilitation progress can lead to timely adjustments in care plans based on data trends, improving overall outcomes [42].

An increasing recognition of the impact of social determinants of health on patient outcomes has led to their integration into data analytics. Factors such as socioeconomic status, living conditions, and access to healthcare resources can significantly influence recovery trajectories for burn patients. By analyzing these SDOH alongside clinical data, healthcare providers can identify disparities in care and tailor interventions that meet the unique needs of diverse patient populations [42].

Data analytics in burn management is fostering collaborative research initiatives among hospitals, academic institutions, and research organizations. By sharing anonymized patient data across institutions, researchers can conduct larger studies that yield more robust findings. These collaborative efforts can lead to breakthroughs in understanding burn mechanisms, as well as the long-term impacts of injuries on physical and mental health [43].

While the benefits of data analytics in burn management are substantial, there are also ethical considerations that must be addressed. The collection and analysis of patient data raise concerns about privacy and informed consent. Healthcare providers must ensure that data is used responsibly, adhering to strict regulations and guidelines to protect patient confidentiality. Additionally, biases in data collection, analysis, and interpretation could exacerbate health disparities. Thus, a commitment to equity in data analytics is imperative to ensure that all patients benefit [44].

Conclusion and Future Directions in Burn Care Management:

Skin burns are among the most common forms of injury worldwide, affecting millions of individuals annually, often leading to substantial physical, emotional, and financial burdens. The management of skin burn care encompasses a complex interplay of treatment modalities, rehabilitation practices, and psychological support systems aimed at restoring the quality of life for those affected. As we draw conclusions from the current practices and research in the field, it is equally vital to explore future directions that promise to enhance burn care management, ultimately improving patient outcomes and quality of life [45].

Current Approaches in Burn Care Management

Burn injuries are classified based on their depth and extent, leading to varying treatment protocols. Superficial burns may heal with minimal intervention, while deeper burns often require advanced medical care, including surgical interventions like skin grafting. Modern burn management includes a spectrum of strategies aimed at wound healing and scarring prevention.

Key components of current burn management include:

1. **Wound Care**: The initial phase of burn treatment focuses on cleaning the wound, preventing infection, and promoting optimal healing conditions. This may include the use of topical antimicrobials

and dressings that facilitate moist wound healing [46].

2. **Pain Management**: Effective pain relief is paramount, as burns are notoriously painful. Opioids, non-opioid analgesics, and adjunctive medications such as gabapentin are commonly employed to manage pain [46].
3. **Fluid Resuscitation**: For moderate to severe burns, particularly those involving more than 10% of the body surface area in adults, prompt fluid resuscitation is critical. The Parkland formula is widely used to guide fluid replacement, ensuring the patient is hemodynamically stable and can maintain tissue perfusion [47].
4. **Surgical Interventions**: In cases of severe burns, surgical intervention may be necessary. Techniques such as debridement and skin grafting are employed to remove necrotic tissue and promote healing, minimizing scarring and maximizing functional recovery.
5. **Rehabilitation and Psychological Support**: Burn injuries can lead to significant physical limitations and psychological distress. Comprehensive rehabilitation programs often incorporate physical therapy to restore function and occupational therapy to support reintegration into daily life. Psychological support is also crucial, as many patients experience post-traumatic stress disorder (PTSD), anxiety, and depression following their injuries [48].

Conclusion on Current Management Practices

While current management strategies have significantly improved survival rates and recovery outcomes for burn patients, challenges remain. The burden of burn injuries continues to extend beyond physical scars, affecting emotional well-being and societal reintegration. Additionally, disparities in access to care can influence outcomes, highlighting the importance of equitable healthcare delivery [49].

Future Directions in Burn Care Management

As we look to the future, several promising avenues in skin burn management emerge, driven by advances in technology, research, and multidisciplinary approaches.

1. **Regenerative Medicine**: One of the most promising areas of burn care lies in regenerative medicine, particularly stem cell therapy and tissue engineering. Researchers are exploring the use of stem cells to promote healing and reduce scarring. Bioengineered skin substitutes hold the potential to revolutionize wound healing, minimizing the need for donor site harvests and enhancing recovery outcomes [50].
2. **Telemedicine**: The rise of telemedicine offers the potential for improved access to burn care, particularly in remote or underserved areas. Virtual consultations can facilitate timely evaluations and follow-ups, thereby ensuring ongoing care without the need for travel, which may be burdensome for patients recovering from severe injuries [51].
3. **Personalized Medicine**: Advances in genomics and proteomics may lead to tailored approaches in burn care. Understanding a patient's unique biological response to burns could inform interventions that optimize healing and improve psychological outcomes.
4. **Enhanced Pain Management Strategies**: As our understanding of pain mechanisms improves, new pharmacological and non-pharmacological interventions will likely emerge. Integrative approaches such as acupuncture, lidocaine patches, and other modalities can be explored further to enhance pain management protocols in burn care [52].
5. **Multidisciplinary Collaboration**: Future burn care will benefit from a more holistic, multidisciplinary approach. Collaboration among surgeons, nurses, physical therapists, psychologists, and social workers can create comprehensive care plans that address the diverse needs of burn survivors, encompassing physical rehabilitation, mental health support, and societal reintegration [53].

6. **Education and Prevention**: Finally, greater emphasis on education and prevention strategies will be important in reducing the incidence of burn injuries. Community outreach programs designed to educate the public about fire safety, burn first aid, and the importance of seeking timely medical intervention can help mitigate the impact of burn injuries [54].

Conclusion:

In conclusion, the effective management of dermal burn injuries in emergency rooms within Primary Health Care Centers (PHCCs) is critical to minimizing the physical and psychological impact of such injuries on patients. Adopting standardized treatment protocols allows healthcare professionals to provide prompt and effective care, significantly improving patient outcomes. The integration of health informatics into burn management enhances clinical decision-making, facilitates communication among providers, and ensures adherence to evidence-based practices. By utilizing electronic health records and data analytics, PHCCs can better track treatment efficacy, identify trends, and allocate resources more effectively.

Future efforts should focus on further integrating health informatics into burn care management systems, promoting training for healthcare workers in both technical and clinical aspects, and continually updating treatment protocols based on emerging evidence. By prioritizing these areas, PHCCs can not only improve immediate care for burn victims but also enhance overall healthcare delivery, leading to better recovery trajectories and quality of life for patients affected by burn injuries. Continuous collaboration between healthcare professionals and health informatics experts will be vital in developing innovative solutions that address the complexities of burn management in emergency settings.

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