WHASA consensus document on the management of acute burns

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Introduction

Burns are among the most common and devastating forms of trauma. Increased morbidity and mortality accompany thermal injury, and survival is dependent on the correct assessment and management. Although acute treatment regimens and dressing selection have evolved to improve outcomes, deep burn injuries often leave patients with considerable cosmetic and functional disabilities, which may lead to a lifetime of challenges. Patients with major burns should be referred to a burn unit or multidisciplinary centre where the primary objective is to care for burn patients and to optimise their outcomes. Such centres comprise teams of specialist burn surgeons, plastic and reconstructive surgeons, physiotherapists, occupational therapists, dietitians, social workers and nursing staff, as well as other consultants, who all strive to obtain rapid wound closure and return burn survivors to a functional and well adapted life.

The real incidence or prevalence of burn injuries in South Africa has not been accurately determined, but may be as high as 3% of the population per year. It is known that burns are the leading cause of non-natural deaths in infants and children aged five years and younger, and the fourth major cause of accidental deaths within the 5- to 9-year-old age group.[1,2]

This document has been adapted from the published guideline document issued by the South African Burn Society[3] (SABS) and the Emergency Management of Severe Burns Course Manual,[4] which refer to acute burn management. Specific guidelines for wound management are proposed, based on expert opinion and a literature review. Every effort has been made to obtain the best level of evidence for the recommendations proposed in this document, in order to offer an evidence-based approach needed for decision-making to South African healthcare professionals involved in the management of burns.

Method

An expert multidisciplinary collaboration panel group assembled for two days in Gauteng, South Africa, to discuss and formulate a consensus document on the management of acute burn injury as a guide for wound care practice in South Africa. Attendees were selected based on their clinical expertise and background in general surgery, paediatric surgery, plastic and reconstructive surgery, critical care, wound management, product application and managed health care.

Key messages overall

1. Major burns should be managed in multidisciplinary units and centres accustomed to managing those injuries
2. A structured, algorithmic approach to the management of burn injuries should be followed, as taught in the Emergency Management of Severe Burns Course, offered by the South African Burn Society
3. Early, goal-directed strategies during the initial period after the burn injury have a critical impact on survival

The burn team consisted of members, of whom 69% had more than 15 years of experience, and 50% of them were specialists in surgery and nursing. Panel participants were asked to review the literature pertaining to their area of expertise, and present their findings at the meeting in a format based on the wound bed preparation paradigm.[5] The purpose was not to re-create the recommendations, but rather to incorporate South African

opinion and experience within a list of recommendations. The list of recommendations was presented on the second day to the full audience, where a modified Delphi method was used to evaluate the recommendations proposed by each team in order to generate at least an 80% immediate consensus for each recommendation.

An online-based modified Delphi method was then utilised, where each team member voted independently to verify the strength of the initially obtained recommendations. Thereafter, the findings were further verified by an independent second panel, consisting of national and international experts who were not part of the former panel. A four-point Likert scale ("strongly agree", "partially agree", "partially disagree" and "strongly disagree") was used, with the option of additional commentary. Each item to be included in this document achieved 80% agreement, i.e. either strong or partial agreement, by all panels. This process took 24 months to complete.

A draft of this document was presented to members of the SABS to review and submit the final document, which was then presented in collaboration with the Wound Healing Association of Southern Africa.

Contributors

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Results

A quick reference guide of recommendations on the management of acute burns, following the format based on the wound bed preparation paradigm is depicted in Table 1.

Table 1: Quick reference guide on the management of acute thermal burns following the format based on the wound bed preparation paradigm

Recommendations for the management of acute thermal burns		Agreement (%)
1.	**Assess patient ability to heal and treat the cause**	
A.	***Determine the extent of the burn wound***	
1.	Care for extremes of age	100
2.	The hand of the patient may help to estimate the extent of the burns	85
B.	***Determine the depth of the burn wound***	
1.	Use capillary filling to help determine the depth	96-100
C.	***Determine the anatomical area involved***	
1.	Care for hands, joints, circumferential burns	100
D.	***Identify and address co-morbid factors***	96-100
2.	**Develop an individualised plan of care**	
1.	Superficial burns re-epithelialise within 3-4 days with little care	100
2.	Dermal burns will need moisture to heal	100
3.	Full thickness burns will need excision and grafting to heal	96
3.	**Assess and support individualised patient-centred concerns**	
1.	Use first aid measures to reduce impact of the burn injury	96-100
2.	Follow the emergency treatment guidelines applicable to burn trauma for life threatening injuries	100
3.	Start enteral feeding early	100
4.	Assess, relieve and keep levels of pain under control	100
4.	**Local wound care**	
1.	Debride loose skin and remove all exudate from burn wound	96
2.	Choose a dressing that is appropriate to prevent colonization of the wound, minimise pain, ensure adequate moisture that is conducive to optimum wound healing	100
5.	**Advanced therapies**	
6.	**Educational aspects when dealing with post-burn care issues**	
1.	Post burn care relies on education that incorporates long-term care action and lifestyle adaptation to promote a better quality of life	96-100

1. Assess patient ability to heal and treat the cause

A burn injury is damage to the skin caused by the incitation of agents, such as heat, chemicals and electrical current.[6] The burn wound is a local injury, and may also be followed by a profound hypermetabolic response involving multiple organ systems which may contribute to the patient's demise. The severity of the burn is influenced by the age (extremes of age) and physiological state of the patient (which determine the capacity of the patient's wounds to heal), the mechanism of injury, the duration of contact with the agent, the extent and depth of the burn, the anatomic site involved, as well as any concomitant injuries.[7] Management strategies depend on an accurate evaluation of these factors and awareness of the local and systemic sequelae.

The majority (in excess of 60%) of burn wounds in children are caused by scalds, usually from boiling water or cooking oil. Frequently, these are accidental spills from a surface

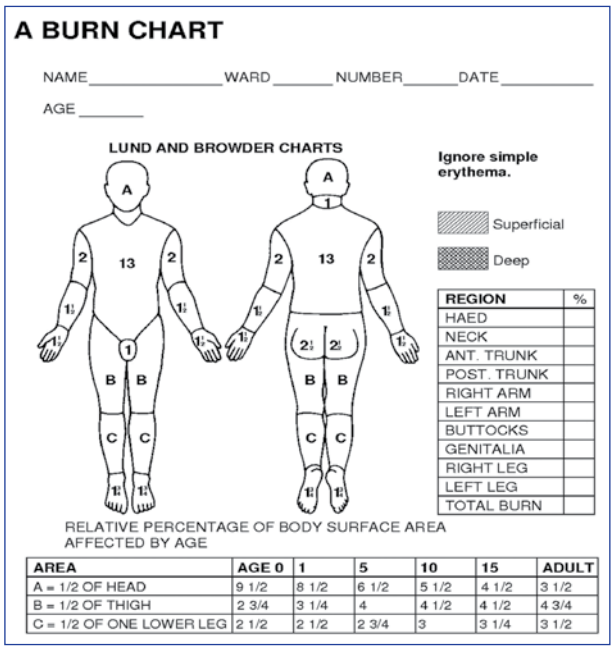

Figure 1a: Lund and Browder burn area estimation chart

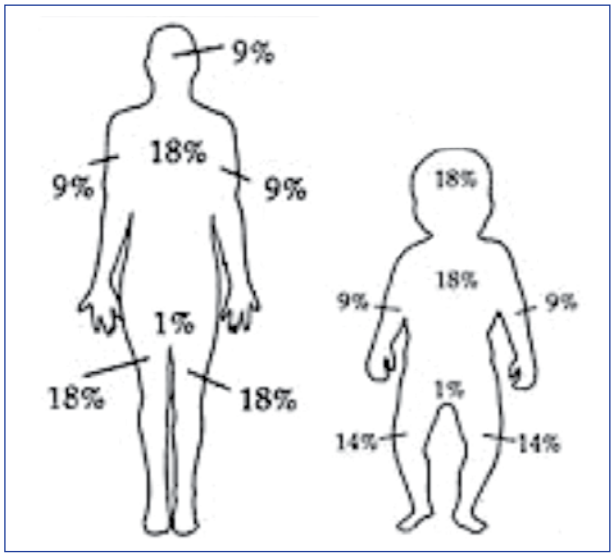

Figure 1b: Rule of nines burn area estimation chart

Figure 1c: Hand rule burn area estimation chart

situated above them in the domestic setting (often the kitchen), resulting in a characteristic pattern involving the face and upper chest.[7] Scald burns in middle-aged adults are frequently small hot oil or grease burns, but have important functional consequences when the hands are involved, as they are sustained during occupational activities or in the home during cooking.[7] Scalds are generally more superficial and less severe than flame burns, which comprise only 20% of hospitalised burns, but are responsible for at least half of the mortality due to thermal injury. These are often sustained during house fires in the South African context. Contact burns (10%), and electrical and chemical burns account for the remaining 15% of burns.[7]

The extent of burns is usually estimated using a chart (Figure 1) which divides the body in percentages in terms of the total body surface area (TBSA) burnt. The Lund and Browder chart (Figure 1a) is more accurate as the proportion of the head and lower limbs, according to the age of the burn victim, is taken into consideration.[4,7] The rule of nines (Figure 1b) is not as accurate, but often more practical than the Lund & Browder chart, and can be adjusted for age (the head is larger, and the lower extremities shorter in children).[4,7] The hand of the patient (palmar aspect, adducted extended fingers included) is useful for small and scattered burns, and corresponds to approximately 1% of the TBSA (Figure 1c). It is particularly useful when used for subtraction from larger areas.

Burn injuries are divided according to their depth into superficial, superficial partial-thickness, deep-partial thickness and full-thickness burns. The Jackson model[8] (Figure 2) has been utilised to understand the local physiology of the deep burn. The central zone of the burn wound, irreparably damaged, corresponds with a zone of coagulative necrosis devoid of blood supply. This is surrounded by a zone of relative ischaemia characterised by the stasis of blood flow, the outcome of which may be influenced by cooling measures and appropriate fluid resuscitation (Figure 3). The outer layer of the burn wound represents an inflammatory or hyperaemic zone, with increased flow and vessel reactivity.

Although other methods are available, most clinicians rely on the clinical assessment of burn depth. This determination dictates the therapeutic modality selected, i.e. whether surgery or dressings are indicated. If uncertainty exists, an

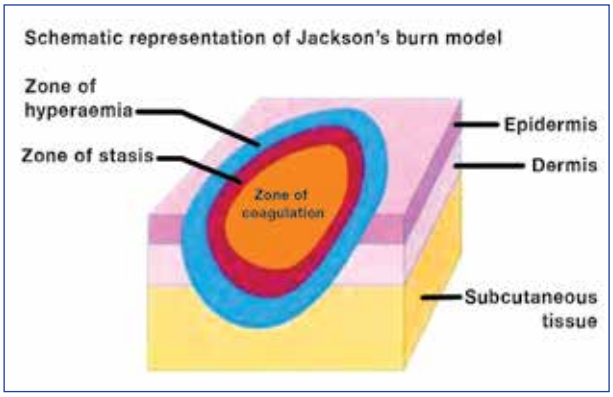

Figure 2: Schematic representation of acute burn wound zones, according to Jackson's model[8]

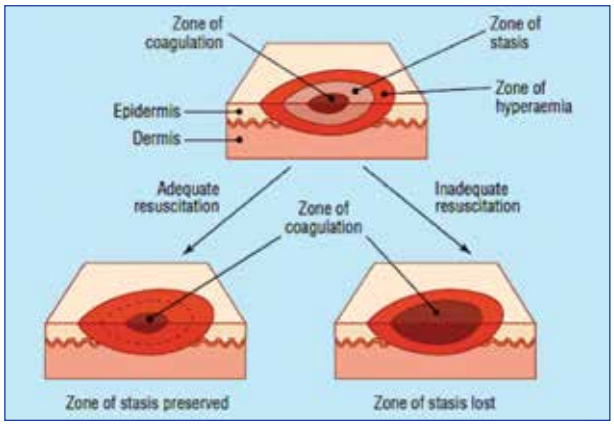

Figure 3: A schematic representation of the effects of adequate and inadequate resuscitation relating to Jackson's burn zones

Key messages with respect to assessing the patient's ability to heal and when treating the cause of the burn injury

1. An accurate assessment of burn depth should be made to determine the appropriate treatment strategy
2. Every effort should be made for the wounds to heal within three weeks from the time of injury in order to prevent hypertrophic scarring and contracture
3. Deep-partial thickness and full-thickness burns should undergo early excision and skin grafting
4. Extremes of age, co-morbid factors, anatomical location, and the extent and depth of the burn injuries influence management and outcomes
5. The Lund and Browder chart provides an accurate calculation of the burn extent calculation or total body surface area, while the rule of nines and hand palmar surface provide an estimation

appropriate dressing may be applied, and the burn reassessed after 24-72 hours. The depth of a burn can be determined by the presence of capillary filling (blanching and refilling with pressure), the colour and moisture of the burn, as well as sensation (Table 2).[4,7]

Table 2: Causes of burn injury[4,7]

Causes of burn injury
Causes of burn injury are as follows: • Thermal (scalding, flame, flash burns and frostbite) • Chemical • Electrical • Radiation • Contact • Friction

Certain anatomical areas require greater expertise during management, and therefore demand management in burn centres without needing to meet the extent criteria. These areas include the hands, face, over joint surfaces, the perineum and feet.

Certain co-morbid conditions impact greatly on the prognosis of the burn wound outcome, and may prolong or complicate the clinical course. Common examples of such conditions in the South African context include human immunodeficiency virus, especially a CD4 count < 200 cells/mm^3; diabetes, obstructive airway disease, obesity, epilepsy, depression and schizophrenia. Prescription and recreational drug and alcohol use and abuse are increasingly implicated in the mechanism and sequelae of burn injuries.

The classification and characterisation of burn wounds according to depth of the injury[4] is provided in Table 3.

Table 4 details the recommendations with respect to assessing a patient's ability to heal when treating the cause of the burn injury.

2. Develop an individualised plan of care

Since superficial and most superficial partial-thickness burns have remnants of epithelium, healing for these types of wounds involves re-epithelialisation. The process of re-epithelialisation is usually complete within 3-4 days for very superficial burns, such as sunburn. Little treatment is needed to manage these wounds, other than the application of a water-based moisturiser or possibly a protective dressing, e.g. a film.

Once the burn extends deeper into the dermis (mid and deep dermal-partial thickness), the epidermis regenerates from the wound edges and the adnexal structures. Basal keratinocytes at the wound edge and the adnexal epithelial cells are stimulated to migrate onto the surface of the wound, provided inflammation and bacterial colonisation are controlled and a healthy dermal wound bed has been established. As the epithelial cells migrate up from the adnexal structures, whitish dots (epithelial buds) appear on the wound bed. Wounds with the highest concentration of skin adnexa heal the fastest. This is the reason why partial-thickness scalp wounds heal within 5-10 days, while areas lacking hair, such as the lower legs in older people, take longer to re-epithelialise.

It has been shown that maintaining a moist and viable wound bed leads to more rapid re-epithelialisation than if the wound

Table 3: Classification and characterisation of burn wounds according to depth of the injury[4]

Skin depth	Cause	Surface and colour	Pain
Superficial (epidermal)	Sunburn, flash burn or minor scald	Dry, erythema, and brisk capillary return	Painful
Partial thickness (superficial dermal)	Scald	Moist, pale pink, broken blisters, and brisk capillary return	Painful
Partial thickness (mid dermal)	Scald, flame and contact	Moist, dark pink, and sluggish capillary return	May or not be painful
Partial thickness (deep dermal)	Scald, flame and contact	Moist, blotchy red, white, mottled, sluggish, or an absence of capillary return	Painless
Full thickness	Flame, severe scald and electrical	Dry, charred, whitish, leathery, and an absence of capillary return	Painless

Table 4: Recommendations with respect to assessing a patient's ability to heal when treating the cause of the burn injury

Recommendation 1.A.1 (agreement of 100%)
The extremes (youngest and oldest) of age and the extent of the burn directly affect the clinical outcome
Recommendation 1.A.2 (agreement of 85%)
The hand (adducted extended fingers) of the patient may be used to estimate 1% TBSA. It is useful for small and scattered burns and can be used for subtraction e.g. to subtract for parts of a burned arm.
Recommendation 1.B.1 (agreement of 96-100%)
The depth of a burn can be assessed by the appearance of the capillary filling: • *Superficial (epidermal):* With blanching and good capillary filling • *Dermal or partial thickness:* May be difficult to assess and needs reassessment every 48 hours - *Superficial dermal or partial thickness:* With brisk capillary filling - *Mid dermal or partial thickness:* With mottled sluggish capillary return - *Deep dermal or partial thickness:* With absent capillary return • *Full thickness:* With absent capillary return
Recommendation 1.C.1 (agreement of 100%)
The anatomical location (hands, flexion contractures and circumferential burns) dictate the method of treatment and management
Recommendation 1.D (agreement of 96-100%)
Special treatment and management considerations are indicated for: • Human immunodeficiency virus (CD4 count < 200 cells/m^3), as it indicates poor prognosis in burn patients • Tuberculosis • Diabetes mellitus types 1 and 2 • Obesity • Epilepsy • Drug eruption (toxic epidermal necrolysis or Stevens-Johnson syndrome) • Medication and recreational drug abuse

is allowed to dry out and desiccate.[9] If the wound forms a "scab" (composed of fibrin, dead neutrophils and other debris), then the keratinocytes have to "cut" their way along the viable surface by releasing proteases and other enzymes, and the time to epithelialisation will be extended.

As opposed to superficial or dermal burns, full-thickness burns involve areas of central necrosis and coagulation which need to be excised and grafted as soon as possible to facilitate wound closure.[10] Re-epithelialisation does not take place owing to a lack of adnexal structures, and healing depends on the contraction of the wound edges, which may take longer. In the absence of active intervention through the excision of the compromised tissue and replacement by skin grafting, the contraction may lead to secondary contracture and deformity of the adjacent structures. Accurate assessment of the depth of partial-thickness injuries allows the surgeon to determine whether a wound will heal spontaneously, or whether surgical intervention is required to prevent protracted healing and scarring. Ideally, all burn wounds should be closed within three weeks. Therefore, distinguishing between superficial partial-thickness burns and deep partial-thickness burns (previously classified together as a second degree burn) is where judgment is required in modern burn care.

Table 5: Recommendations with respect to the development of an individualised plan of care for burn patients

Recommendation 2.1 (agreement of 100%)
The process of re-epithelialisation is usually complete within 3-4 days for very superficial burns, such as sunburn. Little treatment is needed to manage these wounds, other than the provision of a protective dressing, i.e. a film and possibly a moisturiser
Recommendation 2.2. (agreement of 100%)
It has been shown that maintaining a moist and viable wound bed in superficial to mid dermal partial-thickness wounds leads to more rapid re-epithelialisation than if the wound is allowed to dry out
Recommendation 2.3 (agreement of 96%)
As opposed to superficial or dermal burns, full-thickness burns involve areas of central necrosis and coagulation which need to be excised and grafted as soon as possible

Table 5 details the recommendations with respect to developing an individualised plan of care for burn patients.

3. Assess and support individualised patient-centred concerns

The life of the burn victim is at stake and he or she should receive priority. In order to incorporate rapid action with respect to management of the cause and effect of the burn wounds, an interprofessional team needs to participate in the process from admission of the patient to his or her discharge from hospital, and in his or her rehabilitation.

3.1 First aid treatment

The application of timely and effective first aid measures (Table 6), such as cool running water for at least 20 minutes, given within the first three hours of the injury, can have a beneficial effect on the zone of stasis by abating the burning process and assisting in cell survival. Conversely, lack of effective first aid can lead to an increased chance of further tissue necrosis as the zone of stasis can progress to coagulation.[11] In the absence of initial clean, cool water, and after cooling with water and during patient transfer, cool compresses, e.g. Burnshield®, or cling film, help to relieve pain and discomfort. Patients with larger burns should be monitored for hypothermia. Copious irrigation of the wound with water is also indicated for most chemical burns.[4,7]

Table 7 details the recommendations with respect to using first aid measures to reduce the impact of the burn injury.

Key messages with respect to first aid treatment

- Ice causes vasoconstriction, hypothermia and thermal injury if directly applied for a prolonged period to the skin
- Cool running water should be used for 20 minutes or more, unless other factors prevent this (e.g. a large burn causing rapid heat loss, hypothermia and multiple trauma)
- Avoid wet towels as they heat up quickly. If available, use two moistened towels or pads and alternate at two-minute intervals
- Remove any jewellery or constrictive clothing as soon as possible

Table 6: First aid measures to treat burn victims

Priority	Action	Caution
Stop the burning process	• The patient must be removed from the source of the injury • If the patient is on fire, he or she must stop, drop, cover his or her face and roll • Hot, scalding or charred clothing must be removed	• Self-harm should be avoided during those steps
Cool the burn wound	• Cool the burn with cold, running tap water for at least 20 minutes • The ideal water temperature for cooling is 15°C, with a range of 8-25°C • Keep the remaining areas dry and warm, to avoid hypothermia • If the patient's body temperature falls below 35°C, stop cooling	• Do not apply ice to the burn wound • Do not apply toothpaste to the burn wound • Do not use homemade remedies to the burn wound • Do not apply butter to the burn wound • Do not apply wet towels to the burn wound
Cover the burn wound	• Where the surface is blistered and/or raw, the wound should be covered with a dressing • In the absence of any wound dressings, the wound must be covered with cling film, or a clean cloth to keep the burn wound clean until definitive management can occur. This protects against colonisation and excessive fluid and heat loss • Cling film is a suitable dressing for patients who are being transferred to the nearest burn unit	• Avoid wrapping the affected area circumferentially with cling film and keeping it wrapped for a long period, as this can have a tourniquet effect as the oedema worsens
Obtain specialist help	• Children • Elderly • Hands and face • See Addendum A and B	• Do not wait

Table 7: Recommendations with respect to using first aid measures to reduce the impact of the burn injury

Recommendation 3.1 (agreement of 96-100%)
First aid measures, which are a priority, include: • Stopping the burning process • Cooling the burn wound • Covering the burn wound • Obtaining medical help

3.2 Emergency treatment

The initial assessment of a burn patient entails an Advanced Trauma Life Support (ATLS)-style approach, as advocated by the Emergency Management of Severe Burns Course,[4,12] including a primary survey to identify and treat life-threatening conditions, followed by a secondary head-to-toe survey (Table 8) and management, as required. Smouldering or hot clothing or agents should be removed, and the patency of the airway ensured. Intravenous fluid should be initiated and a urinary catheter inserted (Table 9) for major burns. Once immediately life-threatening presentations have been addressed and a stepwise history taken, the examination should be followed by appropriate special investigations and a proforma-based management strategy.

The history needs to be AMPLE, and to include:

- **A**llergies
- **M**edications
- **P**ast illnesses
- **L**ast meal
- **E**vents and environment relating to the injury.

The offending source or an electrical burn should be removed from the patient, using a non-conducting object, and the patient's circulation and ventilation evaluated and maintained. One hundred per cent oxygen is given by face mask for

Table 8: Secondary assessment after lifesaving measures have been carried out

Secondary head-to-toe assessment		
P	Perform	A head-to-toe examination
R	Re-assess	A, B, C, D, E and F*
E	Elevate	The affected limb above the heart line
C	Commence	A circulation chart
E	Escharotomy	Perform, to relief compromised tissue
P	Psycho-social care	Give support to the burn survivor
T	Tetanus prophylaxis	If needed
O	Ongoing information	Given to the family as support
R	Reachability	Ensure that direct family members are reachable. Document their mobile and contact numbers
S**	Special observations	Haemoglobin and haematocrit
		Urea and creatinine
		Electrolytes
		Urine microscopy
		Arterial blood gases

A: airway maintenance, B: breathing and ventilation, C: circulation, D: disability, E: exposure with environmental control, F: fluid resuscitation
*Refer to Table 11 for full details
** An expert or specialist, such as a physician, who gives practical experience and training to a student, especially in medicine or nursing

Key message in respect of information gathering
Gather information from the patient or others on the following:

- The date and time of the burn injury
- The date and time of the first presentation
- The source of injury and the length of contact time
- The clothing worn.
- Activities at the time of the burn injury.
- The adequacy of first aid.

Table 9: Fluid resuscitation guidelines for major burns

Fluid resuscitation for major burn wound patients		
Who	**How**	**What**
> 10% for children > 15% for adults	• Calculate the percentage of TBSA burnt • Insert two large-bore, peripheral intravenous lines, preferably through unburnt tissue • Collect blood simultaneously for essential base line tests, i.e. FBC, EUC and LFT, type and screen, coagulation, drug and alcohol screening, andamylase and carboxyhaemoglobin, if available • Obtain the patient's body weight in kilograms	• Intravenous Hartmann's solution or Ringer's lactate, at an initial rate of the Parkland formula • But adjust according to the hourly urine output and other parameters
Fluid requirement calculation formula: • 2-4 ml x kg x % TBSA burnt = intravenous fluid (ml) to be given in the 24 hours following injury • Regular re-assessment to adjust fluid administration		
When	**Ensure that**	**Vigilance needed**
• Give half of this fluid in the first 8 hours from the time of the injury • Give the other half of this fluid in the following 16 hours	• Children weighing less than 30 kg require maintenance fluid, in addition to resuscitation fluid • Insert a urinary catheter for all burns • The intravenous fluid solution is adjusted each hour, according to the previous hour's urine output	• The urine output is maintained at a rate of 0.5-1 ml/kg/hour in an adult • Aim for 1 ml/kg/hour in children
The infusion rate is guided by the urine output, not by a formula		
Consider patient response	**Adjustments needed**	**Additional need if there is**
• Monitor the patient's hourly urine output • Monitor the patient's heart rate • Monitor the patient's blood pressure	• If urine output < 0.5 ml/kg/hour, increase intravenous fluid by one third of the current intravenous fluid amount • If urine output > 1 ml/kg/hour in adults or > 2 ml/kg/hour in children, decrease the intravenous fluid by up to one third of the current intravenous fluid amount	• *Pigmenturia or dark red, or black urine:* Pigmenturia occurs with thermal damage to the muscle, e.g. from an electrical injury • Inhalation injury • Delayed resuscitation

EUC: electrolytes (sodium, potassium and chloride), and urea and creatinine, FBC: full blood count, LFT: liver function test, TBSA: total body surface area

suspected inhalation injury and for all major burns. Progressive airway obstruction may occur, and early intubation should be considered. Bronchoscopic grading of the inhalation injury may assist with directing therapeutic strategies. While early intubation may be a life-saving measure, poorly executed intubation under unnecessarily difficult circumstances may precipitate aspiration or respiratory barotrauma, for example.[13]

Decompressive escharotomies (Addendum C) are emergency procedures performed to constrict circumferential full-thickness burns, especially around the arms, legs, abdomen and chest, to avoid irreversible ischaemic damage distally. Escharotomies are performed on both sides of the chest and abdomen, and on either the lateral or medial sides of the affected limbs, or both. The incision must traverse the dead tissue as far into the subcutaneous layer, as necessary, to encounter viable tissue, and must extend into the viable tissue at the edges of the burn. Practitioners should be aware of important structures, such as nerves, e.g. superficial peroneal and ulnar, and blood vessels. Anaesthesia may not be necessary for the procedure, as full-thickness burns are insensate, although conscious sedation is usually required.[4]

Adequate pain control is important in the management of burns, and also forms a prominent part of patient-centred concerns. Control of background pain and procedural pain must be followed through admission of the patient to the hospital, as well as adequate nutritional support to manage the hypermetabolic demands of the burn injury (Table 10). Recommendations with respect to emergency treatment guidelines are provided in Table 11.

4. Local wound care

Burn dressing selection revolves around the depth and extent of the injury, the cause of the burn, anatomical location, contamination or sepsis, moisture and exudate level and local patient factors, such as pain. Newer therapies for burn wounds have improved outcomes, allowing ambulatory care for selected burn injuries. Consideration should be given to debriding blisters, applying an antimicrobial modern dressing (a silver-based dressing)[14] and/or a skin substitute, and discharging the patient the same day or the following day after injury, for burns less than 10% (even less than 20% in some cases, providing that they are non-circumferential). The dressing combination, although costly per unit, allows the patient to be discharged cost-effectively and results in better healing outcomes.[1,7]

Some dressings have anti-inflammatory effects in addition to their antimicrobial properties, which have shown to be beneficial to healing and outcome. Avoidance of infection is the key principle in burn wound dressing. Thus, the

Table 10: Nutrition and pain guidelines for major burns

Characteristics	Procedure	Rationale
Nutrition (early enteral feeding is vital and forms part of the pillars of acute burn management)	• Insert a nasogastric or nasoduodenal tube for larger burns, or if the associated injuries are > 20% TBSA in adults and > 15% TBSA in children • If feed is unavailable initially, commence 5% dextrose water via the nasogastric tube • Caloric requirements should be calculated and an appropriate route determined	• Patients with major burns may not be able to meet their caloric requirements • Reduces the hypermetabolic state which occurs in major burns • Decreases the likelihood of gastric stasis, which prohibits the adequate nutrition so vital to patients with burns
Pain relief (acute and background pain)	• Give morphine, or other appropriate analgesia, slowly, intravenously and in small increments, according to the pain score and sedation scale • Paracetamol (and NSAIDS, if not contraindicated) must be given at regular intervals	• Stabilises the patient's metabolism • Improves patient compliance with therapy • Improves wound healing
Pain control for dressing changes (procedural pain)	• There are three drug classes, i.e. sedative and hypnotic, anti-inflammatory and opiate analogues (administered 30 minutes prior to the dressing change) • Make use of conscious or deep sedation for major dressing changes, e.g. using a benzodiazepine, Ketamine® and Fentanyl® • Allow adequate time for analgesia to take effect prior to the dressing changes • Reduce the dressing changes or make use of less adherent dressings (nonadherent silicone-based dressings)	• *Prevents a wind-up phenomenon:* Allodynia, i.e. an exaggerated reaction to stimuli

NSAIDs: nonsteroidal anti-inflammatory drugs, TBSA: total body surface area

Table 11: Recommendations with respect to emergency treatment guidelines

Recommendation 3.2 (agreement of 100%)
Life-threatening burn injuries are treated as per all acute emergency situations. Some esoteric differences are applicable to the burn injury. Thus, perform A, B, C, D, E and F: A. *Airway maintenance with cervical spin control:* This includes early intubation in significant inhalation injuries. Check for carbon monoxide poisoning. Non-burnt skin may be cherry pink in colour in a non-breathing patient B. *Breathing and ventilation:* The limitation of chest expansion may necessitate an escharotomy (Addendum C) C. *Circulation:* Check the patient's peripheral pulse, and conduct a capillary blanching test to assess circulation problems and the need for an escharotomy (Addendum C) on that limb. Stop any obvious bleeding by applying direct pressure D. *Disability:* Determine the patient's neurological status using "AVPU" (alert, responsive to vocal or painful stimuli or unresponsive?) E. *Exposure with environmental control:* Remove all the patient's clothing and jewellery. Keep the patient warm. Remove any wet sheets and examine posterior surfaces for burns and other injuries F. *Fluid resuscitation:* Fluid resuscitation is the usual primary component of resuscitation in acute burn injuries
Recommendation 3.3 (agreement of 100%)
Start enteral feeding early
Recommendation 3.4 (agreement of 100%)
Assess, relieve and keep the levels of wound-related pain under control with appropriate analgesics administered 30 minutes prior to the dressing changes, and by using nonadherent dressings

considerations when choosing a particular dressing depend on the extent of the burn, speed of microbial killing, sustained efficacy, longer duration of action (to avoid multiple dressing changes), and the creation of a moist environment conducive to healing. However, there is a concern that all antimicrobial dressings are to some extent at least cytotoxic, and should be used cautiously or in a goal-directed manner.

As stated previously, the process of re-epithelialisation is usually complete within 3-4 days for very superficial burns, such as sunburn. Regularly applied water-based moisturisers are usually adequate therapy. Once the burn extends into the papillary dermis (superficial partial thickness), the process of re-epithelialisation takes place over approximately two weeks, and is facilitated by the application of dressings. Commonly used first-line dressings for these burn injuries include silver sulphadiazine (ideally applied twice daily), Jelonet® (ideally applied daily), or temporary skin substitutes, such as Biobrane®, the advantage of which is that only a single application is required.[15] Deep-partial and full-thickness burns should be excised and skin grafted as soon as the patient is stable in adequately resourced facilities, i.e. burn units or centres. The dressing selection to prepare the burn wound bed for closure by skin grafting is depicted in Addendum D.

4.1 Cleansing and debridement

Special considerations must be given to cleansing and debridement situations:

- Assess and monitor the patient for possible hypersensitivity or an allergic response to the products.
- Burns to the scalp and excessively hairy areas should be shaved to allow initial burn wound assessment and ongoing wound management, and to prevent folliculitis. Ideally, this should extend 2-5 cm past the boundary of the burn to ensure full visualisation, and to prevent hair impeding skin regeneration.

Table 12: Cleansing and debridement priorities and procedures

Cleansing and debridement		Agreement (%)
Outcome aimed for	The burn wound surface should be free of loose slough, exudate, clots and crusts, and creams. Remove the exudate and creams	100
	Eschar and loose tissue should be non-surgically removed, where possible	96.1
	Adherent dead and devitalised tissue must be surgically debrided	96.1
	Causing damage to the healing burn wound bed must be avoided at all times	100
	Bacterial contamination and infection need to be prevented	100
	Psychological trauma must be minimised and managed	100
	The wound should be assessed and re-assessed on a regular basis	100
Preparation	The patient must be well informed about the procedure	
	The environment (dressing room or operating theatre), and equipment must be adequately prepared, i.e. the environment must be warm. Heated fluids and Bair Huggers® can be used	
	The patient with an acute, large total body surface area burn wound should be washed and dried within 30 minutes or less, if possible	
	Longer sessions may cause heat loss, pain, stress and sodium loss (water is hypotonic). The bathroom and wash area should also be well heated	
Procedure	Cleanse the wound gently to remove loose devitalised tissue and exudate, remove old dressings and/or creams	
	Wash with soft gauze or sterile hand towels soaked in diluted solution, such as chlorexidine gluconate diluted in water 1:2 000, or diluted sodium hypochlorite 0.006%	
	Clean and wash the unburnt parts of the body	
	Dry the patient well. Moisture left behind may macerate the burn, provide an ideal environment for bacterial contamination and cause evaporation, which may decrease the body patient's body temperature	

Table 13: Recommendation for cleansing and debriding a wound

Recommendation 4.1 (agreement of 96%)
Debride the loose skin and remove all exudate from the burn wound surface*

* Sharp debridement should be carried out by an experienced practitioner

- The necessity of this procedure should be discussed with the patient. Some religious beliefs preclude cutting of the hair under normal circumstances, and doing so may cause great distress if the rationale is not understood.
- Burn wounds are an excellent medium for bacterial contamination, colonisation and localised infection, which may spread, resulting in systemic infection.
- Prophylactic antibiotics are not routinely given to burn patients, as they do not reduce the risk of infection. Antibiotics should only be given to patients with clinically suspected or established infection, and are prescribed according to known sensitivity, and in consultation with the resident microbiologist or infectious disease specialist.

To ensure that the above principles are achieved, the concepts for burn wound management which must be followed, together with the agreement levels in this regard, are shown in Table 12.

Table 13 details the recommendation for cleansing and debriding a wound.

4.2 Dressing selection

The full set of circumstances surrounding a patient need to be taken into consideration. This ensures dressing cost-effectiveness, efficacy and efficiency, adding to time and tissue which can be saved. It also prevents potential complications if the dressing is tailored to facilitate optimal dressing function and patient comfort.[16] The face, hands and blister management are of particular importance (Table 14).

The aims and functions of using dressings in burn wound management are as follows:

- Apply the most appropriate dressing, using the correct technique.
- Apply an appropriate dressing in a timely manner to avoid infection, maceration, hypothermia, and excessive pain or trauma.
- Maintain an aseptic technique at all times.
- Apply compression to control haemorrhage, oedema or venous stasis, if indicated.
- Protect the wound and surrounding tissue.
- Promote a moist wound healing environment.

When selecting dressing material, take into account these important points (refer to Addendum D):

- Consider dressings with longer wear times to prevent trauma to the fragile epithelium and pain on dressing removal (agreement of 100%).
- Pre- and post-procedural pain relief is required for most patients (agreement of 100%).
- Care should be taken when applying dressings to protect against impeding distal perfusion due to constrictive dressings (agreement of 100%).
- Consider an appropriate topical antimicrobial dressing to protect the wound bed from bacterial colonisation and infection (agreement of 100%).

Table 14: Cleansing and debridement priorities and procedures

Special considerations
Blisters
• Based on the current available evidence, wherever possible, small blisters should be left intact to reduce the risk of infection, but if the anatomical position necessitates intervention for functional purposes, aspiration appears to result in less pain than deroofing • If the burns are very extensive and the patient is undergoing a surgical debridement, deroofing may be an option • Haemorrhagic blisters should be debrided
Small blisters
• It is acceptable to aspirate or completely remove the blister after 72 hours of aspiration • Treat small blisters as a superficial dermal wound • Reassess the wound depth on all dressing changes • Dress as appropriate
Large blisters
• Remove the blisters if they are extensive to allow adequate assessment of the burn size and depth, and to improve the efficacy of wound therapy
Face
In general, adopt a conservative approach initially, especially around the nose and ears. Consider the following options: • A temporary skin substitute for superficial partial-thickness burns • The use of opical ointment, e.g. polysporin • The application of a topical antimicrobial dressing (kept it moist) • The application of ointment and petroleum jelly on the surrounding skin • The use of debridement and grafting, once depth and/or healing potential have been evaluated

- *Exudate management:* The appropriate absorptive capacity of the dressing must be considered on application. An appropriate primary dressing should be chosen to maintain optimal moisture and to promote wound healing (agreement of 100%).
- A secondary dressing must not come into contact with the wound as it may adhere to it, and cause trauma on removal (agreement of 81%).
- Occlusive dressings, e.g. hydrocolloids, should not be applied to infected wounds (agreement of 77%).
- The healed areas of the skin require appropriate moisturiser and sunblock (agreement of 100%).
- Pressure garments should be considered to counteract and minimise the effects of scarring after the burn wound heals (agreement of 100%).

Table 15 details the recommendation for dressing selection.

Table 15: Recommendation for dressing selection

Recommendation 4.2 (agreement of 100%)
Choose a dressing that is appropriate to prevent colonisation of the wound, minimise pain and ensure adequate moisture conducive to optimum wound healing

5. Advanced therapies

The most modern dressing advances do not compensate for lack of surgical and critical care in the crucial initial period post burn. This relates especially to fluid resuscitation and early excision and grafting. Modern management is focused on maximising tissue preservation in a timely manner.

The following are of particular interest to burn clinicians:

- *Laser Doppler technology:* Laser Doppler technology is not widely used owing to its cost and lack of evidence with respect to its ability to determine injury depth.
- *Tissue preservation with hydrosurgery:* Versajet® has been used with success by experienced surgeons and may preserve viable tissue better than conventional methods for surgical debridement.
- *Negative pressure wound therapy (NPWT):* NPWT has been used with success in the preparation of the burn wound bed for skin grafting and for improved allo- and autograft take[17,18]
- *Dermal substitutes (dermal regeneration templates):* The use of dermal templates, e.g. Integra®, has been indicated in acute extensive burns, when donor sites are limited. They are also particularly useful for burn reconstruction when resulting deformities need reconstructive procedures, e.g. the release of burn contractures
- *Tissue engineering:* Tissue engineering is not available in low- and middle-income countries, such as South Africa and the African continent. Evidence is not conclusive for a wider indication of cultured cells, although it is being investigated as an adjunct to dermal substitute use in developed countries. Epidermal-only options do not offer a satisfactory outcome as the closure is neither resistant to sun, nor contracture

6. Educational aspects when dealing with post-burn care issues

The burn patient has to live with the result of the trauma suffered. Despite lifesaving interventions, factors and aspects of this patient's life will remain permanently. It is important to convey to patients the importance of caring for those permanent aspects as this forms the backbone of vital patient education. This directly influences patients' quality of life, daily living activities and general social adaptations needed in order to live a life as close as possible to that of an unburnt person.

The patient must be educated on the following aspects:

- Avoid unnecessary sun exposure. Protective clothing must be worn, and a high-protection-factor sun block (SPF 50 or higher and which is titanium oxide based) acquired, to be used daily for life.
- Take a tepid bath or shower to avoid temperature sensitivity.
- Moisturiser should be applied at least twice daily to healed skin because of damage that has been caused to the natural oil-secreting glands.
- *Pruritis:* Taking a lukewarm shower, amd the use of bath oil, a colloidal oatmeal product and moisturiser on the

skin may help with itching. Sometimes medication such as antihistamines, gabapentin and clonidine is useful for managing pain and itching.

- Scarring depends on the size, location and depth of the burn. Hypertrophic scarring usually corresponds with any burn that has taken longer than three weeks to heal. Management of the burn scar is varied, and involves a combination of silicone sheeting, compression garments, and massage with certain topical agents. Newer-generation, elasticised, biological, impregnated silicone sheets are being developed to stabilise the burn wound, thereby limiting collagen formation. Scar formation and maturation may take up to two years following a deeper burn injury.

Table 16 lists the recommendation with respect to educational aspects when dealing with post-burn care issues.

Table 16: Recommendation with respect to educational aspects when dealing with post-burn care issues

Recommendation 6.1 (agreement of 96-100%)
Post burn care relies on education which incorporates long-term care action and lifestyle adaptation to promote a better quality of life

The interprofessional team

Care is focused on the most appropriate intervention in the given circumstances at the time. Major burn care spans many specialties and needs a proactive involvement, with a healthy respect for the fragile situation under correction. The team is required to ensure outcomes, and is therefore not divided into disciplines, but into components of:

- Emergency management
- Fluid resuscitation and critical care
- Early enteral feeding
- Early excision and grafting
- Occupational therapy and prosthetics
- Physiotherapy
- Psychological support
- Tissue management and epithelial cover.

Key message with respect to rehabilitation
Occupational and physical therapists should be involved throughout the treatment process, and for deep burns, for some time after wound closure, to optimise function and aesthetic outcomes

Conclusion

The aim of this document is to implement a global wound care guideline adapted to the South African context. This document should not be used in isolation, but together with the international guidelines that it supports.

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Addendum*: Referral procedure
*For Addendum B - D please see the electronic version (www.pntonline.co.za)

SOUTH AFRICAN BURN SOCIETY TRANSFER INFORMATION CHART

REFERRING HOSPITAL:.....
Name of person:.....
Designation:.....
Date: / / Time:.....
Contact No:.....
Transport by: ambulance AMS/ Air other

ACCEPTING HOSPITAL:.....
Name of person:

(Please insert patient ID sticker or write in details)

Patient's name:.....
ID/Folder No:.....
Date of Birth: / /

Gender: Male Female

Address/Contact No:.....

A. HISTORY:

1. Date &Time of incident:.....
2. Time of arrival at referring facility:.....
3. How incident happened:.....
.....
4. Agent: Scald☐ Flame☐ Electricity☐ Chemical☐ Contact ☐
5. Nature: Accident☐ Assault☐ Domestic Violence ☐
Self-Inflicted ☐Other☐
6. Associated Injury: Multiple Trauma Yes ☐ No ☐
MVA ☐Fall☐ Stab☐ Other☐
7. State of consciousness when found: A☐ V☐ P☐ U ☐
8. First aid given (cooling): Yes☐ No☐
<20 min ☐ >20 min☐
9. Tetanus toxoid: Up to date given

B. FLUID REQUIREMENT CALCULATION & MONITORING:

Weight of patient: .....Kg Estimated Burn Area: .....% TBSA
Total for first 24 Hrs:.....
Urine Catheter passed: Yes ☐ No ☐
Urine Output: ..... ml (since insertion catheter; discard urine obtained initially)
Venous access: Peripheral☐ Central ☐
BP: ..... Pulse: ..... Temperature:.....

C. RESPIRATORY CARE:

Smoke inhalation suspected? Yes☐ No☐
Soot in throat/nose? Yes ☐ No☐ Hoarse voice: Yes☐ No☐
Stridor: Yes☐ No ☐
Breathing spontaneously: Yes☐ No☐ Respiratory rate: .....
Intubation required: Yes☐ No☐
Size of tube:..... Sats: .....

D. EXAMS:

Chest X-Rays: Yes ☐ No☐ ABG:.....

Fluid regime estimated given first 12 hrs from injury:

Time	Fluid Type	Amount	Urine Output

Pain Management (Analgesia):

Drug type	Amount	Route	Time given

Wound Management:

Dressing applied: Cling wraps☐ Burn Shield☐
Bactrazine☐ Jelonet☐ Other ☐ .....

Escharotomy done: Yes☐ No☐
Areas: .....