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### Burn Care: Regionalisation, Organisation and Triage



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**The interdisciplinary nature of burn care has driven centre regionalisation. The role of burn centres in the national trauma system cannot be overstated.**

Burn centres, essential components of any trauma system, serve a broad base of patients, including potentially those injured in mass casualty events. Over the past fifty years, the field of burn care has made dramatic improvements in patient outcomes following severe burns, attributable to advances in all aspects of patient management. The complexity of patient care, both in the short- and long-term, requires a well-prepared interdisciplinary team. Such implementation has been made possible by centre regionalisation.

## Regionalisation of Burn Care

Specialised burn care has been in place in the United States since 1947 (Brigham and Dimick 2008). While still a source of significant morbidity and potential mortality, outcomes of burn injury have improved greatly; fire-related deaths fell from 2.9 per 100,000 population in 1970 to 1.5 per 100,000 in 2000 (Gibran et al. 2005). Currently, only 3% of burn centre admissions result in fatality, and almost 88% of patients are discharged to home (American Burn Association (ABA) 2015). This unprecedented survival and functional recovery was brought about through fluid (Baxter et al. 1973) and nutritional (Curreri et al. 1974) resuscitation protocols; early burn wound excision and closure (Desai et al. 1990); expanded graft coverage products and techniques (Jeschke et al. 2013); topical antimicrobials; and the pharmacologic modulation of the hypermetabolic response (Demling and DeSanti 2003). As important was the recognition that such patients require a team of experts to optimise their outcomes. These teams, led by burn surgeons but involving professionals across multiple disciplines, could likely not exist without the regionalisation of care, i.e. the hierarchical consolidation of patients with similar diagnoses in a geographic catchment area. Similar groupings have demonstrated benefits in many other complex surgical conditions (Mackenzie et al. 2006; Luft et al. 2007; Birkmeyer 2000; Birkmeyer et al. 2002). That these benefits would extend to burn patients is unsurprising.

With the physiologic damage that results from thermal injuries often comes significant physical and psychosocial rehabilitation requirements necessary to facilitate reentry into society. As such, successful and cost-effective burn management requires not only a surgeon experienced in burns and critical care, but a skilled nursing staff, physical and occupational therapists, social workers, nutritionists, pharmacists and chaplains. Paediatricians and [child life specialists](#) are commonplace when caring for younger patients (Kastenmeier et al. 2010). Representing multidisciplinary care in its truest sense, this care extends well beyond the initial treatment, with burn serving as a hub for necessary aftercare as well (Sheridan et al. 2000). It would be difficult to provide this level of expertise in a non-regionalised fashion, and the benefits are mutual to patients and providers — providers stay busy enough to maintain their skills, patients benefit from the derived expertise (Warden and Heimbach 2003).

This approach has proven benefits. Mortality has been improving for decades (Wolf et al. 1997; Sheridan et al. 2003; Palmieri et al. 2008). Verified burn centres in California were shown to have comparable mortality rates to non-verified burn centres, despite admitting more patients per centre and caring for more severely injured patients (Palmieri et al. 2008). Delayed transfer to a burn centre was shown to have deleterious effects on risk of infection, renal dysfunction, wound sepsis and bacteraemia, and was also associated with a longer time to 95% wound closure and a longer hospital stay in paediatric patients (Sheridan et al. 1999). While multidisciplinary treatment has been shown to have significant impact on patient quality of life after discharge (Sheridan et al. 2000), patients treated in high-volume centres have been shown in multiple studies to be more likely to discharge home, rather than to skilled nursing facilities, implying better functional outcomes at discharge (Pacella et al. 2006; Klein et al. 2008).

Regionalisation has prompted appropriate concerns that with a reduction in centres most equipped to treat burns would come morbidity associated with a delay in care. These concerns have not been borne out. If injuries occur at a significant distance from a burn centre, patients are triaged at an outside hospital and resuscitation is begun, often under remote guidance from a burn centre. Patients are then transported for definitive management. Transfer itself, even over substantial distances, has been shown to be safe (Klein et al. 2007). Transfer from an outside facility has not been shown to increase length of stay, operations, hospital charges or mortality (Klein et al. 2006; Bell et al. 2012).

The consolidation of expert wound care and critical care management has benefits extending beyond burn treatment. Clinically, highly morbid conditions such as toxic epidermal necrolysis, necrotising fasciitis and frostbite are routinely referred to burn centres acting as 'wound intensive care units' for definitive management with excellent outcomes (Barillo et al. 1989; Faucher et al. 2001; Palmieri et al. 2002; Endorf et al. 2005). From an educational perspective, these centres drive the outreach in their respective areas, and serve as excellent training grounds for clinicians, whether students, residents, fellows, nurses, therapists, pharmacists or nutritionists. Burn centres are also at the forefront of clinical and basic science research pertaining to all facets of burn and wound care (Gibran et al. 2005). The concept of burn care regionalisation has been around for decades (Praiss et al. 1980). However, despite documented improvements in outcomes and easily accessible ABA transfer criteria, the adherence to such criteria remains fairly low, with studies demonstrating that significant numbers of patients meeting ABA referral criteria are not transferred to ABA-verified burn centres (Zonies et al. 2010; Holmes et al. 2011). The responsibility for educating outside hospitals and arranging transfer agreements falls on such facilities to ensure that burn patients benefit from the expertise and resources that they are uniquely able to offer

## Staffing Guidelines

In North America, approximately 60% of acutely injured burn patients are hospitalised at the 128 burn centres, with the remainder spread across the other 5,600 acute care hospitals. This results in a 200:1 ratio of admissions in favour of the dedicated burn centre (Healthcare Cost and Utilization Project 2010). Of these 128 centres, only 63 have achieved external verification by an outside agency, the American Burn Association

(ABA). The guidelines for providing optimal care of severely burned patients were set forth initially in the *Resources for Optimal Care of the Injured Patient* (American College of Surgeons, Committee on Trauma 2006), and are now refined on the [ABA website](#) (ABA 2014). Where possible, numbers are listed, reflecting average values derived from a cross-sectional biopsy of verified burn centres.

In 1995 the ABA and the American College of Surgeons Committee on Trauma (ACSCOT) developed a verification process to externally validate the quality of care by U.S. burn centres (Gamelli et al. 2007). In addition to its focus on survival, objective review of complications to determine preventability, emotional health, and reintegration in society, this rigorous process sets minimum guidelines for burn centre facilities, volume, staffing, experience, continuing education, dedication to prevention, teaching and research.

The burn centre hospital must maintain a specialised unit, with designated ICU-capable beds dedicated to acute burn care (ABA 2014). There must be a sufficient number of admissions to maintain clinical competency for the staff in the critical care of burn patients (ABA 2006). The minimum number of yearly admissions is 100 for both adult and paediatric programmes (ABA 2014). Overall burn centre admissions number more than 200 (Healthcare Cost and Utilization Project 2010), while verified burn centres (VBC) average 250. The average number of burn centre beds is 17. While the average daily census must be greater than three (ABA 2014), the mean VBC census is eight. If the burn centre is not a designated trauma facility, there must be transfer agreements to provide care for the 5% of burn patients who have associated trauma. Burn surgeons demonstrate expertise in burn treatment by completion of a burn fellowship or by two or more years of mentored experience in the management of patients with acute burn injuries. Each must be involved in the primary decision-making of at least 35 burn patients each year (50 for the burn director). There must be at least one burn surgeon for every 300 admissions.

The burn unit manager must have two or more years of acute burn care experience and six months of managerial experience. A staffing system that adjusts for patient acuity is required. The average VBC has one nurse for every critically ill acute burn admission during the first 24 hours; the ratio can be as high as three nurses per patient during wound care. The patient:nurse ratio decreases to 1.5:1 during the next 24 hours, and stabilises between 2-3:1 during the remaining acute hospitalisation. Burn-specific nursing orientation and ongoing education is required. Due to the extensive learning curve and camaraderie developed through shared experiences, it is not surprising that burn centre nursing teams show an average experience and turnover at VBC of 8 years and 8.5% respectively. The nursing managers are expected to participate in burn-related clinical, education and performance improvement activities.

Because rehabilitation is so important for the functional recovery of burn patients, an organised rehabilitation programme with patient-specific goals is essential (ABA 2006). Both occupational and physical therapists are mandated, with availability seven days a week, and staffing must be one therapist per six patients. Ideally, speech therapy and cognitive therapy are also present. Burn aftercare requirements state that more than 75% of all discharged patients must be followed by the burn programme. Access to appropriate rehabilitation, reconstructive surgery, peer support/survivor groups and vocational counselling must be available (ABA 2014). A dedicated anaesthesia team with burn experience, surgical technicians and nurses who regularly work with the thermally injured patient, and burn specific pre- and postoperative protocols are required. Integration of the critical care pharmacist into daily clinical burn rounds results in improved overall care and significant cost avoidance, and prevents drug-related toxicity (Patel et al. 2006). Respiratory therapists and dietitians with adequate critical care and burn experience should be available on a 24 hour basis (ABA 2014). As with physicians and nurses, all members of the burn team must complete varying amounts of burn-specific education each year. For centres caring for the burn-injured child, child life or recreational therapy personnel are required. Opportunity to continue with school while hospitalised is standard; school re-entry programmes are strongly encouraged. Paediatric intensivists and paediatricians participate in the age-specific care of these young patients.

### **Triage in Burn Injury**

Despite improved regionalisation and staffing of burn centres, there are rare occasions in which mass disasters may overwhelm the resources of any given burn care facility. In these cases, it is important to triage patients appropriately in order to maximise overall survival.

Burns are a unique injury in that mortality can be very accurately predicted using simply the patient's age and percent total body surface area burned (%TBSA) (Hussain et al. 2013). The ABA adopted a table created by Saffle et al. (2005) that used data from the National Burn Repository to predict outcome to resources ratios for the spectrum of ages and burn severity (**see Table 1**). The following categories for the possibility of survival and the required resources to care for those patients are used:

1. **Outpatient:** Patients that will have greater than 95% survival and will not need to be hospitalised.
2. **Very High:** Survival greater than or equal to 90%, length of stay (LOS) less than or equal to 14-21 days, 1 to 2 operations needed.
3. **High:** Survival greater than or equal to 90%, LOS 14-21 days, multiple operations necessary, prolonged rehabilitation.

4. **Medium:** Survival greater than 50% but less than 90% even with full treatment.
5. **Low:** Survival greater than 10% but less than 50% despite full treatment.
6. **Expectant:** Survival less than or equal to 10% despite full treatment.

□ These criteria were reviewed in 2014 by Taylor et al., who added inhalation injury to better reflect true mortality numbers, as updated by newer data from the National Burn Repository. The ABA has a defined disaster management plan including triage scenarios (ABA Board of Trustees and the Committee on Organisation and Delivery of Burn Care 2005). Primary triage requires burn patients to be sent to a burn centre within 24 hours of a disaster. The incident commander on site should contact the nearest verified burn centre, determine available capacity, and solicit alternative burn centre information if necessary. Secondary triage is the transfer of patients from one burn centre to another when a given centre's surge capacity is reached. This determination should be made by the burn centre director, but is based on a surge capacity of 50% more than the normal maximum number of burn patients at that facility. Transfer is recommended to ABA-verified burn centres when possible and then to other burn centres. Secondary triage should ideally be completed within the first 48 hours following the disaster.

#### **Conclusion**

Optimal burn care requires a diverse team of professionals. Consolidation of resources, including staff expertise and availability, has produced a trend towards regionalisation, which has proven beneficial to patient outcomes. Preparedness to handle large-scale disasters is just part of what makes verified burn centres so essential to the national trauma system.

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