Quality improvement and patient safety in burn care

AD Rogers
Ross Tilley Burn Centre, Sunnybrook Health Sciences Centre, and Department of Surgery, University of Toronto, Canada
Corresponding author, email: alandavid.rogers@sunnybrook.ca

Few clinical sub-specialties require the same degree of intense, dedicated interdisciplinary involvement as major burn injury does. There are countless opportunities for quality improvement interventions to optimise the care that is delivered for these patients at each stage of their care. Burn centres do well to maintain a quality improvement focus in the execution of all activities, and to constantly evaluate how local practices can adapt to evidence-based knowledge. This second part of a series on Quality Improvement (QI), relates to QI specifically in the context of the care of patients with major burn injury, with reference to concepts like benchmarking and verification, and describes a single published QI initiative.

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Background

This is the second in a two-part series on Quality Improvement (QI). The first part defined and outlined the scope of QI, and introduced some of the various instruments and methods used for QI interventions.[1] It highlighted the difference between traditional research and QI, emphasising that the latter is more effective at introducing evidence-based medicine and meaningful change, because it adapts to local conditions, the patients, and the systems which manage their needs. This second part of the series relates to QI specifically in the context of the care of patients with major burn injury, with reference to concepts like benchmarking and verification, and describes a single published QI initiative.[2]

Quality improvement strategies are widely applicable to the care of patients with burn injuries, and a comprehensive review of the range of quality improvement interventions applied to the practice of the care of the burn injured patient would be impossible to limit to this article. That being said, there remains a remarkable paucity of quality improvement interventions (as distinct from traditional research masquerading as QI) in the burn literature. As mentioned previously, QI initiatives described for publication are distinct from traditional research publications and have different objectives.[1]

Unfortunately, quality improvement manuscripts submitted for publication are usually evaluated through a traditional research lens, more often than not resulting in rejection. In line with burn organisations' increasing requirement for quality improvement to form part of verification processes of burn centres,[3] and the limited number of qualified reviewers able to assess quality improvement submissions, there is considerable need to roll out QI training amongst burn care practitioners both for execution, and peer review. The American Burn Association (ABA) has made huge strides in advancing QI as it applies to the delivery of burn care,[4-8] and this culture has spread to other national and international burn organisations.

Nevertheless, when it comes to QI interventions, there remain only a few in the literature. Of 58 articles referring to QI over the last ten years, only seven were *bone fide* QI interventions, while the remainder utilised traditional research methods like randomised controlled trials, systematic reviews, and retrospective cohort studies.[9] In a survey of burn care practitioners internationally, the majority claimed to be participating in QI, in the form of mortality and morbidity case reviews, verification and other structured processes, and yet few had ever participated in QI interventions using QI methodology and approaches, and fewer still had published their experiences.[10]

An example of a QI intervention in burn care

Burn centres are well placed to introduce QI initiatives, either independently, or as pilot studies for hospital wide strategies. During one such intervention, we aimed to reduce the incidence of perioperative hypothermia, which has been shown to predispose patients to morbidity and even mortality.[2] The SMART aim (Specific, Measurable, Applicable, Realistic and Timely) for the project was to reduce the incidence of perioperative hypothermia to below 10% of cases, in patients with major burn (Total Body Surface Area [TBSA] > 15%), within a one-year period. A baseline diagnostic phase was undertaken to provide a greater understanding of the incidence, natural history and risk factors of perioperative hypothermia in the patients we cared for. We also reviewed and reinforced intraoperative measures in current use, including pre-emptive adjustment of the ambient temperature, underbody warming mattress use, warming blanket application over areas not operated, regular temperature monitoring, and discussion at the World Health Organization surgical checklist. Preoperative forced air warming was identified as a sound and easily applicable change initiative, which had also been found to significantly improve outcomes in other settings. The primary outcome measure was the percentage of cases of perioperative

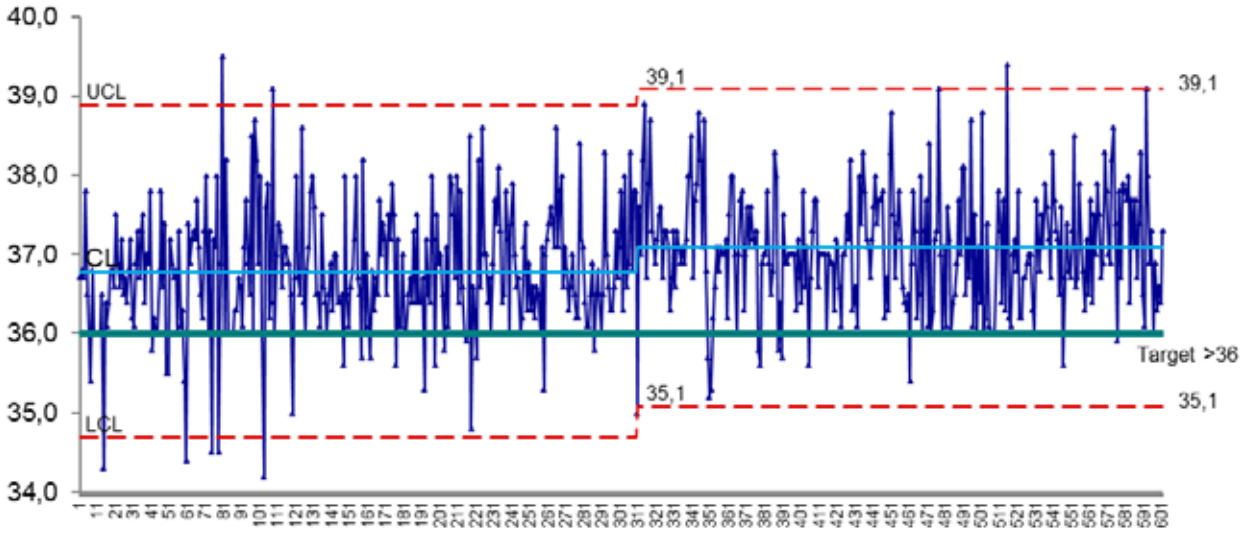

Figure 1: This is a statistical process control chart of patient core temperatures at the conclusion of surgery for major burn injury, over a two-year period. Note the reduction in cases of perioperative hypothermia since the introduction of pre-warming half way through the period.

hypothermia (< 36 ºC), utilising a time series design for the one-year period between 1 November 2016 and 31 October 2017.

Fifty-three patients with burn injuries greater than 15% TBSA were admitted over the one-year period. Of these, 40 patients required 127 operative procedures. Their mean age was 48.23 years, their mean TBSA was 27.65% (range 15–75%), and their mean length of hospital stay was 31.2 days. After the introduction of pre-warming, the proportion of cases of inadvertent hypothermia reduced to 13.77% (n = 14/102), with special cause variation (statistical significance in QI terms), from 24% (n = 6/25) in the baseline data collection period. Based on stakeholder feedback and consensus from the literature, an algorithm was developed which forms the basis for a medical directive for preoperative warming for eligible patients. In other words, pre-warming was incorporated into a pre-printed admission order-set, which obligates the bed-side nursing staff to apply preoperative warming, without the need for a specific order for each patient at each operation. No significant balancing measures were identified, nor any undue costs incurred. Long-term tracking of core temperatures at the end of major burn cases over a two-year period independently demonstrated the improvement too (Figure 1).

Benchmarks in burn care

Quality improvement is nothing without the reliable collection of data. The nature of burn care is such that the best conclusions about clinical practices can often only be made by collecting and sharing between institutions. In order to be able to compare outcomes, and then to derive broadly acceptable 'benchmarks', common unambiguous definitions are required. Although organisations such as the American Burn Association have published consensus documents about definitions for conditions such as sepsis, ventilator-associated pneumonia, wound infection etc., considerable challenges still exist in their interpretation and application. As a result, reporting is variable and inconsistent between sites. This highlights the fact that valuable traditional research in burn care is becoming increasingly difficult to undertake without enormous resources, time and funding, while QI is increasingly being seen as a way to introduce tangible change within specific environments.

Traditionally, mortality rates and hospital lengths of stay have been the key reported outcomes; mortality rates have declined significantly over the last three decades in modern burn centres. But these outcome measures are no longer adequate or satisfactory, the most obvious reasons being that mortality rates will depend more than anything else on factors beyond the control of the clinicians, including patient age and comorbidities.[11,12] Length of stay, as well as length of stay per percentage burn, is equally flawed as a measure, depending on the availability of and demand for rehabilitation services, how much longer some clinicians keep their patients in the acute hospital setting depending on their targets for range of motion, independence, and other measures (with improvements in outcomes). Other factors determining this decision include socio-economic ones that are dictated by the community served and geographic considerations, the need for follow-up, and patient comorbidities.[13] The Ross Tilley Burn Centre in Toronto, for example, serves patients who reside further than 13 000 km away in Thunder Bay, Ontario, where limited resources are available for wound care and rehabilitation.

Without consensus on viable measures we will have difficulty evaluating standards of care, comparing our services, interpreting research, and undertaking meaningful audit and quality improvement. In recent times there has been a greater focus on long-term outcomes such as measures of disability, distress, social reintegration and quality of life: how best to measure these and other patient-reported outcomes are justifiably at the forefront of debate within the burn fraternity. Klassen et al., for example, recently validated a patient reported outcome scale with respect to scar assessment, recognising that healthcare workers' opinions about satisfactory outcomes are not necessarily shared by their patients.[14]

Table 1: Summarised criteria for verification of a burn centre by the American Burn Association

Category	Criteria
1. Facilities	Support for a burn programme
	At a designated trauma centre
	Dedicated burn ICU beds with adequate census
	Timely access to an operating room appropriately set up for acute and reconstructive burn surgery
	Accredited source of allograft skin
	Access to a range of wound care materials, skin substitutes and antimicrobial dressings
	Dialysis, radiology and laboratory support at all times
	Dedicated outpatient facilities, appropriate supply of wound dressings, splints and ability to perform minor procedures
	Affiliation to local university, with accredited, formalised resident/registrar and/or fellow training programmes
2. Burn surgeons	The burn director oversees all clinical aspects of administration
	Appropriate certification and experience which may include fellowship training in burn care
	EMSB/ABLS or equivalent training
	Commitment to research, audit, continuing education and quality improvement
	A director or delegate is available at all times
	24-hour coverage and a call schedule
	Participation in regional, national and international meetings
	Able to perform or have access to learn reconstructive surgery
	Local, regional, national and international outreach, advocacy and teaching
3. Nursing	Nurse manager to oversee all nursing administration
	Continuous coverage of appropriately trained nurses in burn wound and ICU care
	Education programme
	Participation in regional, national and international meetings
	Quality improvement
4. Physical and occupational therapists	Appropriate experience and credentials
	Oversee rehabilitation plan for all patients
	Continuous education programme involvement
	Quality improvement involvement
5. Multidisciplinary coverage	Operating room nurses with burn surgery experience and knowledge of protocols
	Psychiatry consultant
	Anaesthesia, preferably dedicated, with allocated liaison/representative
	Respiratory therapists
	Paediatric- (child life) and geriatric-specific services as indicated
	Consulting services from all medical and surgical specialties
	Dedicated social worker
	Dedicated pharmacist with oversight over drug policies including antibiotic therapies and DVT prophylaxis
	Dedicated dietitian
6. Quality improvement	Weekly patient care conferences
	Monthly morbidity and mortality rounds to discuss adverse events, complications and to classify deaths as preventable or not preventable
	Oversight by non-involved external surgical critical care peer
	Multidisciplinary involvement
	Formal quality improvement training
	Ongoing quality improvement initiatives as part of the centre and hospital strategic plan, with an emphasis on safety
	Documentation, data collection, benchmark auditing and reporting systems
	Ability to identify weaknesses, intervene to correct, and undertake loop closure
	Formal incident reporting strategy
	Infection control policies and procedures compliance, with an emphasis on multidrug resistance and hospital acquired infection
7. Other policies	Regularly reviewed and practical mass casualty plan
	Memorandum of understanding with other burn units and trauma centres
	Documented guidelines on patient care
	Guidelines on patient transport and transfers
	Peer support programmes
	Policies for polytrauma patients with burn injuries
	Close communication with rehabilitation facilities and community dressing and support nurses

The National Burn Registry (NBR) in the United States collects a series of data submitted by participating burn centres for the purposes of research, and ultimately aims to be able to make comparisons between different burn units, which may serve to motivate for improvements in resources in burn care regionally. Klein et al., using data from the NBR, were able to compare outcomes with fixed accepted benchmarks in burn care at six academic burn centres. The study demonstrated a 29% survival rate benefit for patients managed in these six academic burn centres compared to those patients in the NBR, adding further motivation for centralisation of subspecialist areas of care like burns. The authors proposed a benchmark of time to recovery of organ dysfunction as an excellent marker for good clinical care in the management of major burns.[15] Falder et al. reviewed seven core domains of assessment including skin, neuromuscular function, sensation and pain, psychological function, physical role function, community participation, and perceived quality of life.[16]

Similarly, Ryan et al. sought to evaluate the young adults burn outcome questionnaires (YABOQ) as a means of monitoring and predicting recovery and evaluating treatment.[17] The study was undertaken over a five-year period and was prospective, controlled and multicentre in nature, with 12-month follow-up after burn injury. The questionnaire evaluated 15 sectors, with recovery curves in itch, perceived appearance, social function limited by appearance, family concern, and satisfaction with symptom relief, remaining below the reference control group at two years. The authors concluded that this tool was reliable at assessing multidimensional functional outcomes.

Verification of burn care facilities

One way of improving the services offered by burn care facilities is to apply a process of objective peer-review, referred to as accreditation or verification. The American Burn Association (ABA) has published a number of criteria which it utilises to verify burn centres, and successful verification has become a mark of distinction for North American burn centres.[3] To achieve burn centre verification, a centre must meet rigorous standards for organisational structure, personnel qualifications, resources, and medical care services from the time of injury to rehabilitation. These criteria are summarised in Table 1. The ABA Verification Program strives for an objective, consistent, evidence-based process to assist burn centres to maintain quality by promoting patient safety, cost containment, regional education and outreach, injury prevention, innovation and research, and advocacy. There is no reason that these principles could not be be adapted to evaluate units and motivate for change in other countries, both developing and developed.

Some of the benchmarks that burn centres might use are tabulated (Table 2). Verification gives burn centres the opportunity to hone in on those areas of relative weakness and reinforce areas of strength. In line with evidence from numerous specialties, burn care literature has suggested that centres providing high-volume, focused and specialised care tend to offer improved outcomes with fewer complications and a lower overall cost compared to lower volume burn centres. Palmieri et al., for example, showed that verified burn centres in California admitted more patients per centre and treated more severely injured patients than non-verified centres, and offered improved outcomes.[18]

Table 2: Selected benchmark criteria that may be utilised for organisational reporting of burn care

Selected outcome/Benchmark criteria
Total fluid volume received (ml/kg) for the first 24 hours after burn injury per % burn
Time to consultation for ambulatory patients and time to arrival from referral in patients requiring admission
Mortality rate (stratified by burns less than 20% total body surface area [TBSA], 20–40% TBSA, more than 40% TBSA, over 60 years old)
Burn wound and surgical site infection rates
Time from acute burn injury to first surgery (or proportion within 72 hours)
Time to recovery after organ dysfunction (e.g. length of dialysis, ventilation etc.)
Time from acute burn injury to complete excision (or proportion within one week)
Time from acute burn injury to 95% wound healing (or one week after last surgery)
Time to initiation of enteral feeding (e.g. proportion within 24 hours)
Incidence of ventilator-associated pneumonia
Incidence of acute renal failure requiring dialysis
Incidence of catheter-associated urinary tract infections
Number of cases requiring surgery for graft or flap loss
Proportion of cases of perioperative hypothermia
Mean length of stay per percentage burn
Proportion of patients managed on an ambulatory basis
Proportion of patients undergoing day case surgery
Readmission rate for complications
Waiting time for reconstructive surgery after booking
Time to return to work after burn injury
Incidence of pressure sores
Incidence of DVT and pulmonary embolus
Proportion of patients followed up by own service (on-site or via telemedicine)
Proportion screened for PTSD and depression
Proportion seen by a social worker within one week

Mason et al. reviewed data of 1 895 patients who had sustained a burn injury. Patients who received their index acute burn care in a verified burn centre experienced significantly less need for subsequent unplanned acute care, fewer emergency department visits and acute hospital readmissions. While the odds of death reduced significantly over the last 20 years, it is evident that this improvement has occurred as a result of regionalisation, with greater numbers of patients managed in burn centres than previous years in the province of Ontario.[19]

Conclusions

Few clinical sub-specialties require the same degree of intense, dedicated interdisciplinary involvement as major burn injury does. There are countless opportunities for quality improvement interventions to optimise the care that is delivered for these patients at each stage of their care. Burn centres do well to maintain a quality improvement focus in the execution of all activities, and to constantly evaluate how local practices can adapt to evidence-based knowledge.

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