

Trauma, a preventable burden of disease in South Africa: review of the evidence, with a focus on KwaZulu-Natal

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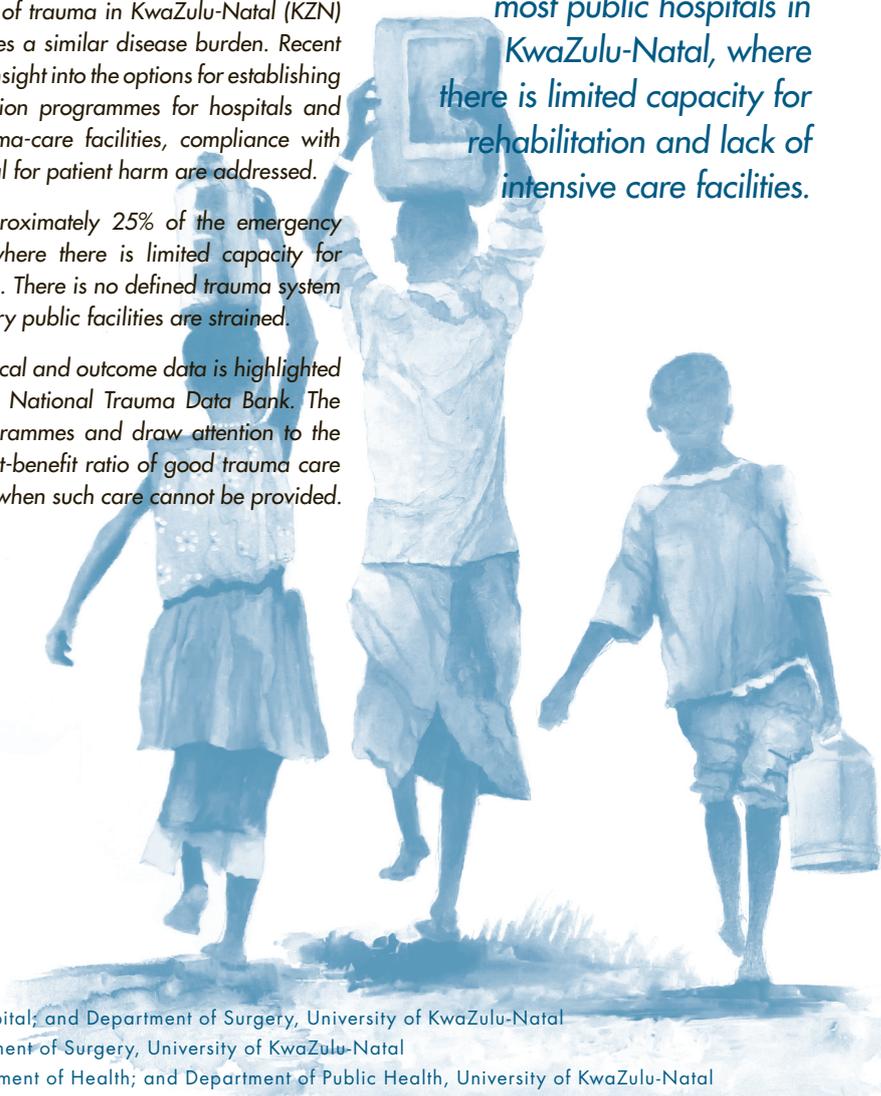
Trauma is a major burden of disease in lower- and middle-income countries, and to address the causes and treatment requires specialist services and multidisciplinary care. Despite this, governments have given trauma low priority as they have focused largely on primary health care.

This chapter demonstrates the extensive burden of trauma in KwaZulu-Natal (KZN) and illustrates that the entire country experiences a similar disease burden. Recent data from numerous studies are used to provide insight into the options for establishing systems of quality trauma care and accreditation programmes for hospitals and systems. Current and optimal staffing of trauma-care facilities, compliance with minimum equipment standards, and the potential for patient harm are addressed.

The authors show that trauma constitutes approximately 25% of the emergency workload at most public hospitals in KZN, where there is limited capacity for rehabilitation and lack of intensive care facilities. There is no defined trauma system and the existing resources at regional and tertiary public facilities are strained.

The role of sound databases in providing numerical and outcome data is highlighted and a call is made for the establishment of a National Trauma Data Bank. The authors highlight the need for prevention programmes and draw attention to the cost implications of trauma care, noting the cost-benefit ratio of good trauma care compared with the litigation risk to government when such care cannot be provided.

Trauma constitutes approximately 25% of the emergency workload at most public hospitals in KwaZulu-Natal, where there is limited capacity for rehabilitation and lack of intensive care facilities.



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Introduction

Trauma is well known to be a major disease burden in lower- and middle-income countries (LMICs), with South Africa falling into the middle-income group. Over 90% of trauma deaths occur in LMICs, yet facilities that can provide optimal care and rehabilitation are lacking in many of these countries. Recent publications from the World Health Organization place the global injury mortality rate at five million per annum, with one-fifth of these deaths occurring in India, and almost one-fifth in Africa.^{1,2} In the near future, the injury mortality rate will exceed that of HIV and AIDS, tuberculosis, malaria and obstetric causes combined.¹ Over 50 000 trauma-related deaths were recorded in 2009 across South Africa, with the majority related to transport and violence.³

For every mortality that occurs it is estimated that there are between 10 and 50 injured survivors, half of whom will have a permanent disability.⁴ Lack of access to rehabilitation services in most LMICs leads to severe loss of disability adjusted life-years (DALYs).⁵

Injuries in LMICs are largely violence or transport-related, and occur mostly among young healthy men of low socio-economic status influenced by alcohol and drug misuse, which increases the burden on developing communities. Data from Cape Town, where a large single-centre electronic record was recently implemented, reflect the same demographic pattern of violence- and transport-related injury in young male adults, with alcohol playing a central role in the injury profile.⁶⁻⁸

The burden of trauma has been given low priority by government, and institutional apathy, lack of translational research and government's primary health care focus have resulted in neglect of this disease process and a trauma care crisis. Trauma requires access to specialist services and multidisciplinary care; however, it is a largely preventable community-based pathology.⁹⁻¹¹ A recent inaugural professorial speech highlighted the following with regard to trauma:

No-one talks about it or studies it; it's not part of the Millennium Development Goals; there are no global funds fighting it; and the World Health Organization has devoted few resources to it. This needs to change.⁹

Potential preventive measures can be categorised as follows:

- primary prevention, which includes measures such as traffic-calming and safety devices such as speed-bumps and helmet use, legal compliance, alcohol avoidance, etc.;
- secondary prevention, which includes optimised pre-hospital and in-hospital care; and
- tertiary prevention, which includes rehabilitation programmes and support groups.

Actions focused on the 'upstream' conditions that promote health and protect the community through injury reduction can alleviate the 'downstream' injuries that fuel the trauma care crisis. However, lack of compliance on the part of the community is not uncommon, causing increased implications for more severe injury.^{12,13}

This chapter aims to demonstrate the extensive burden of trauma in South Africa, using recent data mainly from large public hospitals currently bearing the extensive burden of trauma care. It refers

mainly to local research published in the past five years from KwaZulu-Natal (KZN) and other parts of South Africa, and from theses published online by the University of KwaZulu-Natal (UKZN). Data were also sourced from public service planning and policy documents. Extrapolation of KZN data to arrive at national estimates was based on the fact that the province contains over one-fifth of the national population, rendering extrapolation from a 20% sample statistically relevant.

The study addressed current and optimal staffing of trauma-care facilities, compliance with minimum equipment standards, and the potential for patient harm in the current trauma system. The chapter provides insight into the accreditation programmes for hospitals, and options for establishing cost-efficient high-quality trauma care systems. The role of sound databases in providing numerical and outcome data is highlighted and a call is made for the establishment of a National Trauma Data Bank. The chapter also provides insight into the need for prevention programmes and the cost implications of trauma care, noting the cost-benefit ratio of good trauma care compared with the litigation risk to government when such care cannot be provided.

All these aspects are considered in the context of the relevant Sustainable Development Goals (SDGs), specifically: SDG 3 (Good health and wellbeing); SDG 11 (Sustainable cities and communities); and SDG 16 (Peace, justice and strong institutions).

We also identify some good practices and hindrances to policy implementation, while noting possible implications for policy reform in terms of cost and human resource requirements.

Use of terms

For the purposes of this chapter, 'trauma' is defined as injuries, both intentional and non-intentional, while 'major trauma' is defined as injuries that require hospital admission beyond the emergency centre of the receiving hospital, i.e. where definitive in-patient care is required, operative or otherwise, either in a ward or an intensive care unit (ICU). In most cases, these are patients with an injury severity score (ISS) greater than nine, and often greater than 16.¹⁴

An 'emergency centre' is the term used by the National Department of Health for the emergency area at any hospital, often incorrectly termed 'casualty' or the 'emergency department', while a 'trauma centre' is a hospital (usually at regional or tertiary level) that has a demonstrated commitment to providing quality definitive trauma care in line with the criteria of the Trauma Society of South Africa, and may be inspected and accredited at an appropriate 'level'.¹⁵ An emergency centre is found within every acute care hospital, but not every emergency centre is in a designated trauma centre, which would be the case for most district-level hospitals.

Review of the evidence

The burden of injuries

Trauma forms a significant component of the emergency centre workload at public hospitals and involves indeterminate budget consumption due to unpredictability of the general burden and injury severity. Additionally, the need for scarce high-dependency and intensive care resources¹⁶ leads to roll-over blockages for urgent elective surgery.^{17,18} In order to assess and contextualise this healthcare burden and its impact on the health system, a series of studies,¹⁷⁻¹⁹ was undertaken in 2010 to determine the trauma burden in KZN covering three major categories of injury, namely motor-vehicle-related, violence-related and domestic/work-related. These studies examined both the pre-hospital and in-hospital disease burden, using two non-holiday season months extrapolated to a one-year incidence, and determined that almost 102 000 pre-hospital trauma (emergency medical services (EMS)) call-outs were recorded, equating to almost 12/1 000 of the population per year, while over 124 000 persons were treated in public hospitals for these three injury categories in 2010. Over 70% of these EMS callouts or hospital attendances were for either motor-vehicle related or violence-related injuries.

The challenge noted was that almost 80% of patients were considered serious or critical (meeting the criteria for major trauma), yet due to the primary-care focused referral pathway, only 40% were admitted directly to the correct level of care. These rates far exceed the comparative international incidence.^{17,18} Furthermore, recent work showed that almost 15% of the total trauma burden are critically injured patients requiring direct admission to a major trauma facility²⁰ and this data correlates with the 18% determined in the pre-hospital phase of the 2010 studies. This distribution of patients to the incorrect level delays definitive care, mostly provided at regional and tertiary facilities, and necessitates costly inter-hospital transfers.

A similar pattern was seen in the Eastern Cape, where almost 70% of all trauma admissions to the teaching hospitals were due to either transport- or violence-related mechanisms and almost 38% of these incidents were preventable.^{21,22} Similar patterns were also reported in Mpumalanga.²³ The excessive EMS workload means that many patients do not arrive during the immediate post-injury period.²⁴

Findings in the Western Cape (mainly urban areas) are in keeping with the numbers and mechanisms of injury found in more rural provinces, and the need for improved, locally relevant injury surveillance programmes applicable to LMICs has been identified.²⁵

Other studies examining the epidemiology of injuries have largely focused on single-centres or specific pathologies. For example, Howlett and colleagues found that passengers on the back of pick-up trucks ('bakkies') were at severe risk of injury through ejection (90% of such injuries involved prolonged hospital stays of around two weeks, and almost one-third of survivors required ICU admission).²⁶ Mnguni et al. examined abdominal injury over a seven-year period at King Edward VIII Hospital in Durban and noted that 488 cases were admitted to a single surgical firm (of six firms in total), with penetrating trauma outnumbering blunt trauma by a staggering 9:1, and an overall mortality rate of 11%.²⁷ Extrapolation of these figures suggests that around 18 000 abdominal trauma cases will be

seen in the major KZN hospitals annually. This implies that around 90 000 cases will be seen annually across the country.

Wall and associates²⁸ examined trauma incidence among the pregnant population in Pietermaritzburg and surrounding areas, and found that 4% of all female trauma cases admitted to the Pietermaritzburg Trauma Service were injured during pregnancy, with over 50% due to assault; this resulted in foetal loss in over 33% of cases, rising to 86% in those requiring emergency surgery. They further noted that 3 000 female patients sought trauma care in the 30-month study period, implying 1 200 cases per year at their centre. This was extrapolated to around 8 400 female trauma patients per year across the major KZN hospitals, and therefore almost 42 000 countrywide.

Moodley and associates²⁹ examined trauma burden and mortality in the Pietermaritzburg region and noted that over 5 000 trauma cases per year were treated at the three hospitals under review, with an almost 4:1 male/female ratio. Extrapolation of these figures to the province suggests that almost 35 000 trauma admissions occur per year in KZN. During that period, 1 105 trauma deaths underwent forensic post-mortems, of which over half took place at the accident scene.²⁹

Pillay, Ross and Van der Linde³⁰ reviewed King Edward VIII Hospital's emergency centre trauma attendances and noted that in a one-month period, 1 465 trauma cases were treated, equating to over 17 500 per annum for their facility alone. Importantly, over 66% of cases had a violent underlying cause and almost 10% required ICU admission.

This disease burden involves not only the emergency centre or the surgical wards; it also influences the workload of orthopaedics, with 63% of the 850 operative cases at one facility in 2000 being due to injury.³¹ Similar figures were noted by Parkinson et al., with over 100 patients treated for road-related injury per month at the Pietermaritzburg service, one-third of which required admission for surgery.³² Incidence of pedestrian injury is far higher than one would expect, with almost 50% of vehicular trauma sustained by pedestrians,^{32,33} and with figures in the paediatric population ranging from 21% to 58% at a referral centre and as high as 75% in those with major chest trauma.³⁴⁻³⁶ Recent published data from the Red Cross War Memorial Children's Hospital, a referral centre in Cape Town, demonstrates very similar rates of injury mechanism, with boys between five and nine years of age accounting for 75% of pedestrian trauma cases. Many of them had traumatic brain injury.^{37,38}

Most of these studies excluded burn patients; however, the burn-injury burden in KZN was reviewed in four recent papers from the three main burn centres in the province (two regional and one quaternary). The reviews demonstrated that children and epilepsy sufferers were at particular risk, with flame burns and hot-water scalds predominating. Annual incidence across the province was estimated to be somewhere between 7 000 and 30 000 cases, depending on whether minor burns treated at clinics and outpatient facilities were included.³⁹⁻⁴² Major burns (>30% body surface area in adults and >20% in children) constituted around 320 cases per year referred to the major burn units, with regional and district hospitals caring for the majority of moderate and minor burns. Data from other major burn centres in Cape Town show that across the

Western Cape (a better-resourced province) there was satisfactory initial burn care, but again a delay in definitive care through the primary care pathway, leading to multiple transfers.⁴³

Much of the published work from other trauma care facilities around South Africa reports on the specific management of single injuries or small numbers of complex injury patterns, while some report on management consequences after ICU admission. While these facilities are excellent in clinical management, there is insufficient overall information provided to determine the actual provincial trauma burden in the host provinces to enable comparative extrapolation of the disease burden of trauma. What these studies do highlight is the enormous surgical burden that trauma adds to the already large burden of non-communicable surgical disease.⁴⁴⁻⁵⁹

It is also readily acknowledged that emergency centres worldwide are faced with a major space challenge, and overcrowding is not uncommon in South Africa. Trauma care often requires more time and resources than ordinary medical care, so that given the huge burden identified in these studies, it is even more essential to develop robust trauma systems in South Africa.^{60,61}

The KZN studies led to the development of the first province-wide data-capture tool linked to the District Health Information System (DHIS),⁶² which captures basic epidemiological data from every public district, regional and tertiary, as well as the single quaternary central hospital. Over two years' data have been collected, collated and summarised, which has enabled a province-wide overview of the actual trauma burden, incorporating some of the variables not collected in previous studies. The aggregated data show that there were 197 219 emergency department visits for trauma in the period under review, which constituted 27% of all emergency department visits in the province, with 18 716 cases (9.5%) requiring ward or ICU admission. This demonstrates that the actual burden was significantly greater than earlier estimates.^{63,64} While similar figures were reported from primary care facilities in the Western Cape where injuries accounted for 20% of the emergency centre workload,⁶⁵ at the present time there is no parallel system linked to the DHIS in the other provinces with which to compare these results.

The cost of trauma care

Healthcare costing is a difficult process, given that government-employed healthcare practitioners are salaried staff, and that trauma patients may require multiple aspects of care (emergency department, ward care, intensive care, rehabilitation services, allied health services and various medical specialists, etc.). Despite these challenges, a number of recent studies have attempted to provide trauma costing in South Africa.

Lutge and Muirhead³¹ undertook costing using a bottom-up/top-down approach to determine the costs of managing orthopaedic injuries in the year 2000, and found that using either method, the costs were in excess of R5 million. Allorto and colleagues⁶⁶ undertook a costing study on burns patients at Edendale Burn Service over an 18-month period and estimated an overall cost in excess of R29 million for the 450 patients treated during that period.

Parkinson et al. examined the cost of road-traffic injury in Pietermaritzburg⁶⁷ and found that the cost per patient was around US\$6 988.50 (almost R105 000 at current rates). However, Bowman et al.⁶⁸ highlighted that costing and a cost-culture were

largely absent in the public sector, making accurate costing difficult. They examined trauma patients in Johannesburg in 2004 and found that for 48 patients reviewed, the cost was in excess of R220 000, excluding personnel and bed costs. More recent work from a large trauma referral centre serving most of rural KZN showed that the cost of interpersonal violence only (38% of the trauma burden), amounted to over R8 million per three-month period, therefore more than R32 million per year.⁶⁹

Costing estimates using data from trauma-burden studies^{17,18,70} show that at 2010 Rand-value, the overall cost of trauma care in KZN would amount to almost R5.4 billion, excluding the cost of proposed facility upgrades to ensure compliance with the National Core Standards.^{70,71}

Human resources

There are low staffing levels in emergency departments, which are often served by the most junior doctors; insufficient basic resuscitation facilities; and limited imaging facilities at clinics and district hospitals, especially after normal hours, which is when most trauma incidents occur. This leads to delays in initial care and definitive care, resulting in more complications and the subsequent need for ICU care. There is also a lack of nurses specifically trained to manage trauma and emergency cases.¹⁶⁻¹⁸ Moreover, there is poor access to surgical facilities and, despite expectation of the existence of surgical capability, very few minor operations are possible in district hospitals.⁷²

The human resources required to establish an efficient trauma system have been estimated using standardised formulae applied to public-service facilities. Estimations include the following, per referral hospital expected to manage major trauma:^{64,65}

- Three to six medical officers per emergency centre (depending on size) dedicated to trauma and acute care, with two emergency medicine specialists to lead the emergency centre in regional or large district hospitals (per unit). District hospitals would be staffed with family physicians.
- Nurses trained in emergency nursing to staff the emergency centres in ratios of one professional nurse (PN) per resuscitation bed and one PN per five other (non-resuscitation) patients, with enrolled nurses (ENs) to assist in a ratio of three per 10 patients.
- Radiographers to cover computed tomography (CT) and other imaging services 24/7.
- Laboratory service staff to cover all laboratories 24/7.
- Surgeons with a commitment to consultant-led trauma care, ideally headed by a certified trauma surgeon, if available, at regional hospital level, preferably in a hospital certified as a 'Trauma Centre'.
- Allied health service staff to provide ward services.
- Operation room staff (scrub nurse, circulating nurse and anaesthetic assistant) to provide a dedicated trauma operation suite 24/7, not competing with Caesarean sections and non-trauma acute surgery, or elective surgery; plus anaesthetic specialist cover for the operation suite.
- Clerk and porter services to ensure adequate internal administrative support.

- Cleaners and infection-control staff to ensure a safe working environment.
- Management support, enabling patient-focused resource allocation.
- Wards staffed with nurses in a 1:10 PN/patient ratio and a 1:5 EN/patient ratio, with the High Dependency Unit (HDU) staffed in a 1:2 nurse/patient ratio and ICU staffed in a 1:1 PN/patient ratio, with additional staff to allow for continuity of care during teas and lunches.
- ICU staff should be trained to use dialysis equipment.
- Regarding pre-hospital trauma care, there should be at least one intermediate paramedic per ambulance and at least one advanced paramedic per five ambulances; this should exclude staff at the call centres and management officers who should be trained in efficient management of resources.

Infrastructure requirements

Despite self-reported assurances regarding the existence of adequate equipment at various healthcare facilities, one study¹⁸ in KZN showed this was not the case, with 54% of district facilities having inadequate resuscitation-area facilities, none having in-house CT-scanners, only 62.5% having emergency mobile X-ray units, and 58% not having access to an emergency operating room (a requirement of the District care-package). Only 25% of district hospitals had an emergency observation ward, despite the need to accommodate many patients awaiting transfer to a higher level of care. Sixty-two per cent of medical staff had no formal trauma training, and 50% of the hospitals had inadequate helicopter-landing facilities.

Equipment and facilities will need to be upgraded according to the established national norms, such as the Trauma Society of South Africa (TSSA) criteria for trauma centres, the Council for Scientific and Industrial Research (CSIR) built-environment guidelines, the administrative recommendations of the Council for Health Service Accreditation of Southern Africa (COHSASA) trauma document,^{15,73,74} and the National Core Standards.⁷⁰ Active liaison with clinicians in the field of trauma care is essential to ensure that optimal equipment choices are made. For example:

- Sufficient ambulances will be required to ensure the minimum correct ambulance-to-patient ratio of 1:10 000 population, and they must be stocked with appropriate equipment for mass casualty and normal patient treatment.
- Operating resources should include an electronic link between all hospitals to enable data capture on the regional trauma registry, data storage for the image services, and facilities to transfer images more effectively and allow for telemedicine consultations between regional and district facilities.

The need for a national trauma database

A national minimum trauma database is required urgently in the country; this could include identifiers at facility level to ensure the ability to update outcome data. Data should be collated nationally to establish trends, disease burden, injury severity patterns and outcomes. This would enable rational funding for trauma care, the identification of areas with specific need, and accurate prediction of the need for rehabilitation services. Additionally, the results would

indicate the success of prevention strategies if reduced injury numbers were achieved over time. There are currently locally designed and highly functional local and regional databases that could easily be expanded to provide such a national trauma database, including a 'shareware' phone-based app offered by the Trauma Association of Canada.^{33,75-79}

Accreditation programmes

To achieve both competence and a demonstrable commitment to quality trauma care, independent assessment of trauma facilities is common practice across the world, as reflected in World Health Organization and American College of Surgeons documents.^{80,81} The Trauma Society of South Africa¹⁵ has developed a locally relevant assessment model and accreditation programme, currently with uptake mainly in the private health sector, and with over 15 hospitals currently accredited. However, there may be merit in examining the system for its suitability in the public sector.

Quality assurance in trauma care

A useful overview of management theory relative to quality assurance in trauma care highlighted that using a strategic planning approach enables quality metrics to be applied to the acute care system.⁸² Additionally, a number of other studies have demonstrated that quality assurance systems can be implemented effectively and readily assessed.⁸³⁻⁸⁸ Many of the problems identified in such assessments are related to missed injury^{89,90} or delayed diagnosis, which can be addressed through the various quality assessment tools and systems. Similar findings from a pre-hospital study in Johannesburg highlight the need for optimised patient management.⁹¹ The World Health Organization offers a Trauma Quality Assurance tool that can guide the assessment of quality of care and the success of new interventions undertaken.

The role of primary health care in trauma

Primary health care services have a pivotal role to play in implementing effective trauma primary prevention strategies. Examples include education on safe pedestrian practice, use of seatbelts, and reduced alcohol abuse. These strategies can be introduced when people with minor injuries present to a primary care facility, or when the primary care staff undertake local outreach. Education should also be directed at basic first-aid instruction and appropriate use of emergency care services.⁹²⁻⁹⁵ Simple interventions have led to dramatic injury reduction in certain areas,⁹⁶ and many novel concepts have been mooted.^{97,98}

The existing referral pathway in the public sector is protracted, resulting in the delay of appropriate care to the trauma victim. Pre-hospital services transport approximately 70% of all trauma cases to district hospitals and clinic facilities. It is then the responsibility of the treating nurses and doctors to manage the patient, irrespective of whether the facility is adequately staffed or suitably equipped. The facility is then responsible for arranging transfer of the patient to a higher level of care if required; an ambulance must be booked and the patient must wait to be transferred. This process protracts the time taken to reach definitive care and increases the risk of sepsis, resulting in a more urgent need for ICU admission, prolonged stay in hospital and higher mortality.

In the case of severe injury (major trauma/ISS>16), patients taken to regional-level hospitals have to compete for emergency care with medical and obstetric emergencies, often in inadequately designed and equipped emergency centres. There is also competition for access to operation rooms and imaging facilities, which may be unavailable after hours. There is also insufficient ICU capacity at most regional facilities, and lack of dialysis for acute kidney injury, which often complicates major trauma and other emergencies.

Risks of litigation

When the care of trauma and other emergency cases is not adequate, there is a significant possibility of litigation against the various Departments of Health.^{99,100}

The obligation to provide emergency medical care was illustrated in a recent Constitutional Court ruling in the case of *Oppelt vs. Head: Health Western Cape*.¹⁰¹ The court held that any life-threatening medical emergency requiring further specialist intervention as part of the resuscitation/stabilisation process is now regarded as part of emergency medical treatment, and any specialist/consultant contacted by an emergency department doctor for further assistance/consultation and who refuses to provide such support, will be held liable for refusing emergency medical treatment. The court also held that strict adherence to a protocol that does not accommodate emergencies is not an excuse for the delays caused by such refusal. The court also found that the purpose of Section 27(3) of the Constitution is to ensure that treatment is given in an emergency, and that it is not frustrated by reason of bureaucratic requirements or other formalities, and that a person who suffers a sudden catastrophe calling for immediate medical attention should not be refused ambulance or other emergency services that are available, and should not be turned away from a hospital that is able to provide the necessary treatment. The court found that emergency medical treatment is not confined to that which is undertaken in an emergency department, but includes that which is continued into definitive medical care if this is required for life-saving reasons, and may therefore also involve referral of multi-trauma patients to a Level 1 Trauma Unit.¹⁰¹ This judgment has implications for the National Department of Health to plan efficient, cost-effective and defensible trauma systems to maximise survival and minimise morbidity, and avoid costly legal battles. This would indirectly release more money to fund actual health care across all the disease burdens.¹⁰²

Sustainable Development Goals

The United Nations has recently established a set of Sustainable Development Goals (SDGs),¹⁰³ some of which have a direct bearing on trauma prevention and mitigation, through either healthcare or generic interventions aimed at improving access to health care and reducing risk-taking behaviour. SDGs 3, 11 and 16 in particular relate to such aspects, which if optimally addressed will result in achievement of the stated targets. Specifically, SDG 3, which relates to health care, aims to halve the number of global deaths and injuries from road-traffic accidents by 2020, and to achieve universal health coverage (including financial risk protection), access to quality essential healthcare services, and access to safe, effective, quality and affordable essential medicines and vaccines for all (potentially addressed in the National Health Insurance White Paper).¹⁰⁴ Additionally, the aim is to strengthen the capacity of all

countries, in particular developing countries, with regard to early warning, risk reduction and management of national and global health risks, achievable through disaster planning that would include EMS and trauma care.

SDG 11 addresses the potential root cause of violence-related trauma through recommending that cities be made safe and sustainable by ensuring access to safe and affordable housing. This also involves upgrading slum settlements, investing in public transport, creating green public spaces, and improving urban planning and management in a way that is both participatory and inclusive, thus reducing reliance on own-transport and potentially reducing pedestrian collisions on highways.

SDG 11 can be read hand-in-hand with SDG 16, which aims to reduce all forms of violence significantly, and to encourage governments and communities to work together to find lasting solutions to conflict and insecurity. By strengthening the rule of law through effective policing and traffic enforcement, the two major components of the trauma burden can be prevented and mitigated. Promoting respect for human rights is central to this process.

Good practices and hindrances to policy implementation

Good practices in the current KZN trauma care environment are mainly based on optimal clinical care in the face of logistical and human resource challenges. The Pietermaritzburg Metropolitan Trauma Service and the Inkosi Albert Luthuli Central Hospital (IALCH) Trauma Unit are examples of where the best use is made of the current system to achieve the best potential outcomes, in line with management strategies developed by international consensus and collaboration.^{19,33,77,105,106}

Some examples of the results of good practice at these units include:

- assessment of the knowledge and skills of junior staff regarding chest-drain placement, an important technical skill;¹⁰⁷
- diagnosis and management of blunt cardiac injury and acute kidney injury;^{108,109}
- avoidance of tracheal damage due to high cuff pressures or misplaced tubes;¹¹⁰
- optimal control of body temperature in trauma patients (now part of the National Core Standards);¹¹¹
- optimal management of vascular injury in the polytrauma population;¹¹² and
- reduction in complications and errors in care.^{83–87,90,113}

Outcome prediction, using lactate clearance, for mortality risk and timing of safe orthopaedic intervention, has also been studied,^{114–116} as has the management of penetrating trauma, which makes up 35% of the trauma burden due to violence.^{117–120}

At national level, implementation of the National Core Standards,⁷⁰ in particular those relating to the emergency centre and the ICU, serve to improve quality and to reduce financial implications for the injured. The major units in KZN have achieved good results in the peer-review process in this regard, with IALCH achieving almost 90% compliance.¹²

One of the aims of the National Health Insurance (NHI) White Paper¹⁰⁴ is to provide a mechanism for cross-subsidisation across

the entire health system, while meeting acceptable standards of care and achieving positive health outcomes. This aim is similar to that of trauma care and as such is unfortunately a cost driver for curative care in a poorly resourced and poorly structured health system. This is seen in light of the major cost drivers such as blood products, surgical consumables and laboratory services. Given the scale of the injury burden, this is not unexpected, but it is worsened by the private sector, which treats limited trauma profiles and refers many of the indigent cases to the already overburdened public sector. However, the injury burden cited in the White Paper seems to underestimate significantly the real effect on the healthcare system, and the financing mechanisms have not yet been clearly spelt out.^{121,122}

It is encouraging that emergency medical services have been highlighted in the White Paper and that comprehensive pre- and in-hospital aspects are mentioned, with a specific note that district hospitals may be partially removed from emergency care in favour of regional and higher levels of care due to the need for specialist involvement.¹⁰⁴ Optimal preparation of the system for trauma care, in anticipation of the single-payer national plan, must include consultation with practising trauma surgeons.

Potential for policy reform

It has been shown in both developed and developing-world scenarios that reducing the steps to definitive trauma care improves outcomes.^{72,123–126} The current referral pathway in South Africa delays the time to arrival at the appropriate facility. There is also an insufficient number of ambulances, often with poorly trained staff at basic ambulance attendant level, which limits efficient triage and intervention in the pre-hospital phase of care.¹⁷ This results in a lack of ability to bypass lower-level facilities, even when the patient would clearly benefit from direct bypass to a regional or central hospital.

Policy reform in trauma care must therefore be considered in the light of the disease burden outlined, and take into account the challenges of the current human resources and facilities. A system of trauma care must be implemented that ensures early access to definitive care, allowing EMS bypass of less-equipped facilities and ensuring that the patient gets to the appropriate facility within the correct timeframe, thus reducing morbidity and preventing unnecessary mortality.¹⁰² The current primary care pathway is not optimal for trauma care. The major challenge is that time is required to gauge the long-term mortality reduction of trauma systems, with most reports suggesting a 10-year time-lag before statistically significant change can be recorded.^{124–126}

In an ideal system there will be adequately staffed and equipped emergency centres, dedicated trauma wards under a trauma service team, with adequate operation room facilities (featuring separate trauma and non-trauma access) at regional and central hospitals, which will have been accredited as Trauma Centres. ICU back-up, with acute dialysis facilities, must be established at regional centres, with bed allocation based on disease burden. Definitive care facilities must be designed such that acute non-trauma, elective procedures and trauma can be addressed concurrently without one out-competing the other – this may require increased human and structural resources or the designation of certain facilities as ‘trauma hospitals’ and diversion of all major injuries to these designated hospitals.^{18,63,64,72}

Implications of findings

The findings illustrate the burden of injuries and violence on the health system, both in KZN and nationally,^{127,128} and the current lack of human and infrastructural resources to mitigate this burden. Proper re-engineering of the primary care pathway and strengthening of the regional and tertiary/quaternary levels of care, together with establishment of committed and well-resourced trauma care services will reduce risk of litigation. Prevention and rehabilitation services at primary-care level should include community health improvement strategies, which will enhance the return of injured survivors to gainful employment.

A multi-sector approach is required, including strategies to reduce or prevent motor-vehicle and interpersonal or industrial injuries through inter-ministerial units including law-enforcement (Justice/Police), road safety (Transport) and social change (Social Development/Home Affairs). The recently implemented Road Incident Management System (RIMS) is a good example of interaction between the Departments of Health, Transport, Police Services and broader professional societies.¹²⁹

Conclusion

KwaZulu-Natal (and the rest of South Africa) faces a huge injury burden, and requires a multi-sector approach, beyond health, to achieve the SDGs and ensure a functional trauma system that is both cost-efficient and quality-assured, for the proposed NHI to succeed. The KZN DHIS model should be adopted as a national priority.

Government must engage with professional societies and thought-leaders in injury prevention, disaster mitigation and curative trauma care in order to establish a coherent functional trauma system, from pre-hospital to hospital level; the system should deliver the right patient to the right facility in the right timeframe, and reduce morbidity and mortality through provision of quality care. A national Trauma Data Bank should be established to detail the disease burden and the current outcomes, while at the same time, taking into account the varying injury and trauma profiles across the county. Additionally, there should be access to rehabilitation services across the spectrum of care to ensure that injured patients are restored as economically viable members of society, through a well-orchestrated continuous care pathway.

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