

An Assessment of the Hospital Disease Burden and the Facilities for the In-hospital Care of Trauma in KwaZulu-Natal, South Africa

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Abstract

Background Trauma is a significant cause of morbidity and mortality in South Africa. The present study was designed to review the hospital trauma disease burden in light of the facilities available for the care of the injured in KwaZulu-Natal (KZN), South Africa's most populous province.

The primary outcomes were the annual hospital burden of trauma in KZN, determined through data extrapolation, and evaluation of the data in light of available hospital facilities within the province of KZN, a developing province. The data were obtained through review of the trauma load in relation to all emergency cases at all levels of hospitals.

Methods Hospital administrators in KZN were requested to submit trauma caseloads for the months of March and September 2010. Caseloads were reviewed to determine the trauma load for the province per category using two extrapolation methods to determine the predicted range of annual incidence of trauma, intentional versus non-intentional trauma ratios and population-related incidence of trauma. The results were GIS mapped to demonstrate

variations across districts. Hospital data were obtained from assessments of structure, process, and personnel undertaken prior to a major sporting event. These were compared to the ideal facilities required for accreditation of trauma care facilities of the Trauma Society of South Africa and other established documents.

Results Data were obtained from 36 of the 47 public hospitals in KZN that manage acute emergency cases. The predicted annual trauma incidence in KZN ranges from 124,000 to 125,000, or 12.9 per 1,000 population. This would imply a national public hospital trauma load on the order of at least 750,000 cases per year. Most hospitals are required to treat trauma; however, within KZN many hospitals do not have adequate personnel, medical equipment, or structural integrity to be formally accredited as trauma care facilities in terms of existing criteria.

Conclusions There is a significant trauma load that consumes vital emergency center resources. Most hospitals will need extensive upgrading to provide appropriate care for trauma. An inclusive trauma system needs to be formalized and funded, especially in light of the planned National Health Insurance for South Africa

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Introduction

South Africa has a legacy of political turmoil and inter-personal violence. Since the transition to democracy the focus of health care in South Africa has shifted from hospital-centered care to primary care [1]. KwaZulu-Natal (KZN) (Image 1) is South Africa's most populous province, with a population of almost 11 million persons [2]. Trauma varies in scale and mechanism from minor injury, suitably treated at the community hospital level, through to major trauma requiring intensive care and surgical

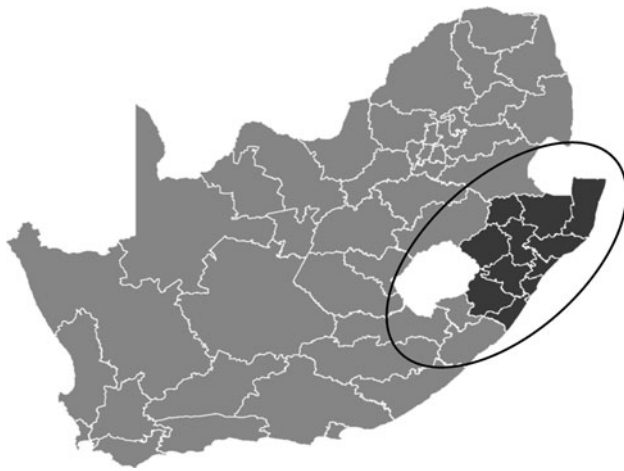


Image 1 Map demonstrating the location of KwaZulu-Natal within the borders of South Africa

intervention. It is known, however, that most trauma patients will be in need of medical care, and thus nurse-led clinics are generally an inappropriate care-level for this disease entity, as even simple suturing is outside the nursing scope of practice [3].

There have been a number of studies over the years examining the mortality burden of trauma in South Africa [4–9], as well as some older studies looking at the overall disease burden [10–13]. To date, however, there have been no recent large-scale studies of the trauma disease burden of live patients admitted to government hospitals providing an overview of these patients generally. Additionally, there are limited data on how well hospitals are equipped, staffed, and prepared for dealing with major trauma, despite national standards existing for the primary care environment.

Aim

The goal of the present study was to review the overall trauma burden of disease in KZN and the facilities available at hospitals in the province as a precursor to the design and establishment of a definitive care trauma system within the province. With such information, the study aimed to place the trauma burden into a national perspective and to provide insights into the adaptations needed prior to the implementation of the planned National Health Insurance, which will need to fund the care of trauma patients.

Methods

A questionnaire was sent to all 47 government hospitals in KZN that treat trauma cases. The questionnaire was

designed to obtain data regarding the trauma caseload, specifically in terms of gunshot wounds, stab wounds, motor vehicular trauma, and other blunt injury for the months of March and September 2010. Drownings, other medical emergencies, and snake bites were excluded. These months were chosen as they represented a “normal” month outside the holiday season (December–January) and outside the FIFA World Cup period (June–July), when no major school vacations occur, thus providing a reasonable average spread of injuries. The data were extrapolated to predicted annual figures (trauma range) by two calculation methods (average of 2 months \times 12 and the total sum of the 2 months \times 6), extended to national figures, and compared to the overall emergency case-census as provided by the Provincial Health Head Office. These results were Geographic Information System (GIS) mapped where relevant. Facilities were physically assessed by a team of specialist trauma and emergency professionals prior to the FIFA 2010 Soccer World Cup (the lead author of this article being one of the members of the team), which took place in June–July 2010. These assessments were compared to the Essential Trauma Care Guidelines (EsTC), the Trauma Society of South Africa Trauma Centre Accreditation criteria (TSSA) recently published by the society, and the expected district service delivery standards of the Department of Health for the accreditation of hospital facilities [14–16]. Based on these results, a proposal will be formulated for the establishment of an inclusive Afrocentric trauma system.

Results

Responses were received from 36 of the 47 hospitals in KZN (77 %). The raw data are summarized in Table 1. Based on the calculations, the range of trauma per annum was between 124,908 and 125,652 cases as a minimum for the hospitals represented. Converting this to an expected case load for all hospitals would yield approximately 160,000 cases per year. This equates to an annual trauma load of 12.9 per 1,000 population, or one in every 77 members of the population. Figure 1 is the Geographical Information System (GIS) map of the overall hospital burden per district. This means that trauma constitutes at least 17.8 % of the overall emergency cases treated in the province (total provincial emergency head count for 2010 was 706,346). Of these trauma patients, 44 % were treated at urban hospitals, 12 % at rural regional hospitals, and 44 % at rural district hospitals. Extrapolating these data to the national population equates to over 750,000 trauma cases per year requiring hospital level healthcare.

The total trauma load included 65 % from intentional trauma and only 35 % from unintentional injuries (this

Table 1 Raw data for the district and regional hospital trauma burden in KwaZulu-Natal

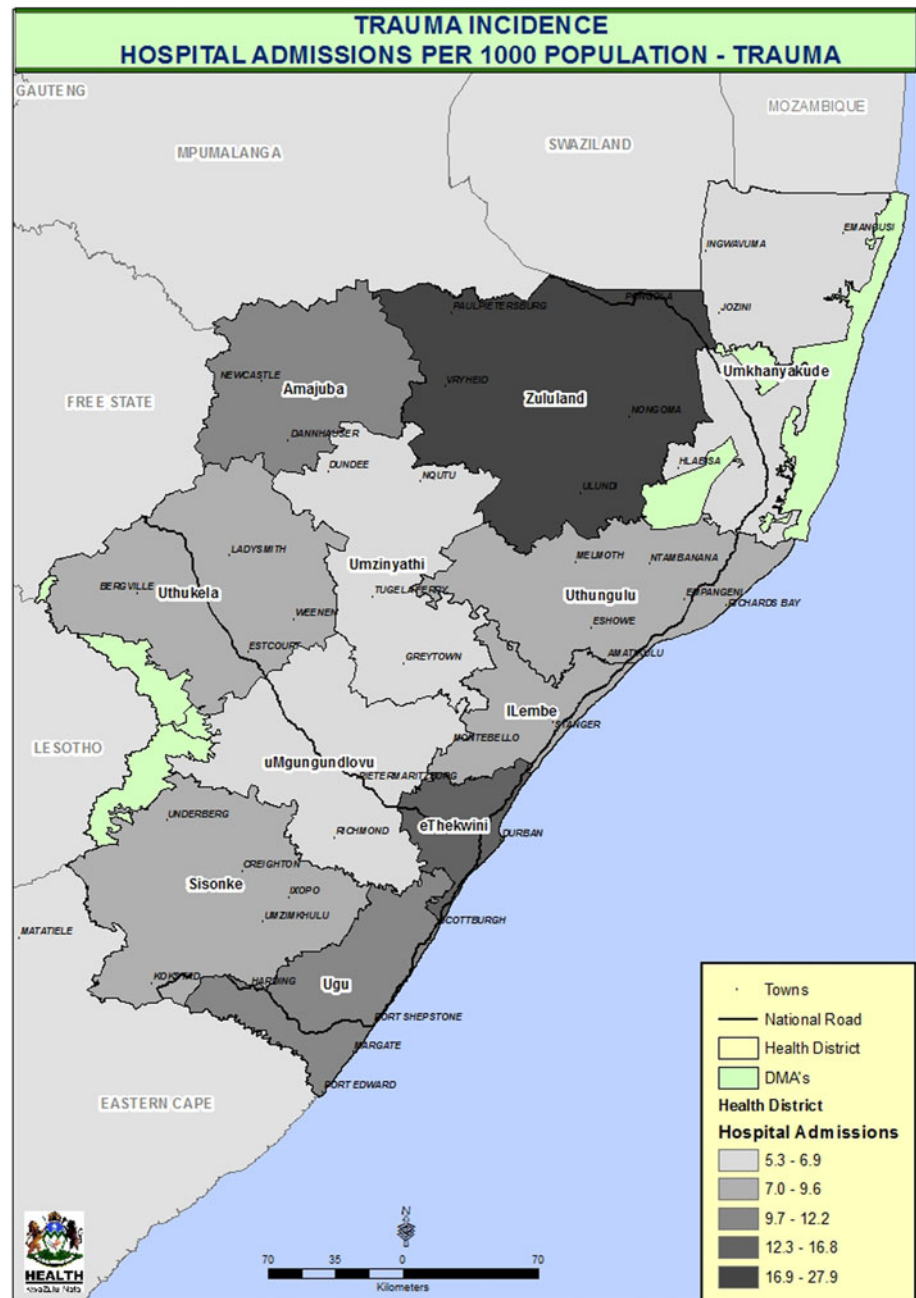
Region	September										Per district Rate per 1,000 per year	Per district Population count						
	March					September												
	Hospital	Stab	GSW	MVA	Assault	Blunt ^a	Burn	Total March	Stab	GSW			MVA	Assault	Blunt ^a	Burn	Total Sep	Total Averages
Amajuba	1	120	9	98	3	230	209	8	62	0	279	255	509	5,244	10.8	48,4673		
Total	2	40	0	75	34	149	30	2	138	46	216	183	365	5,244	10.8	48,4673		
eThikweni	1	119	10	337	344	810	108	13	236	332	689	750	1,499					
	2	105	50	210	130	495	98	31	191	149	469	482	964					
	3	43	12	139	41	235	32	4	83	39	158	197	393					
	4	153	26	364	315	858	26	199	303	337	865	862	1,723					
	5	330	26	536	1274	2,255	243	19	387	843	1,553	1,904	3,808					
	6	38	1	56	199	294	23	1	88	160	272	285	566					
Total		788	125	1642	2303	530	530	267	1,288	1,860	4,480	4,480	8,953	53,718	16.8	3,199,944		
Ilembe	1	160	22	77	86	345	144	9	86	62	301	323	646					
	2	2	3	30	38	73	9	4	34	44	91	82	164					
Total		162	25	107	124	153	153	13	120	106	405	405	810	4,860	8.4	580,307		
Sisonke	1	5	1	5	2	13	5	0	1	36	42	27	55					
	2	12	1	78	103	194	12	1	88	120	221	208	415					
Total		17	2	83	105	17	17	1	89	156	235	235	470	2,820	9.1	308,999		
Umkhanyakude	1	7	2	20	32	59	14	3	26	23	66	64	125					
	2	12	1	3	8	24	12	1	3	8	24	24	48					
	3	3	3	16	4	26	5	0	37	13	55	41	81					
	4	13	1	28	43	85	26	3	14	70	113	99	198					
	5	7	4	33	31	143	7	0	12	50	91	117	234					
Total		42	11	100	118	143	64	7	92	164	345	345	686	4,116	6.9	593,718		
Ugu	1	16	3	26	53	104	24	7	44	73	158	131	264					
	2	10		172		510	8		137		461	485	971					
	3	4	0	25	64	93	23	4	50	79	156	125	249					
Total		30	3	223	117	55	55	11	231	152	55	55	109	8,904	12.2	729,052		
uMgungundlovo	1	10	2	10	32	54	9	0	11	35	249	238	474					
	2	64	10	66	85	225	71	8	91	79	7	8	16					
	3	4	1	2	2	9	3	0	4	0	10	18	36					
	4	53	1	27	42	123	5	1	41	74	121	122	244					
Total		131	14	105	161	143	88	9	147	188	174	423	843	5,058	5.3	960,819		
uMzinyathi	1	23	0	76	44	0	23	0	112	39	10	18	36					
	2	0	0	26		26		3	7		95	94	188					
	3	8	4	26	55	93	9	3	38	45	271	271	541	3,246	6.9	472,682		
Total		31	4	128	99	103	32	6	157	84	103	103	206					
uThukela	1	18	6	46	33	335	45	16	163	161	385	360	720					
	2	44	8	127	156	335	45	16	163	161	385	360	720					
Total		62	14	173	189	335	63	23	208	194	463	463	926	5,556	8.2	680,333		

Table 1 continued

Region	March				September				Total Sep	Total Averages tot 2-mo	Rate per year	Per district Rate per 1,000	Per district Population count				
	Hospital	Stab	GSW	MVA	Assault	Blunt ^a	Burn	Total March						Stab	GSW	MVA	Assault
uThungulu	1	2	1	0	0	0	0	3	1	0	0	0	0	1	2	4	
	2	22	31	21	16		90	59	59	18	31	29		137	114	227	
	3	15	30	252	263		560							560	560	1,120	
	4	4	2	10	32		48	6	66	1	12	53		72	60	120	uThungulu
Total		43	64	283	311		70	5	87	19	43	82		79	736	1,471	917,451
Zululand	1	5	0	21	44		1,485	297	1,485	0	36	46		87	79	157	
	2	297	108	459	621		406	107	334	108	459	621		1,485	1,485	2,970	
	3	118	5	90	193		10,768	409	10,155	5	68	154		10,155	370	740	Zululand
Total		420	113	570	858		125,550		Total	113	563	821		10,155	1,934	3,867	833,037
10,471	20,925													Total averages			
	X6 =													X12 =	125,652		

^a Blunt indicates unintentional blunt injury
GSW gun shot wound; MVA motor vehicle accident

Fig. 1 Total distribution of Trauma Burden per 1,000 population across KwaZulu-Natal health districts

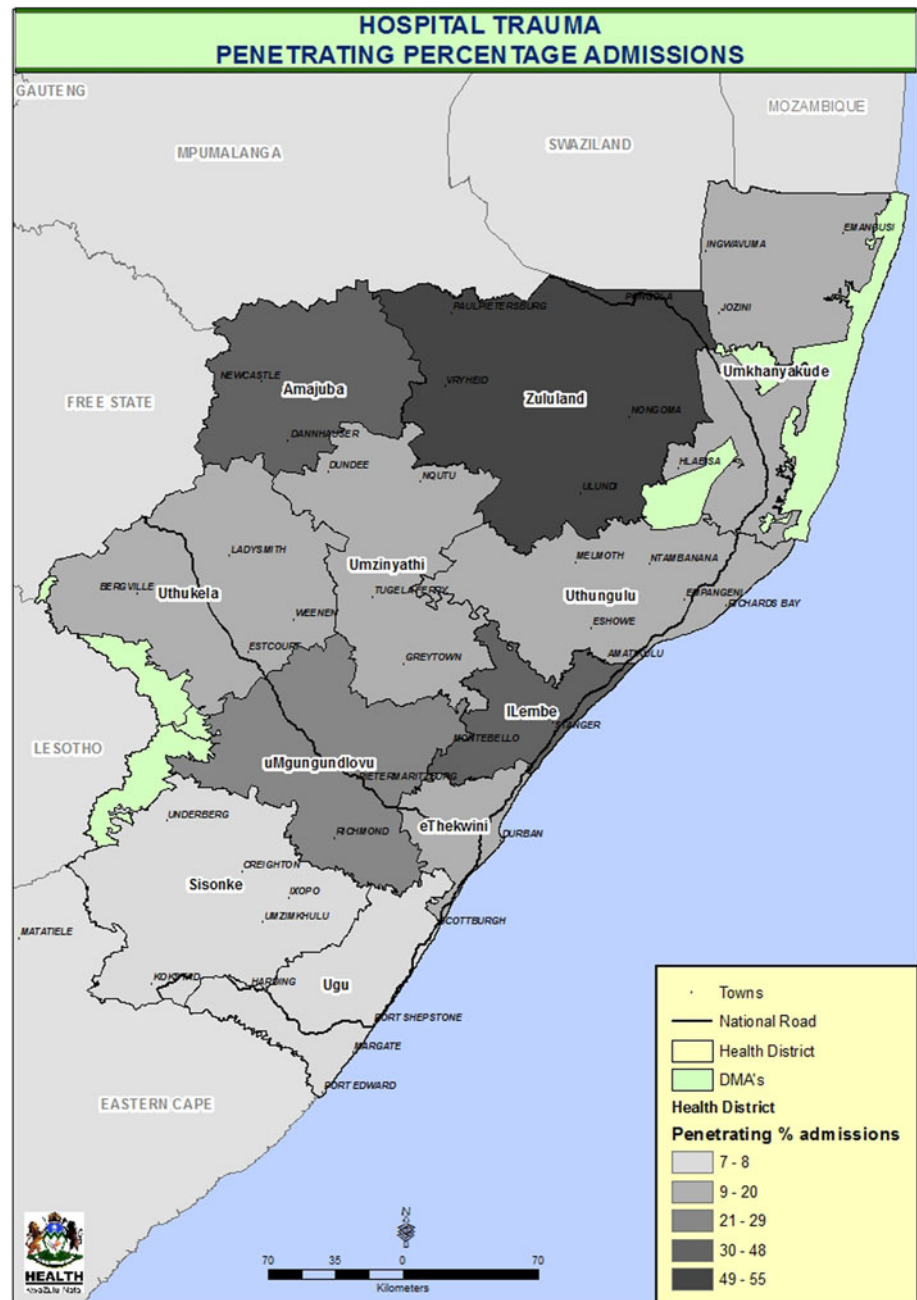


being the motor vehicle collisions [MVC] and “other” groups). Of the intentional trauma admissions, 35 % were due to penetrating injury, either stab wounds or gunshot wounds. Figure 2 illustrates the distribution of the penetrating trauma across the districts, showing that most districts averaged between 21 and 48 % penetrating injuries. When comparing the urban spectrum of injury to the rural environment, there was no distinct variation when examined in context of the population distribution. The ratio of gunshots to stab wounds in the group of penetrating trauma was noted as 1:4. Motor vehicle accidents were the greatest contributor to the trauma burden. Overall, 36 % of all

trauma admissions were due to vehicular trauma (Fig. 3 demonstrates the variation in incidence across the health districts). Other mechanisms (blunt or penetrating non-intentional injuries, burns, and falls constituted the rest of the trauma burden (Fig. 4 demonstrates the variation in incidence across the health districts). The need for appropriate assessment facilities, with appropriate imaging, is therefore essential, as is the need for surgical capability.

The data from the hospitals used for the facility assessments were physically corroborated by the medical expert teams undertaking hospital preparations for the Soccer World Cup event. When comparing the facility

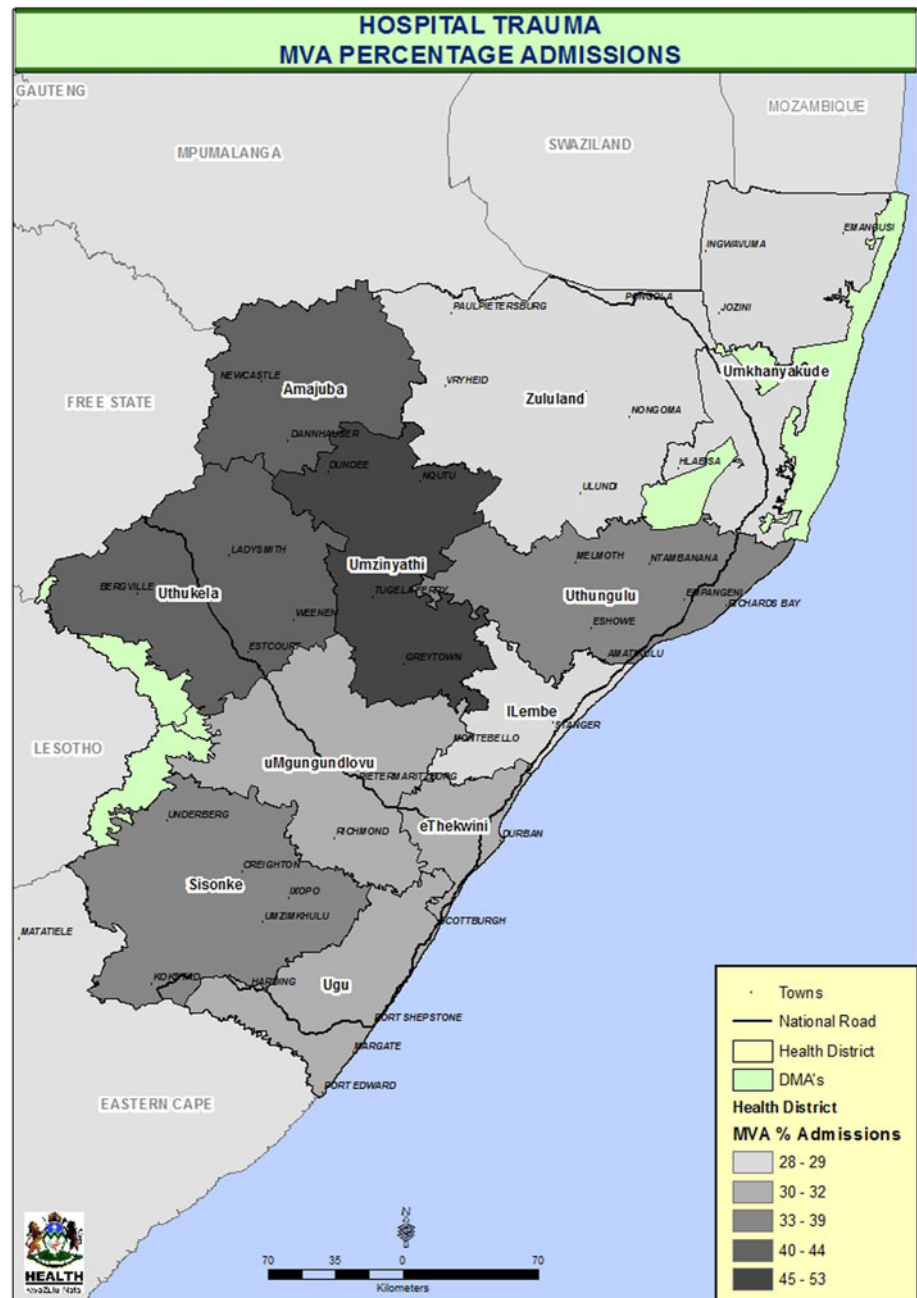
Fig. 2 Penetrating trauma distribution per 1,000 population across KwaZulu-Natal health districts



assessments to the Essential Trauma Care (EsTC) and Trauma Society of South Africa (TSSA) criteria [14, 15], only one hospital met all the criteria for level 1 status, whereas most regional hospitals (66 %) met the criteria for level two status. Even within these facilities, however, only three hospitals had a formal trauma service, with the rest using the general surgical service. Four had inadequate access to emergency operation facilities for trauma and were competing with other emergencies, including cesarean sections, for operating room time. There was a shortage of intensive care unit (ICU) facilities at these regional hospitals, and the imaging services were variable in

availability (some only daytime full service; head scans only after hours). Quality assurance programs were documented for only seven of these regional facilities. Regarding specific criteria, an average of 41 % (range: 12.5–80 %) of staff were Advanced Life Trauma Support (ATLS) [17] trained, and 53 % (range: 10–74 %) had medical resuscitation training. Only 46 % (range: 12.5–75 %) had training in disaster management, such as the one-day hospital major incident medical management & support (HMIMMS) course offered free of charge to all health care providers in preparation for the recent Soccer World Cup event [18]. Further challenges include the lack

Fig. 3 Motor vehicle trauma distribution per 1,000 population across KwaZulu-Natal health districts

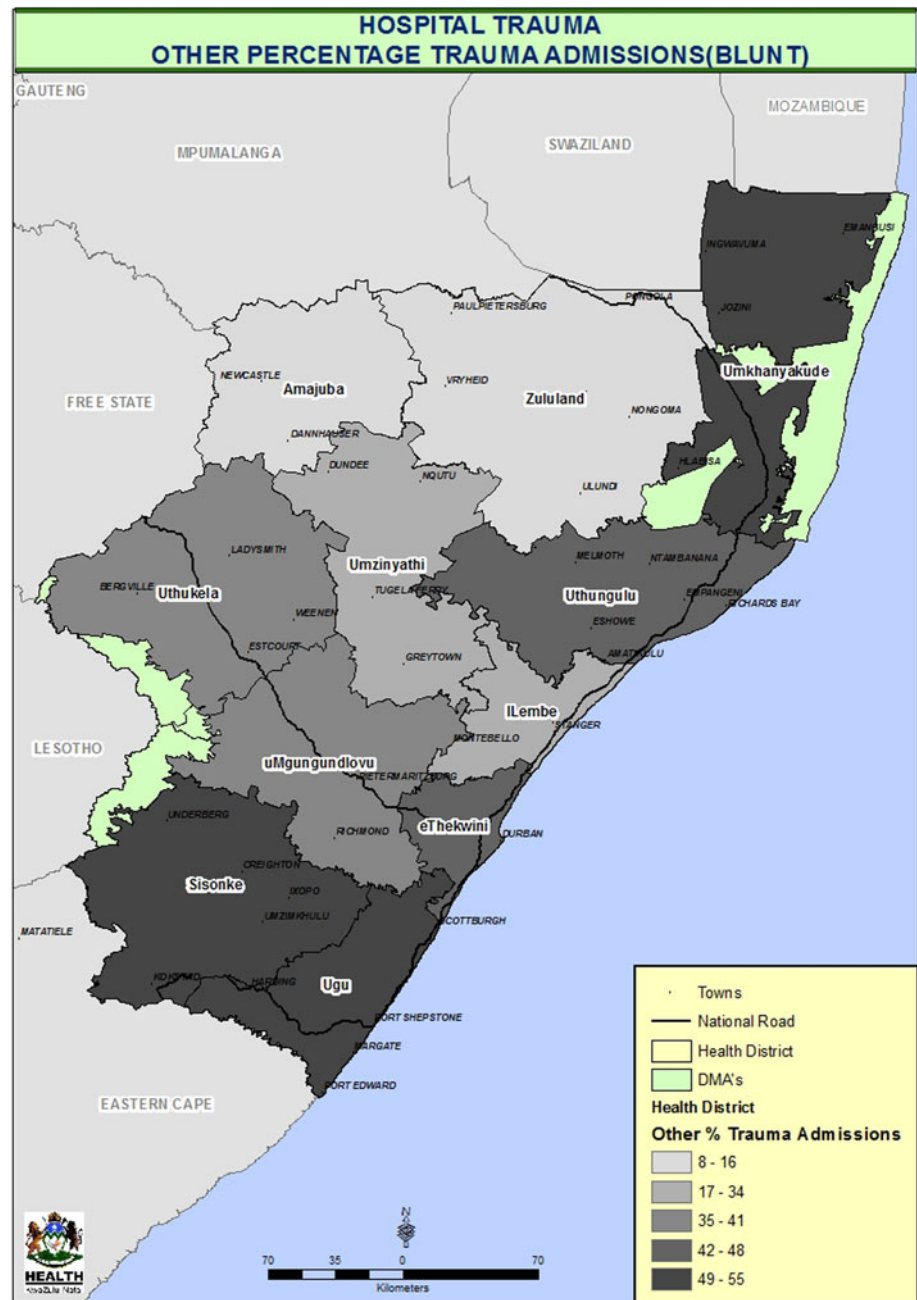


of a uniform trauma registry, limited access to computerized databases—both of which lead to concerns regarding data accuracy—and a distinct shortage of designated space for emergency care within the already overloaded hospital system. The limited trauma data have been addressed partially through the introduction of mandatory injury data reporting to the Provincial Head office Epidemiology Unit, and this, we hope, will mature into a proper Provincial Trauma Registry.

Most district hospitals would be expected to meet level three trauma unit status; however, deficiencies were noted in at least 50 %, such that the commitment to establishing

an effective trauma system appears to be lacking at the regional and national government level. For example, 54 % of district facilities assessed had inadequate resuscitation area facilities, none had in-house CT-scanners, and only 62.5 % had emergency mobile X-ray units, and 58 % did not have access to an emergency operating room. Only 25 % of district hospitals had an emergency observation ward, despite the need to hold many patients awaiting transfer to a higher level of care. Sixty-two percent of medical staff had no formal trauma training, and 50 % of the hospitals had inadequate helicopter landing facilities, despite the rural nature of many hospitals. Only 12.5 % of

Fig. 4 Blunt and domestic trauma per 1,000 population across the KwaZulu-Natal health districts



district hospitals had documented trauma or emergency quality assurance programs. This is highly relevant in a country where public transport incidents involving buses, minibus-taxi, and heavy duty vehicles are an everyday occurrence, and many of these district hospitals are the first “port of call” for trauma victims.

Discussion

Injuries in low and middle income countries (LMIC), which include South Africa, are acknowledged to

contribute significantly to death and disability, as well as loss of life-years [4]. In an effort to address the high mortality and morbidity, it is essential to work on establishing systems of care that are cost efficient, functional, and show a long-term outcome improvement [14, 19]. The challenge is that most governments want to see instant results; however, a number of recent studies have shown that it may take as long as 10 years before a significant mortality reduction becomes evident [20–22]. Most of the relevant reports, however, come from developed high income countries with large healthcare budgets. Africa and other developing regions suffer from the financial burdens

that make establishing such systems more difficult. It was for this reason that the World Health Organization and the International Association for trauma Surgery and Intensive Care (IATSIC) group formulated the Essential Trauma Care Guidelines [14], which have been widely adopted or implemented in various forms within LMIC across a number of continents [23–25].

When comparing the current KZN predicted injury burden determined in the present study with previous publications from South Africa and elsewhere in the world, it is noted that the incidence of 1,290 per 100,000 population is far higher than the trauma burden in the developed world, with rates around 13–20 per 100,000, although it seems to have been reduced from the initial studies in 1999 that suggested a figure closer to 66 per 1,000 population [26–28]. The results compare most strikingly to an epidemiological study from Canada, where the categories “fall” and “other” injury were the highest, at a combined rate of 420 per 100,000, while penetrating injury was only 9.5 per 100,000. The overall rate of all injuries in Canada requiring hospital treatment was 5.34 per 1,000 of the population, half the rate in KZN, and included categories not reviewed in the present study [29]. The difference with the study from 1999 is that it included not only injuries treated in hospitals but also minor injuries treated at community clinics, or by general practitioners and traditional healers, whereas the current study examined hospital admissions at district and regional facilities only and excluded any case remotely unclear as being due to trauma. In contrast, the former study included a category of “other trauma” that may have included a number of conditions (such as drowning, animal bites, or poisoning) not included in the present study. Using the extrapolation method described in the study by Matzopoulos et al. [26] would estimate the current injury burden at about 1.5 million cases per year (about 34/1,000) at a minimum for the entire country, which is still less than previous estimates, although closer to their one estimate of 40/1,000 of the population.

It is interesting that when comparing the South African data to that from other parts of Africa there are stark contrasts, with interpersonal violence contributing a much higher percentage of the injury burden in South Africa (35 %), whereas motor vehicle collisions predominate in other parts of Africa, following a distant second to human immunodeficiency virus (HIV) and other communicable diseases [30–35]. Even the study from a rural district hospital in KZN [36] showed that almost 13 % of patients transported there by ambulance as “walking wounded” were considered by the treating doctor to have an “urgent-care” traumatic injury.

The system of care theoretically in operation within South African health facilities has been described in detail in previous publications [37, 38]. The concern is that these

articles generally focus on urban facilities and academic medical establishments. The broader scenario is far from ideal, with the physical facilities not meeting national core standards [16], not to mention the EsTC or TSSA criteria [14, 15]. There is slow uptake and apparent lack of interest in available short-courses for further training [38]. The national district hospital core standards, for example, require that doctors at district hospitals are able to perform emergency surgery for trauma, yet most of the district hospitals in KZN (58 %) do not even have access to an operating room in emergencies. Where these are present the resources compete with emergency cesarean section and other urgent operations. Across the country facilities are crumbling for lack of maintenance; computerized tomography scanners break down and repairs are delayed, necessitating multiple transfers of patients to receive needed care [39].

This is of particular concern as the National Department of Health is planning to embark on a comprehensive National Health Insurance initiative over the next few years [40]. Of importance is that the current plan does not specifically address trauma care or other emergency medical problems, despite mentioning in the preamble the fourfold problem of HIV-AIDS, maternal and child-health, diseases of lifestyle, and injuries [40]. Additionally, it is widely acknowledged that there is a major shortage of health care providers of all grades in South Africa [37, 41, 42]. This is compounded throughout Africa. The first step the government can take is to invest in human capital, through funding training of staff across the spectrum to better manage the trauma patient. This is especially important given the fact that around 30 % of rural practitioners do not feel competent to undertake emergency trauma surgery (laparotomy) independently [43].

To realistically determine the injury burden to the country it would be prudent to establish a national trauma registry, collecting a limited data set that can guide system development and confirm the disease severity and average length of stay in hospital enabling costing to be performed [14, 15]. A simple Department of Health trauma registry has recently been designed for KZN and is in the initial stages of data collection. The next step is the upgrading of all health facilities to at least the minimal standards expected by national and international norms [14–16].

If one compares the facilities in Africa to the American system [44] it would take most of the specialists within an entire country to staff one major trauma center meeting American standards. This is impractical and thus it is essential that Afrocentric solutions are designed for African systems. Combined with the need for simple solutions is the limited availability of critical care services in Africa, which form an essential component of care for severe trauma [45, 46]. It will indeed take a strong political will to

change the situation for the benefit of all of the people of South and Sub-Saharan Africa [47]. The need is great, yet funding is finite and limited, but to reduce mortality from injury, all levels of care should meet the basic standards, whether in terms of functional equipment, access to surgical services, a basic staffing norm, or rapid transfer to higher levels of care. An established system is better than islands of excellence within a sea of indifference, where the care is provided in a haphazard fashion [19].

In Africa one should consider the role of a “trauma center” as a specialist hospital, with not only multiple subspecialist disciplines present, but providing an overarching leadership role within the greater system, working with the single goal of mortality reduction. This has certainly worked in the UK, where mortality has been reduced through direct access to a dedicated facility for severely injured patients [48]. In Africa the need for such centers is no less, but thoughtful planning is required to locate these lead facilities in a manner to enable optimal access without overloading the health budget. Using the EsTC guidelines and the TSSA criteria will enable the Department of Health to devise suitable patient flow pathways and bypass systems so that the most severely injured patient can gain access to a suitable level of care without undue delay. These centers should not be for “all comers,” but for the small severely injured subgroup, but they should provide outreach and retrieval teams, thus offloading the other facilities of major cases and providing guidance and leadership of the overall system. It is proposed that one such center should cater to a population of some 2–3 million persons in high trauma regions and 4–5 million in lower trauma regions of the continent.

For a population as dispersed and with the geographic layout of rural KZN (and typical of much of rural Africa), the ideal system would thus entail the expansion of the ambulance services and a referral system to bypass smaller facilities and transport the severely injured directly to the regional facilities where surgical capacity and ancillary services exist. Upgrading the number of regional facilities and regionalizing certain specialist disciplines (e.g., neurosurgery) would reduce the time to surgical intervention. It would also enable rational use of the limited number of CT scanning facilities, thus allowing timely care. A recent letter in *World Journal of Surgery* has highlighted the limited role that specialist surgeons are able to play at district level hospitals because of the need for ancillary services [49]. This system should, at least, be generalizable to the rest of South Africa, because the geography and relative population densities are similar throughout the country, and from previous studies [26] the trauma distribution appears to be relatively comparable. The country has one health registration authority and one set of national prehospital treatment protocols, so improving access to the system should be generalizable as well.

It has been shown that, even within institutions caring for major trauma in KZN, the care is variable and inconsistent, which corroborates the findings of the facility audit [50]. This often results in missed injury and unnecessary morbidity or even mortality [51]. To prevent these adverse outcomes, the hospitals participating in the trauma system need to be inspected by an independent non-governmental organization and be formally accredited, have quality improvement programs in place, and have a lead authority with government-endorsed executive authority [14–16, 19]. This way the currently unmet needs of surgical disease in general may be partially addressed [52]. This is especially true in light of the high injury burden (12,9/1,000), which is higher than the 1,6/1,000 reported from Uganda [53].

Finally, the remaining challenge to the establishment of trauma systems in Africa is the distinct lack of rehabilitation facilities, especially residential step-down rehabilitation facilities, thus leading to much lower levels of return to gainful employment. This is so although rehabilitation is recognized in both the EsTC and TSSA guidelines as essential for a trauma care system. Unfortunately, rehabilitation is not seen as an integral part of the trauma care process, which results in bed-blockages to the acute care hospital system and prolongs recovery times considerably. This is not a new problem and not one isolated to South Africa, with similar problems reported from Ghana [54, 55]. At least South Africa has dedicated physiotherapists and occupational therapists who attempt to rehabilitate rural patients against trying odds and while facing ethical dilemmas [56].

Trauma costs money; however, litigation costs the country far more! Appropriate care of trauma has been demonstrated to be cost-effective in numerous studies [57–59], with sustained cost-saving over time with efficient system design of approximately \$36,000 per life-year saved. In a national study from the USA published in 2010 [59] it was found that although trauma centers are more expensive (especially the initial care), the benefits in terms of lives saved and quality of life-years gained outweigh the costs, particularly for the most severely injured patients. The costs of trauma care vary from around 6,396 ZAR (\$540) to 25,000 ZAR (\$2,200) per patient for gunshot wounds, depending on the calculation method used [60–62], whereas for traffic injuries the cost approximates 3,886 ZAR (\$300) per patient per day [60]. It is, however, important to look at the “real” cost of traffic collisions, which approximate R11 million (\$800,000) per day when all costs (policing, medical, repair, rehabilitation, and legal aspects) and not simply medical expenses are included, applying the model of the Council for Scientific and Industrial Research. It should also be noted that pedestrian injuries account for up to half of the medical costs! [63]. Optimizing the transfer of patients, provision of

appropriate equipment, staffing, and other resources at the correct levels of care should result in overall cost savings. These cost savings are further enhanced through multi-sectorial prevention initiatives [19, 64].

Limitations

The present study is limited by the fact that the patient data were retrieved from casualty records collected by ward clerks, thus limiting reliability. In addition, the data were re-interpreted by one person (T.H.), who excluded anything that appeared to be non-trauma, thus potentially reducing the overall numbers. The totals may thus be a significant underestimation of the true trauma burden; however, they do reflect at least a minimum trauma burden. Further, the hospital assessments were significantly different when self-reported (by local hospital managers) compared to the inspection teams. Some of the TSSA criteria [15] were not specifically included in the hospital assessments, thus reducing the direct applicability of the local criteria.

Conclusions

Trauma, particularly interpersonal intentional violence and motor vehicular collisions, constitute a major health care burden on the South African public health system, constituting 18 % of the emergency care burden. The current primary-care focused referral pathways and hospital equipment norms are not suitable for dealing with major trauma. A national trauma registry capturing basic data would ensure that the true trauma burden is recorded. Upgrading facilities to meet minimum national standards is essential prior to establishing and formalizing trauma systems, or instituting the proposed National Health Insurance plan across South Africa. Any trauma system that is implemented will require a central government funding buy-in from all parties and continuous performance improvement programs to ensure compliance and improve patient outcomes, with legislative and political support.

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