



## Original article

# A descriptive study of trauma patients transported by helicopter emergency medical services to a level one trauma centre



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## ABSTRACT

**Background:** KwaZulu-Natal, the largest land mass province that is densely populated in SA has vast distances to referral centres and time to definitive treatment is key in trauma care. Helicopter Emergency Medical Service (HEMS) is still an invaluable prehospital asset for the transport of time sensitive trauma. This study reviews the impact of HEMS in the management of trauma at Inkosi Albert Luthuli hospital (IALCH) which is the only public accredited level one trauma centre in the province.

**Methods:** A retrospective descriptive study of polytrauma patients transported by HEMS in KZN to IALCH over a three-year period from 01 January 2014 to 31 December 2016. Data was collected around patient demographics, transfer details and patient outcomes.

**Results:** Over the three-year period, 117 HEMS transfers were reviewed, with the majority being male (90.6%). Just 26% of HEMS transfers were direct from the scene, with the balance being interhospital transfers largely from distant regional hospitals around the province. Some 60% of injuries were caused by vehicle crashes, and 31% by intentional injury. Mortality was 30% which is reflective of the high severity of injury of the cohort. The injury severity scores (ISS) (median 26 overall) of those who died was higher (median 38) ( $P = .0002$ ), and there were more interventions before and during transfer such as thoracostomy, ventilation and immobilization. Overall, 88% required admission to ICU at IALCH.

**Conclusions:** HEMS in the KwaZulu Natal province was mainly used for long-distance transfer of major trauma patients which is an appropriate use of this essential service, given the single major trauma centre in the province. The majority of patients that were transported by HEMS had severe injury, which was also associated with increased mortality outcomes. Rational use of this essential but expensive resource will require clear policy around the role of HEMS and call out criteria in each setting.

## Introduction

KwaZulu-Natal is the largest South African province in terms of land mass that is densely populated with vast distances to referral centres and is the second most populous province in the Republic of South Africa [1]. Inkosi Albert Luthuli Central Hospital (IALCH), as the sole accredited public Trauma Society of South Africa (TSSA) Level 1 trauma centre within the Province, is no exception to this geospatial referral scenario as it is situated in the eThekweni Metropolitan Municipality and receives a large number of patients from the surrounding rural district hospitals within the KwaZulu-Natal Province and sometimes from other provinces (e.g., Eastern Cape) and neighbouring countries like Mozambique, as defined by its role of a central hospital in the province and the

provincial drainage system [1]. The average distance from these referral hospitals to IALCH is approximately 80 kilometres or more (See Figure 1 below.)

The 8-bed trauma ICU accepts on average 30–35 patients per month, with acceptance dependent on bed-availability, while the neurosurgery and vascular units accept trauma patients as part of multi-disciplinary care, averaging 100 patients a month, managed in concert with the trauma service. In a setting like KwaZulu-Natal where the nearest appropriate referral trauma centre for definitive major trauma care is distant and may take longer in terms of distance covered and accessibility by ground emergency medical services (GEMS), Helicopter Emergency Medical Services (HEMS) plays a critical role in interfacility transfers and primary scene responses [2].

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**Figure 1.** Map of KwaZulu Natal Provincial hospitals (The GIS Unit, KwaZulu-Natal Department of Health. Pietermaritzburg. 2005).  
 Note: PVC, Pedestrian Vehicle Crashes; MVC, Motor Vehicle Crashes; Assault = Assault with blunt object, non-penetrating injuries; Others = Injuries from burns, dog bites, aircraft crash, fell from pickup truck, wall collapse.

The use of helicopters as emergency medical transport has a long-standing history in high-income countries in comparison to low- middle income countries like South Africa [3]. Australia, for example, has a fully integrated aeromedical service and the Royal Flying Doctors Service (RFDS) of Australia offers a 24-hour fixed wing aeromedical emergency medical service to approximately 80% of Australia [3]. The Australian geographical setup closely resembles that of South Africa with difficult terrain between referral centres and makes Australia a good yard stick to measure progress of HEMS in the South African context [3].

A 2018 consensus statement by experts from major emergency medicine authorities in the US agreed on the following broad clinical benefits on the use of HEMS [4]: It significantly shortens the time of

transfer to definitive care for patients with time-sensitive medical or surgical conditions; It plays a role in providing specialized medical expertise or equipment to patients before and/or during transport; and lastly, it is useful for providing transportation to patients who are in inaccessible or obscure environments [4].

South Africa as a low middle-income country has a unique quadruple burden of disease; these include communicable (incl. HIV/AIDS and TB), non-communicable, perinatal, and maternal, and injury-related diseases [5]. In KZN, trauma constitutes approximately 25% of the emergency burden of disease in most public hospitals in the province [1]. Hardcastle et al. [1] argue that injury related mortality rates will, in the near future, surpass that of the leading communicable diseases combined, namely HIV and AIDS, tuberculosis and malaria.

HEMS in South Africa has evolved significantly over the past 40 years from a service initially functioning only as part of interhospital patient transport for cardiac patients, to currently being utilised as part of primary trauma scene response [6]. To date in KZN the public sector HEMS were primarily serviced by the Red Cross Air Mercy Services (AMS). The Red Cross Air Mercy Services (AMS) is a non-profit organization that is contracted to provide HEMS in the public sector in South Africa and to date it has bases located in the Western Cape (Cape Town and Oudtshoorn) and KwaZulu-Natal (Durban- King Shaka and Richards Bay airport) [7]. The HEMS flight crew consisted of at least one Advanced Life Support (ALS) paramedic and an Intermediate Life Support paramedic who have a wide protocol driven scope of practice [8,15,16].

HEMS is considered an expensive yet invaluable asset in the pre-hospital environment for the transport of time sensitive trauma related emergencies as time to definitive treatment is key in trauma care, with the concept of the “Golden Hour” referring to the timely early management of trauma patients [9] thus we have sought to review the impact of HEMS in the management of trauma at the IALCH trauma centre, which is the only accredited level one trauma centre in the Public sector in the Province.

The referral pathway to the IALCH trauma centre is as follows: the patient’s initial diagnosis is made by the referring clinician, or the paramedic on scene and the need for referral is established by this referring clinician or paramedic. The referral is then discussed with the trauma centre consultant- on-call who then accepts or declines the patient for referral. The Provincial Operations centre logs the call and uses the call criteria to decide on the activation of HEMS. All HEMS AMS transfers are dispatched as red codes (highest priority for transportation) not similar to the EMS triage scoring system, but severity is re-classified by the treating paramedic on arrival with the patient.

## Methods

A retrospective descriptive chart-review of trauma patients transported by the KZN HEMS from district and regional hospitals, tertiary referral centres and primary scene responses in KwaZulu - Natal to IALCH Level one trauma centre was conducted. The review was over a three-year period from 01 January 2014 to 31 December 2016.

Inclusion criteria included all trauma patients transported by HEMS AMS to IALCH trauma centre during the given study period (including all trauma patients transported by HEMS from Primary scene to IALCH trauma centre and interhospital transfers). The Level 1 TSSA-accredited trauma centre at Inkosi Albert Luthuli Central hospital initially manage all major trauma cases in the trauma resuscitation bays by a dedicated trauma-surgeon consultant-led trauma team and all ICU requiring cases are managed in-house by that same team, who have access to 24/7 trauma theatres and the trauma ICU. Trauma related vascular, and neurosurgical cases were included in this analysis as they are initially assessed in the trauma receiving area by the trauma team before being referred to the definitive care unit, who manage their area of expertise in conjunction with the trauma team coordinating overall care. No patients were admitted to other ICU’s, while a small number (usually those triaged as “Yellow” may go to a general ward. All patients that were transported by HEMS and died in the centre on arrival were also included as part of the cohort. Secondly only trauma patients transported by the Helicopter (Rotor-wing) were considered.

Patients that were excluded from the study were all non-trauma patients transferred by the AMS HEMS and patients with incomplete patient’s records that do not have two or more of the following descriptors of the patient; the mechanism of injury and referral route and the patient’s primary outcome recorded.

The objectives included a description of the helicopter emergency medical service referral process for these patients (including time parameters and call out criteria); and the demographics and clinical presentation of trauma patients transported by the HEMS to the Trauma Centre. Trauma management interventions performed (prior to and

within the first 48 hours after admission) were recorded as well as outcomes (survival to discharge from trauma ICU/death) of the patients and correlation to the transfer prioritization.

An Excel (Microsoft Corp, Redmond WA) spreadsheet was developed to extract information from both the AMS database and IALCH electronic trauma registries, the latter with UKZN Biomedical Research Ethics (BREC) approval (BCA207-09). The following demographic characteristics were collected from patients transported by HEMS over the study period.

All trauma HEMS cases arriving at IALCH trauma centre are captured on an electronic trauma registry. This includes the clinical notes, laboratory results, radiology results and patient outcomes (whether admission to theatre or ICU, discharge, or death) and are standardised using a template-based system which clinicians have to follow. AMS uses a records control and management system and information from the AMS data base was extracted by the primary investigator from the AMS electronic data base. The student investigator functioned as the sole data abstractor.

AMS flight data includes all the essential patient and flight data which is recorded on the individual patient’s flight data form kept by the AMS. At IALCH patient data is recorded on a fully retrievable UKZN ethics approved electronic medical record system (Meditech®).

There is to date no published evidence-based HEMS call-out criteria in South Africa except for the body of work that was developed by Laatz et al. in which a modified Delphi technique utilised with experts in the field to develop the call-out criteria [10]. The largely practiced activation protocol with many providers in South Africa follows the following process: on-scene (or in hospital) primary clinicians perform a clinical assessment of the injured patient which is then followed by a consultation with the Chief Medical Officer (CMO) on duty, who determines the eligibility and is responsible for the final authorization for a flight.

Data were exported to STATA version 14.1 (STATA Corp, College Station, Texas, USA) for analysis. Normally distributed numerical data are summarised using the mean, range (minimum and maximum) and standard deviation; data that is not normally distributed is summarised using the median and interquartile range (IQR). The Mann-Whitney U test was used to test for the equality of two medians. If data were normally distributed, variances were compared using the F-test. If variances were not significantly different, the t-test for two independent samples was used to compare the means of participants. If the variances were different the modified t-test was used, as was the case when comparing the mean ages of participants between the years of comparison. The Spearman correlation was used to correlate the mission time and the injury severity score (ISS) of patients.

Categorical variables are summarised using frequency tables, percentages, and graphs. The two-sample test of proportions is used to compare categorical variables. The Chi-squared test was used to test for an association between two categorical variables. However, if the expected frequencies are <5, the Fisher’s exact test was used in its place. If data is missing for a variable, only those patients with full data are considered. The Prevalence Ratio (PR) is the measure of association used. The 95% confidence interval (95% CI) is used to describe the precision of the outcome (survival status). The level of significance is p-value  $\leq 0.05$ .

Ethics approvals were obtained from the University of Cape Town Human Research Ethics Committee (UCT HREC) (627/2019). A waiver of consent applied as there was no direct patient contact. Gatekeeper approval was via UKZN BREC BCA207-09 and only de-identified data was collated into the public domain.

## Results

A total of 131 patients were recorded in the AMS information system for the study period as being transported by HEMS. However, 14 (10.7%) did not have available data at IALCH data base and were thus excluded leaving only 117 patients (89.3%) in the final analysis (See Table 2).

**Table 1**  
Demographic characteristics.

Demographic characteristics	Transferring site
Glasgow Coma Scale (GCS) at initial assessment and at discharge	Patient investigations and initial management
ISS and NISS are determined after 24 hrs post arrival, once imaging or initial surgery is complete at IALCH using the Abbreviated injury scale an anatomically based injury severity scoring system that classifies each injury by body region on a 1-6 point scale, 1 indicating minor injuries and 6 indicating life threatening condition [4]	Admission duration in days
SATS triage code assigned by HEMS ALS on scene arrival	
Mission time in minutes (Included time from activation, time of arrival at scene, time of departure from scene to referral centre)	
Main outcome: Survival status (Died or Discharged from trauma ICU)	

ISS, Injury Severity Score; NISS, New Injury Severity Score; IALCH, Inkosi Albert Luthuli Central Hospital; SATS, South Africa Triage Scale; HEM ALS, Helicopter Emergency Medical Services Advanced Life Support; ICU, Intensive Care Unit.

**Table 2**  
Demographic and characteristics of patients by survival status.

Characteristics	Died	Discharged	Total (%)	PR	P-value
<b>Age, years; n (%)</b>					
≤12			17 (14.5)		
13-19			7 (5.9)		
20-29			23 (19.7)		
30-39			32 (27.3)		
40-49			23 (19.7)		
50-59			9 (7.7)		
≥60			6 (5.1)		
<b>Base; n (%)</b>					
Durban			107 (91.5)		
Richards Bay			10 (8.5)		
<b>Sex; n (%)</b>				1.7	.372
Male	33 (94.3)	73 (89.0)	106 (90.6)		
Female	2 (5.7)	9 (11.0)	11 (9.4)		
<b>Age, years; min-max (mean±sd)</b>	4 - 82 (38.8±17.4)	0 - 74 (29.8±15.4)	0 - 82 (32.5±16.5)	-	.007
<b>Triage; n (%)</b>				4.0	.003
Red	32 (91.4)	53 (64.6)	85 (72.7)		
Yellow	3 (8.6)	29 (35.4)	32 (27.4)		
<b>Transfer source; n (%)</b>				1.1	.740
Primary Scene Response	10 (28.6)	21 (25.6)	31 (26.5)		
Inter-hospital transfer	25 (71.4)	61 (74.4)	86 (73.5)		
<b>Initial GCS; n (%)</b>					
Mild traumatic brain injury	4 (11.4)	24 (29.3)	28 (23.9)	-	.117
Moderate traumatic brain injury	2 (5.7)	4 (4.9)	6 (5.1)		
Severe traumatic brain injury	29 (82.9)	54 (65.9)	83 (70.9)		
<b>Discharge GCS; n (%)</b>					
Mild traumatic brain injury			61 (52.1)		
Moderate traumatic brain injury			14 (12.0)		
Severe traumatic brain injury			7 (6.0)		
<b>Operating Theatre; n (%)</b>				0.7	
Yes	26 (74.3)	68 (82.9)	94 (80.3)		.282
No	9 (25.7)	14 (17.1)	23 (19.7)		
<b>ICD; n (%)</b>				2.3	.002
Yes	17 (48.9)	17 (20.7)	34 (29.1)		
No	18 (51.4)	65 (79.3)	83 (70.9)		
<b>Invasive ventilation; n (%)</b>					
Yes	35 (100.0)	62 (75.6)	97 (82.9)	-	.001*
No	0 (0.0)	20 (24.4)	20 (17.1)		
<b># Central line; n (%)</b>				2.0	.064
Yes	29 (82.9)	54 (65.9)	83 (70.9)		
No	6 (17.1)	28 (34.2)	34 (29.1)		
<b>Full Spinal Immobilisation; n (%)</b>					
Yes	35 (100.0)	60 (76.0)	95 (83.3)	-	.001*
No	0 (0.0)	19 (24.1)	19 (16.7)		
<b>CT Imaging; n (%)</b>				0.5	.046
Yes	28 (80.0)	76 (92.7)	104 (88.9)		
No	7 (20.0)	6 (7.3)	13 (11.1)		
<b>Mission time, minutes; Median (IQR)</b>	215 (155 - 249)	187 (140 - 215)	193.5 (145 - 233)	-	.019
<b>Admission duration, days; Median (IQR)</b>	4 (0 - 9)	11 (5 - 18)	9 (4 - 17)	-	<.001
<b>Injury Severity Score; Median (IQR)</b>	38 (25 - 54)	19 (9 - 38)	26 (9 - 42)	-	.0002
<b>Survival status; n (%)</b>	35 (29.9)	82 (70.1)	117 (100)	-	<.001

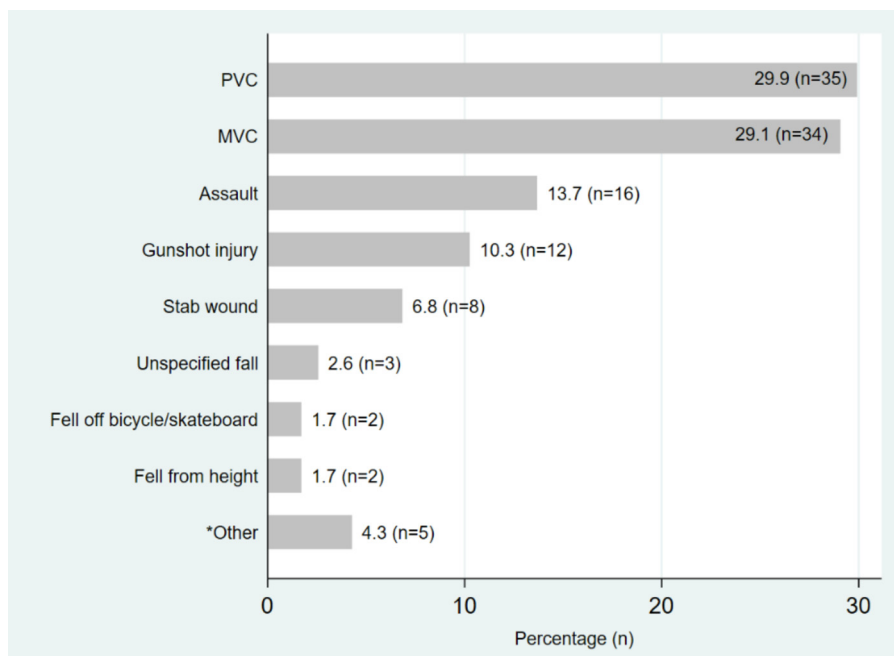


Figure 2. Injury Mechanism.

Table 2 describes the characteristics of patients, as well as by survival status. Males accounted for 90.6% (106/117) of all patients. The youngest patient was less than a year old and the oldest was 82 years old. The mean age for patients transported for the years under study, was 32 years old.

The majority of patients that were transported by HEMS were triaged as red codes (72.7%) in comparison to those that were triaged as yellow codes (23.3%) and it is worth observing that a significantly higher percentage were assessed as having severe traumatic brain injuries with low GCS (70.9%) on initial assessment compared to mild traumatic brain injury (23.9%). Of the total patients transported by HEMS, the proportion of interhospital transfers (73.5%) were significantly higher than primary scene responses (26.5%).

Thirty-five (35/117 (29.9%); 95% CI: 21.8% – 39.1%) of the patients died before they were discharged from trauma ICU of which 94.3% (33/35) were male. However, there was no association in the proportion of males or females who died to those that were discharged. It is further worth noting that there was an association between the differences in mean ages of those who died compared to those who were discharged. There was no association in the patient's outcome which was measured by death or being discharged from trauma ICU and the following variables: sex of the transferred patients ( $P=.372$ ), transfer source indicating whether they were interhospital or primary scene response ( $P=.740$ ), and the initial GCS on arrival to the trauma centre ( $P=.117$ ).

Patients triaged as red were associated with 4 times increased risk of death than those triaged as yellow ( $P=.003$ ).

Furthermore, patients who died all had full spinal immobilisation and invasive ventilation; 71.4% (25/35) were interhospital transfers; 82.9% (29/35) had a severe traumatic brain injury and a central line; 80.0% (28/35) had CT imaging; 74.3% (26/35) needed to be taken into an operating theatre and 48.9% (17/35) had an ICD. The median mission time, and median injury severity scores were higher in those who died, and those with an ICD were associated with 2.3 increased risk of death compared to those without an ICD.

Pedestrian and motor vehicle crashes were the mechanisms of injury accounting for the majority of all patients transported (69/117) (Figure 2). The proportion of gunshot injuries (10.3%) were comparable to injuries by assault with blunt object or non-penetrating injuries (13.7%).

Patients that were transported in the inter-hospital transfer group accounted for 73.5% (86/117) of patients who were transported by HEMS and the other 26.5% (31/117) were primary scene responses, respectively. Of the regional hospitals in KwaZulu Natal, Ngwelezana Hospital accounted for the majority of inter-hospital transfers which (37.2% (32/86)), 23.3% (20/86) were from Edendale Hospital, 12.8% (11/86) were from Greys Hospital, and 11.6% were from Port Shepstone Hospital (Figure 3).

The majority of patients transported by HEMS to IALCH had a whole-body multi-slice (PAN) CT scan performed 65.4% (68/104), while 14.4% (15/104) had a CT brain, 10.6% (11/104) had a CT brain and C-spine scan, and 6.7% (7/104) had a CT angiogram (Figure 4). All of the cases that had a whole-body multi-slice (PAN) CT scan were assessed as being polytrauma cases ( $n=68$ ) and the majority of these cases were primary scene responses 35.3% ( $n=24$ ). All the cases that had both a CT-Brain and CT-C-spine done were isolated neuro-trauma cases referred to neurosurgery ( $n=26$ ). In patients that had only a CT chest & abdomen/pelvic, or CT abdomen & pelvis performed, most had already had a CT-Brain scan at the referring hospital. All cases that had a CT angiogram done were cases that were initially referred to vascular surgery at IALCH with a suspected vascular injury.

All patients brought in by HEMS to IALH were initially assessed by the trauma centre team in the trauma resuscitation unit and then referred to the appropriate discipline, except when a referral was accepted directly to a receiving speciality team (when referred from a regional facility post-imaging). The disposition of patients was two-thirds ( $n=78$ ) admitted in the trauma intensive care unit (ICU), 21.4% (25/117) in neurosurgical intensive care unit, 4.3% (5/117) to vascular surgery and 2.6% (3/117) to the neurosurgery ward after initial assessment and stabilisation.

## Discussion

Trauma is a major burden on the health services in South Africa, with significant distances to definitive care [1]. As elsewhere on the continent, access to central, specialized trauma and intensive care, although vital for severely injured patients, often requires transport over large distances, often time dependant, hence the need for rapid transport, such as that provided by a HEMS service [1,4].

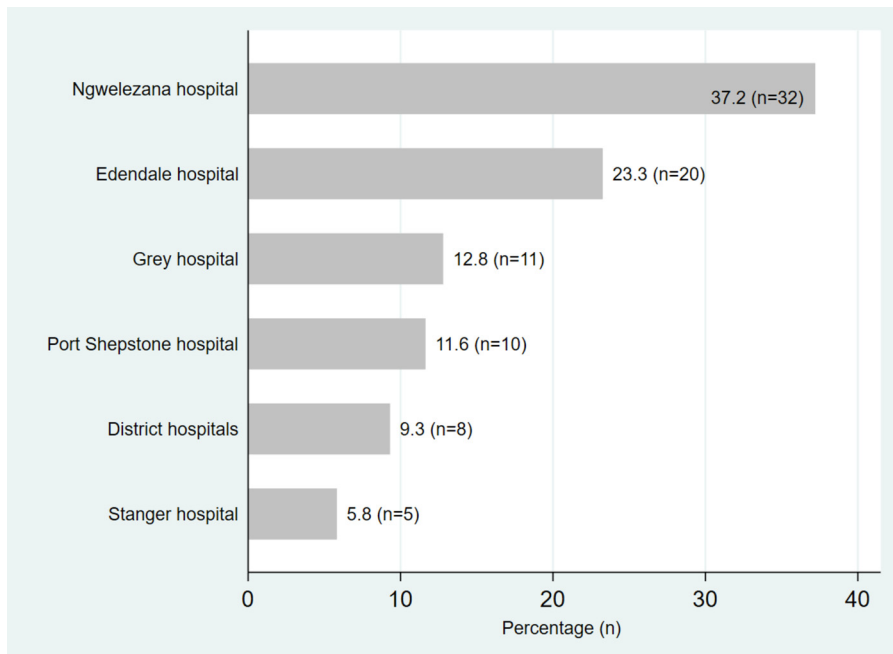


Figure 3. Referring Hospital.

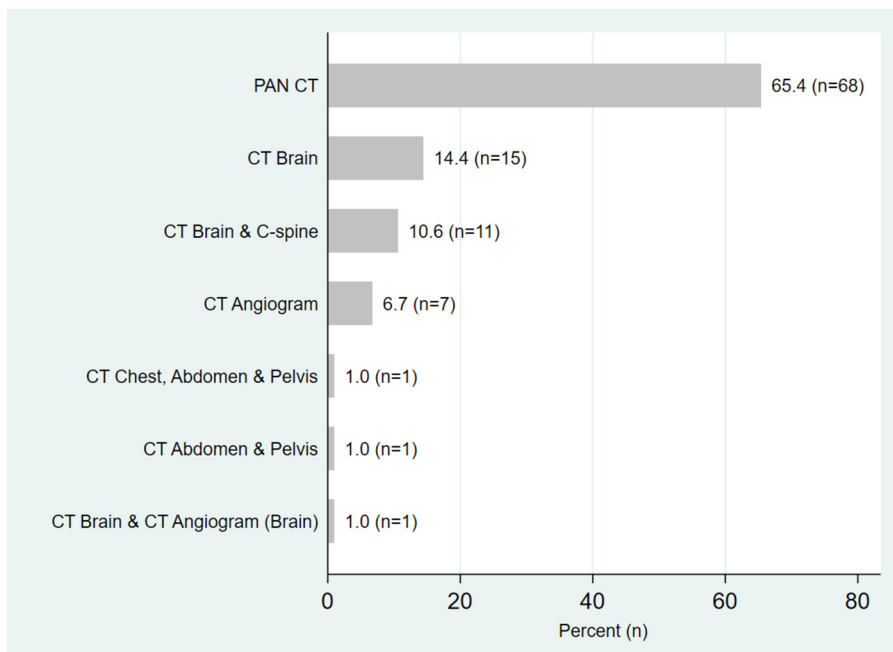


Figure 4. Type of Computerised Tomography (CT) scan.

The majority of patients that are transported by KZN HEMS in the setting of trauma are severely injured as indicated by the high injury severity score (ISS) and a majority triaged as red on the South African Triage Score which indicates a life or limb threatening condition, this confirms an appropriate utilisation of this service which is in line with other similar studies [2,10]. In this light the mortality of 30% in our patients is not unexpected, nor the fact that 88% were managed in intensive care initially. Trauma was related to vehicle crashes in 74% of cases, likely similar to other countries on the continent, while some 31% were caused by intentional injury best described in the South African context as related to interpersonal violence and possibly a more South African phenomenon [1].

The triage score and ISS proved important in predicting patient outcomes. Patients triaged as red were associated with increased risk of death than those triaged as yellow (p-value= 0.003) and for the Injury

severity score, patients with a higher median ISS were associated with increased risk of death compared to those with a lower median ISS.

HEMS was used for inter-hospital transfers more than for primary scene responses, and we found no association ( $P=.740$ ) in the survival outcomes between those that were transported as part of primary scene response group and the inter-hospital transfer group. This finding is important in the resource allocation for HEMS as to whether it should be primarily used for either primary scene response or inter hospital transfer. In many international HEMS systems, such as in the United Kingdom, a fulltime employed emergency physician is part of the crew [14], while in South African HEMS it is largely a paramedic run service with two paramedics (usually of the Emergency Care Practitioner(ECP level) and a pilot. However, the South African paramedic scope of practice is comparable to a country like the UK, more specifically consultant level paramedics in the UK, among others both having skills such as ad-

vanced airway management and intravenous administration of scheduled drugs [7]. However, the South African paramedics have a higher exposure to the management of trauma related injuries compared to their UK paramedic counterparts [7]. In South Africa there is a shift towards ECPs being more independent and critical-thinking practitioners, with the ability to make decisions in the pre-hospital environment [7]. This is essential in a resource limited setting where doctors are a critical limited resource, it is appropriate and within their skillset for paramedics to transfer even the most critically injured patients [10].

The majority of the severely injured patients were young males, and this confirms that trauma is indeed a male-dominated pathology [12,13] as found elsewhere - Muhlbauer et al. [10] where males accounted for 62% of all the patients that were transported, and Taylor et al. [11] in Australia noted similar findings. Wong et al. [17] notes that in LMIC settings, motor vehicle crashes are by far the most common cause of severe trauma and occur wherever people come into contact with high-speed vehicles, often related to alcohol abuse, as is assault and gun violence.

One of the important indications for HEMS activation is distance from referring to receiving hospital, and if it would take longer to transport by road and lead to potentially poor patient outcome [10]. Our data shows that HEMS was used for inter-hospital transfers more than primary scene response (74% vs 26%), and predominantly from five regional hospitals. These figures are in line with other studies in the South African context which indicate that HEMS is largely utilised for inter-hospital transfers compared to primary scene response [2,10].

One of the perceived advantages of HEMS is that patients that are transported faster to referral centres for definitive management have better outcomes compared to those transported by road [5]. Patients were flown into IALCH from around the province, with the frequent referring hospitals reflecting large urban populations outside of Durban, as well as the lack of trauma specific facilities at hospitals outside of Durban. Having a centralized highly specialised trauma referral centre has been demonstrated to be associated with improved patient outcomes, with many benefits such as staff with unique trauma skills (trauma emergency unit, neurosurgery, cardiothoracic, vascular etc), trauma specific intensive care resources, imaging, and rehabilitation services [18,20]. But such a system in a large geographical area can only function with rapid transport such as HEMS and our data would suggest appropriate conveyance of critically injured patients, although the decision to transfer by road or air is a critical one (which we were not able to assess with this data).

Evaluating the effectiveness of HEMS over GEMS is difficult to ascertain as it would be unethical to perform randomised controlled trials of helicopter versus ground EMS transport patients with time sensitive emergency illnesses[4]. A recent Cochrane review by Galvagno et al. 2015 concluded that based on the review of current evidence, there is an unclear benefit of HEMS compared with GEMS [12]. However, a more recent retrospective case control study was conducted by Stassen et al. [19] in which they concluded that when comparing HEMS and GEMS for major trauma patients, HEMS does not seem to improve mortality over GEMS in South Africa.

HEMS is an expensive service to operate, more so in a LMIC like South Africa, thus an appropriate call-out criterion is essential in improving the cost-effectiveness of this particular service [9]. It is only recently that a body of work was developed by Laatz et al. using a modified Delphi technique, with experts in the field, to develop the call-out criteria for the South African context, however the criteria is yet to be validated and accepted in South Africa [9].

Our study shows that the mission time was typically longer for those who died ( $P = .019$ ). This might be because patients that died were more severely injured compared to those that were discharged alive and thus needed more pre-flight preparation and management, although correlation with transfer distance may also explain this phenomenon. The average on scene time for IHT in this study was 52.8 minutes and the primary response on scene time was 60.56 minutes, the IHT findings

are comparable with other studies that were conducted in the Western Cape and in Kwazulu-Natal Provinces here in South Africa which were 58.7minutes and 40 minutes respectively [2,16].

This is an important study that adds to the body of knowledge into describing trauma HEMS specifically in the public sector in South Africa and has important messages for HEMS use in other LMIC settings. The limitations of the dataset are primarily that there was no method of ensuring the consistency of the data entered into the data collection tool, and data transcription errors may have occurred at various stages. While we note these potential errors in data collection and the impact on the results, we do not believe that the conclusion of the study will be influenced by these potential errors. An additional limitation is that the decision-making at the Provincial Health Operations Centre regarding the decision to activate the HEMS was not evaluated and this may have led to some unconscious bias due to individual approval bias.

## Conclusion

It can be concluded based on this research that HEMS use was appropriate for transfer of major trauma patients to the only major trauma centre in the KwaZulu Natal province and was mainly used for long-distance transfer which is an appropriate use of this essential service. This is essential for the development of a policy framework regarding the role of HEMS in the prehospital environment and further in the development of call-out criteria. We demonstrated that trauma is not just an urban problem since the transfers were from distant facilities outside the eThekweni Metropolitan region Table 1.

## Dissemination of results

Results from this study have only been submitted to the University of Cape Town's Emergency Medicine Centre as part of a MPhil dissertation submission.

## Author contribution

Authors contributed as follows to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: MP contributed 50%, PH contributed 25%, TCH contributed 25%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

## Declaration of Competing Interest

The authors have no conflicts of interest to declare.

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