Demographics and Clinical Profile of patients transported by a South African Helicopter Emergency Medical Service

Grace M Chatsika

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I, **Grace Chatsika**, student number **680800**, declare that this research report is my own work and that I contributed adequately towards research findings published in the article stated below which are included in my Research Report.

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Authors	**Name**	**Signature**	**date**
Steven Lunt			

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Demographics and Clinical Profile of patients transported by a South African Helicopter Emergency Medical Service

Grace Chatsika MBBS[a] *, Steven Lunt MBBCh MSc(Med)[b]

a Department of Emergency medicine, University of Witwatersrand, Johannesburg, South Africa

b International SOS, Johannesburg, South Africa

**Correspondence to Grace Chatsika gracechatsika@hotmail.com*

ABSTRACT

Background: Helicopter Emergency Medical Services (HEMS) are a specialized flying emergency service providing in-flight specialized care. There is a paucity of data on the use of HEMS in South Africa.

Objective: To describe demographics and clinical characteristics of patients transported with HEMS and the indications for HEMS dispatches. Medical crew configuration, clinical procedures undertaken by the HEMS crew, time frames from HEMS dispatch to delivery of patient to the receiving hospital and flight patterns were analyzed.

Methods: A retrospective medical chart review of flights conducted over the calendar year 2013 by a private HEMS based in Gauteng province, South Africa.

Results: A total of 199 flights were reviewed. The most common reason for transport was trauma (70%). Primary transfers constituted 62% of all flights undertaken and 93% were due to trauma. For inter-hospital transfers, the most common reason for transport was cardiac emergencies (40%). Transfer to specialist care was the most common indication for transport. Advanced life support paramedics performed 99% of HEMS transfers. The most common procedures done by HEMS crews were sedation and pain control followed by intravenous access.

Conclusions: There is a high incidence of primary transfers in this study, mainly due to trauma. Further research should focus on optimal flight activation criteria for HEMS use within a resource constrained setting to optimize the potential benefits. HEMS crew need continuous professional training to maintain knowledge and skills. Incorporation of finger thoracostomy in required skills for advanced life support paramedics should be considered.

Introduction

Emergency Medical Services (EMS) forms an integral part of medical services. EMS provides patient stabilization and transport ideally to definitive care but occasionally to the nearest hospital. The aim of EMS should be to reduce morbidity and mortality. Different modes of transport are used in patient transport including ground, air and water transport.[1] Medical evacuation have been classified as (i) primary transfer: transportation of a patient from the scene of an accident or incident to hospital; and (ii) inter-hospital transfer (IHT): transportation of a patient between health facilities[2]. A helicopter emergency medical service (HEMS) is part of the global EMS, and has been shown to be a relatively faster option. Transport time by helicopter has been estimated to be 75% less than that of ground transport.[1] The use of HEMS has become an important part of modern emergency care systems.

While HEMS is a specialized flying emergency service providing in-flight specialized care it is more expensive compared to the other modes of transport.[3,4] HEMS has been in use since the 1920's when it was used in the military to transport injured soldiers and later adopted to transport civilian patients.[1] Since the 1960s,[5] a number of operations have been established across South Africa (SA) in both the private and public sectors. The HEMS in SA currently comprises three major service providers: Netcare 911, ER24 and the Red Cross Air Mercy Service.

There are no universally accepted criteria for HEMS use. Several international bodies have developed guidelines to provide guidance on the appropriate and safe use of HEMS.[6] The guidelines generally agree that the use of HEMS should be considered if a clinical benefit can potentially be provided. These clinical benefits have been described as: (i) meaningfully shortening the time to delivery of definitive care to patients with time-sensitive medical conditions; (ii) providing necessary specialized medical expertise or equipment to patients before and/or during transport; and (iii) providing transport to patients inaccessible by other means of transport.[6] Local guidelines may be set to then more specifically guide the appropriate use of HEMS.

This study gives an understanding of HEMS use in an urban setting in South Africa. In the South African setting, most HEMS are run by private service providers in collaboration with provincial health services, and transport private patients as well as state-funded patients. The cost of transporting state-funded patients is recovered from the provincial health services. This study is thus relevant in the South Africa setting and currently applicable as the Health Professions Council of South Africa (HPCSA) is developing clinical practice guidelines to be used in the prehospital setting[7] to improve service delivery.

There is however a paucity of data on the use of HEMS in the South African setting. Characteristics of patients using HEMS have therefore not been well described. This study aimed to describe the use of a single HEMS system including patient characteristics, medical personnel and flight times.

Objective

This study describes demographic and clinical characteristics of patients using a private HEMS, indications used for HEMS dispatch and describes procedures performed by HEMS crew. This study thus interrogates the utility of HEMS in the urban setting and contributes towards improving local guidelines.

Methods

A retrospective case record review of all flights conducted by ER24 a private HEMS in Gauteng province, over a period between the 1st January 2013 to 31st December 2013 was undertaken. Ethics approval was obtained from The University of Witwatersrand Human Research Ethics Committee (ref M140863) and permission was granted by ER24.

Study setting

ER24 in Gauteng Province is based at Lanseria airport, 47km from Johannesburg. ER24 services primary call-outs and inter-facility transfers and is configured to transport one patient at a time. Patients from both the private and provincial health care systems are transported. ER24 operates 365 days a year but only operates between sunrise and sunset. The HEMS crew consists of a pilot and two health care providers, one of whom is at least an advanced life support (ALS) paramedic.

Study population

All flights where a patient was transported were reviewed. Flights with missing case records were excluded. Data for flights undertaken without ultimate patient transportation were collected and reasons for not transporting patients were recorded.

Data collection and management

Relevant data was extracted from the case records (flight patient report form) of the HEMS onto a data collection sheet by the researcher. The demographics, patient assessment including vital signs and procedures done by HEMS crew, indications for flight, crew on flight, and flight times were recorded. The data was compared with a summarized record of all flights kept at the base to identify any missing flights. A data number was assigned to each case reviewed. A cross-referenced spreadsheet was used to link the flight record to the data number to ensure there was no duplication of case reviews. Once case and data numbers were assigned, the cross reference sheet was kept separately to maintain case anonymity.

Flights were classified as either primary or IHT. Not-transported flights were defined as flights where the helicopter landed at the scene but no patient was transported. The first recorded vital signs and the initial Glasgow coma score (GCS) were used to calculate the Revised Trauma Score (RTS) for trauma patients. Flight details recorded included medical crew configuration, indication for flight, procedures done by medical crew and the flight times. On-scene time was defined as the time between landing and taking off from the pre-hospital scene or healthcare facility.

Statistical analysis

Data analysis was performed using Statistical Package for the Social Sciences (SPSS) version 22(IBM, USA). Means and standard deviations were used to describe numerical data and percentages for categorical data. The P-value was set at <0.05.

Results

Two hundred and ten flights were completed during the study period. One patient record was missing and thus excluded from analysis. Ten (4.7%) flights did not result in patient transports. One hundred and ninety-nine flights were therefore reviewed and analysed. There were 123 (62%) primary transfers and 76 (38%) IHT. Six primary response flights (4.7%) did not ultimately transport patients - four patients died on scene, one patient was transported by another HEMS and no clear reason was documented for not transporting one other patient. Four IHT flights (5%) did not culminate in patient transport; two patients died, one became too unstable for transport and one was transferred by ground ambulance as the sun had set.

Demographic and clinical characteristics

The mean (SD) age of trauma patients was 33.9 years (19.9) while the mean age for non-trauma patients was 43.1 years (25.9). There was a significant age difference between the trauma and non-trauma group (p-value 0.003). There was no age significant difference between the primary and IHT group (p-value 0.377).

Table 1 summarizes the demographic and social characteristics of patients.

Table 1: Demographic and social characteristics

		All	Primary	IHT
Age	Mean (SD) age	36.2(21.93)	35.1(20.6)	37.9(23.8)
	<28 days	8(4%)	0 (0%)	8(11%)
	1 month to 12 years	30 (15%)	20 (16%)	10(13%)
	>12 years	155(78%)	97(79%)	58(76%)
	Unknown	6(3%)	6(5%)	0(0%)
Sex	Male	124(62%)	77(63%)	47(62%)
Payment type	Medical aid	104(52%)	40(33%)	64(84%)
	Provincial government	50(25%)	46(37%)	4(5%)
	Road accident fund	19(10%)	18(15%)	1(1%)
	Workman Compensation	18(9%)	15(12%)	3(4%)
	Private	5(3%)	2(2%)	3(4%)
	Other government departments	3(2%)	2(2%)	1(1%)
Case type	Trauma	140(70%)	115(93%)	27(36%)

For primary transfers: Road-related incidents comprised 67% (n=82) (55 motor vehicle collisions, 20 pedestrian vehicle collisions and 7 motorbike accidents), falls from a height 12% (15), and cardiovascular emergencies 4%(5) comprised the largest groups of patients. Electrocution accidents, burns, assault and shootings formed 8% of the group with three patients in each group. Another 8% of the patients included neurological emergencies, drowning emergencies, industrial injuries and sport injuries with 2 patients in each group. One percent (1) was due to respiratory emergencies. Thus trauma (93%) was the main reason for transport in the study population. The small group of non-traumatic conditions was comprised of five cardiovascular cases, two neurological emergencies and one respiratory emergency.

The severity of injury of trauma patients transported was calculated from the initial vital signs recorded by the HEMS medical team, and only those transported in the primary group had a revised trauma score (RTS) calculated. Ten (8.7%) patients had a RTS of less than 4, requiring transport to a level 1 trauma centre.[8] Fifty-two (45.2%) had a normal RTS of 7.84 on HEMS arrival, the other 53(46.1%) had an RTS between 4 and 7.55 with a survival probability between 60% and 97%.

In the IHT group, 25%(19) were cardiovascular emergencies, 20%(15) were due to road related incidents, (11 motor vehicle collisions, 1 pedestrian vehicle collision and 3 motorbike accidents) 11% (8), respiratory emergencies, 9% (7) neonatal cases and 9% (7) surgical emergencies. Falls and aortic aneurysm together comprised 10% (4 patients each). Neurological and industrial injuries together 8% (3 patients each), burn and assaults together comprised 6% (2 patients each) and electrocution, drowning and sports injuries made up the remaining 3% together (1 patient each).

Flight crew composition, medical procedures & indications for flight

Four (2%) of the primary transfers were activated by non-medical personnel. The remaining 98% of the primary transfers were activated by paramedics already on scene, termed “secondary activation.” All IHT requests were facilitated by referring facility medical staff.

Two (1%) flights which were both primary transfers, were attended by a doctor-paramedic team. Paramedic-paramedic teams attended to all other flights. Advanced life support (ALS) paramedics with national diplomas attended to 58 % (115) of all flights, 56% (69) of primary and 61% (46) of IHT. Emergency care practitioners (ECP) attended to 41% (82) of flights, 42% (52) of primary and 39%(30) of IHT. No nurses attended to flights during the study period.

Table 2 summarizes the indications for HEMS transport. 25% (51) of all patients had multiple reasons for helicopter transfer request including 27% (33) of primary transfers and 25% (18) IHT’s. Two IHT patients were transported from private hospitals to provincial hospitals by HEMS because these patients had no medical aid. One patient, a neonate who had an inoperable gastroschisis, was down-referred from specialist care to a hospital nearer home to open up a neonatal intensive care bed.

Table 2: Indications for Flights

	All	Primary	IHT
Upgrade to specialist care	64(26%)	44(28%)	20(22%)
Distance to hospital	52(21%)	33(21%)	19(20%)
Polytrauma	29(12%)	20(13%)	9(10%)
Head injury	24(10%)	13(8%)	11(12%)
Neuro fall out	13(5%)	7(4%)	6(7%)
Multiple patients	11(4%)	6(4%)	5(5%)
Peak traffic congestion	5(2%)	5(3%)	0(0%)
Prolonged entrapment time	8(3%)	5(3%)	3(3%)
Spinal injury	9(4%)	5(3%)	4(4%)
Trauma(reason not specified)	7(3%)	4(3%)	3(3%)
Bad terrain	6(2%)	3(2%)	3(3%)
Burns	4(2%)	3(2%)	1(1%)
Threatened limb	6(2%)	3(2%)	3(3%)
No ALS on scene	5(2%)	3(2%)	2(2%)
No medical aid	2(1%)	2(1%)	0(0%)
Down referral	1(0%)	1(1%)	0(0%)
Status asthmaticus	1(0%)	1(1%)	0(%)
Post ROSC	2(1%)	0(0%)	2(2%)
Facial trauma	1(0%)	0(0%)	1(1%)

Table 3 summarizes the procedures done by HEMS crew both on-scene and in flight. Patients were mainly monitored with non-invasive blood pressure, continuous ECG tracing, oxygen saturation and $ETCO_2$ for intubated patients. The major procedure done was intravenous catheterization for various reasons as well as sedation or pain control. A total of 87 intubated cases were transported, of which 18 were intubated by HEMS crew, 6 in health facilities and 12 on the primary scenes. There were no failed attempts at intubation reported. Five patients were manually ventilated using a bag-valve device due to problems initiating mechanical ventilation. Needle decompression of pneumothorax, provision of non-invasive ventilation and defibrillation were rare procedures.

Table 3: Medical procedures performed by flight crew

	On Scene	In Flight
Full spinal Immobilization	90	0
Sedation	28	51
Endotracheal intubation	18	0
Pain control	17	21
Intravenous cannulation	16	2
Intravenous fluid administration	14	159
Mechanical ventilation	9	87
Intraosseos insertion	5	0
Nasogastric tube insertion	4	0
Pelvic binder application	4	0
ACLS drug administration	3	0
Fracture immobilization	3	0
Inotrope administration	3	18
Urinary catheter insertion	3	0
Extrication	2	0
Wound dressing	2	0
Defibrillation	1	0
Pneumothorax Needle decompression	0	1
Control of hemorrhage	0	2
Nebulization	0	2
Manual ventilation	0	5

*ACLS *advanced cardiac life support*

Flight times and flight patterns

Travel times to scene, on scene and to hospital have been summarized in Table 4. As the HEMS in this study operates during the day time only there was no day-night variation to report. There was a slight increase in transfers on Saturdays but no significant daily variations were seen, Figure 1.

Table 4: Mean Mission Times

Times(Minutes)	All	Primary	IHT
Time to scene	35.41(26.54)	31.47(25.29)	46.23(26.43)
Time on scene	37.31 (32.20)	29.34(28)	59.22(32.51)
Time to hospital	30.31(23.08)	27.27(23.16)	38.55(20.45)
Total mission	2:51(1.23)	2:33(1.17)	3:40 (1.21)

All values in the table are mean (SD)

Figure 1: Daily variation in transport of patients

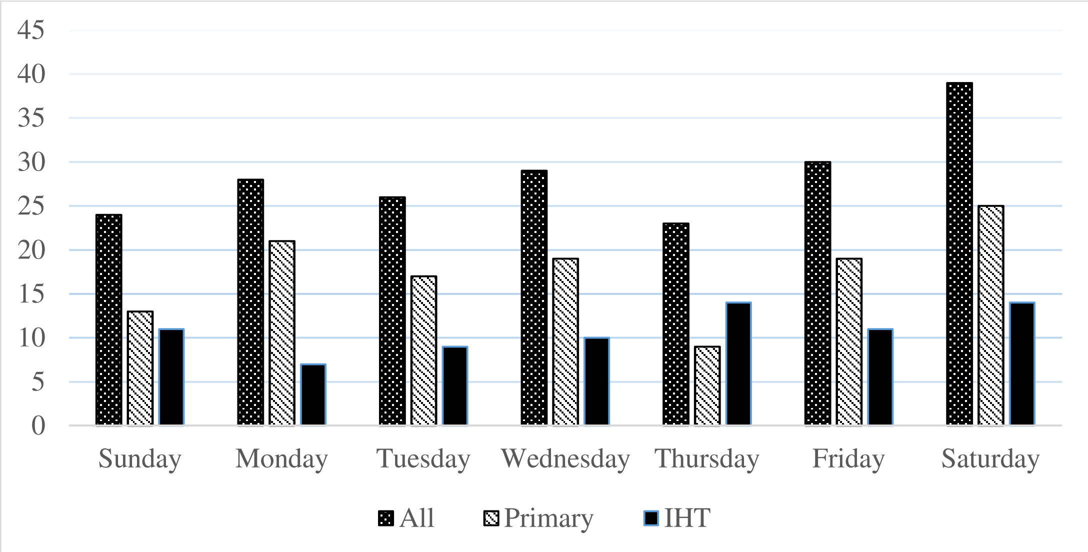
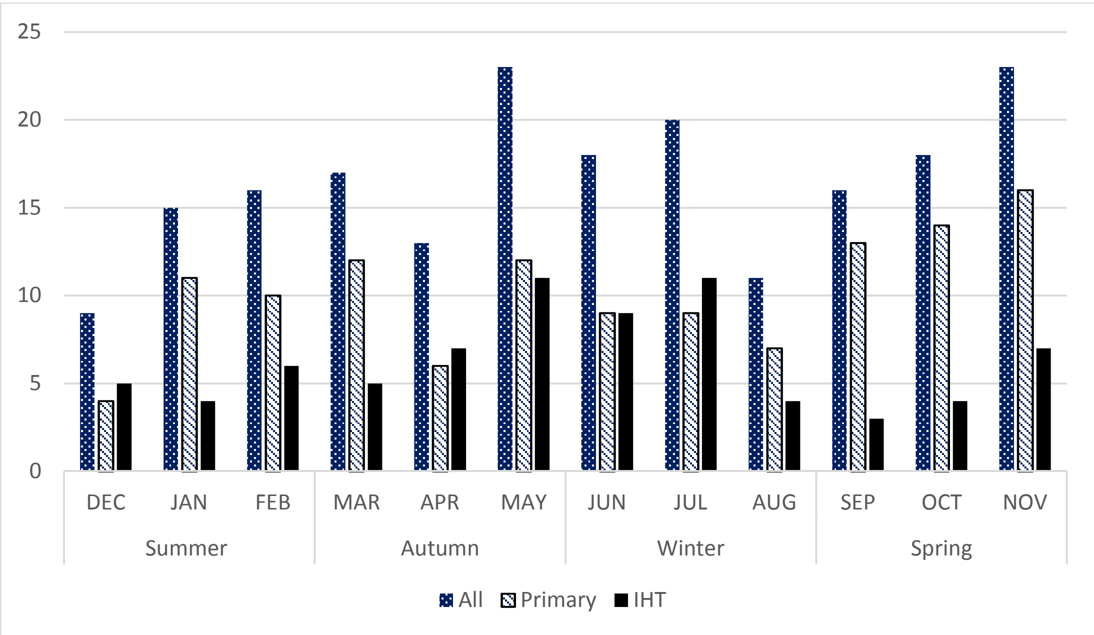


Figure 2 shows a fall in transfers in December and August, while an increase in transfers in May and November is noted. No significant monthly or seasonal variation was seen.

Figure 2: Monthly and Seasonal Variations



Discussion

This study is relevant to the South African setting as most HEMS are run by private service providers that service both private and provincial health service. This study has given an insight into how HEMS are used in an urban South African setting.

Demographics

Recently, two retrospective studies have looked at characteristics of patients using HEMS in South Africa: a five-year review of HEMS flights conducted by the South African Red Cross Air Mercy Service from 1 January 2006 to 31 December 2010, in Richards Bay, Kwa-Zulu Natal[9] and a Netcare retrospective review of flights conducted in 2011 in Gauteng and Kwa-Zulu Natal.[10] The 63% rate of primary transfers in our study was comparable to the 66% found in the Netcare[10] study. Trauma, especially high impact motor vehicle collisions, accounted for most of the transfers in both studies. Unlike our study, 88.4% of transfers in the Richards Bay study[9] were IHT due to the rural setting and because the HEMS was based at a regional obstetric referral hospital.

The majority of the patients transported in our study and the Netcare study were males; 62% in our study versus 74% in Netcare.[10] This appears to be in line with international trends where more male patients are transported; a review of primary transfers in Australia between 2008 and 2009 showed the same.[11] The mean age for trauma patients was significantly lower than that of non-trauma patients. This is also consistent with international trends that show mostly younger trauma patients using HEMS services. This was also demonstrated in America[3] and Australia.[11] Trauma constituted 70% of all cases – this trend is expected as SA has a high injury-related burden of disease.[12] This shows a good utility of HEMS as internationally and in SA[13] it has been shown that trauma patients benefit from HEMS.[4,14]

Indications

The low rate of severely injured patients transported by HEMS as defined by the RTS is a concern. This was also demonstrated in Australia where patients with low RTS were transferred.[11] Differences in flight activation in the two systems exist. HEMS may be activated by mechanism of injury or by a ground paramedic in Australia, while in our study HEMS was activated by ground EMS. This is a common finding as a meta-analysis of 22 studies also showed that patients with low injury severity scores are using HEMS.[15] In our study, we cannot comment on the impact of initial resuscitation by ground EMS on the RTS recorded by HEMS crew. HEMS call-outs for other indications such as multiple patients on scene, distance to hospital and mechanism of injury may also explain why patients with normal RTS were transported by HEMS in our study. Use of HEMS for patients with low injury scores reduces the cost efficiency of HEMS.[3]This could also be an indication of over triage of patients as some studies have shown that only severely injured patients benefit from HEMS use.[13,14]

The most common indication for transport for both primary and IHT was transport to specialist care. For primary transfers, it is not clear if HEMS bypassed the closest hospital for trauma patients to rather go to a specialized trauma hospital. Use of HEMS for down-referral for patients with poor prognosis in a resource limited setting is questionable. A flight of this nature was however utilized to make available an intensive care bed hence the urgency to have the patient moved. The flight distance was 161km which would take 2 hours by road, the availability of ground EMS at the time is unknown, if a ground ambulance was available, it would have been more appropriate. This was a unique but appropriate use of HEMS as it was used to make available a scarce hospital resource and thus impacting, presumably positively, on the other patient's outcome.

Having non-trauma patients in the primary transport group transferred by HEMS is a good indicator of a new trend of transporting "time sensitive cases" by HEMS which is developing worldwide.[6,16] HEMS are currently being advocated for patients that require timely interventions. Such patients include cardiac patients requiring percutaneous cardiac intervention or thrombolysis as well as stroke patients who may benefit from thrombolysis. Cardiovascular emergencies were the most common indication for transport in our study and the Netcare study.[10] This is consistent with the trend seen in Australia[12] but different from Hong Kong[17] where neurological emergencies were the most common reason for IHT transfer. Different incident rates for medical conditions in different geographical regions may explain this difference. Lack of availability of specialized centres that can ably treat cardiovascular emergencies may also contribute significantly to more transfers in the African setting.

Of interest is the fact that no obstetric patients were transported by the HEMS service during this period. Obstetrics was the number one reason for inter-hospital transfer in Richards Bay.[9] This may suggest a good coverage of obstetric services in the urban area compared to Richards Bay,[9] which is a rural area and the HEMS was based at a referral hospital where obstetric patients are referred.

Flight crew and procedures

The low rate of flights attended by doctors could be a reflection of the low number of doctors working in the pre-hospital setting in South Africa and in Africa as a whole. This is unlike developed countries, in particular Europe where specialist doctors (anaesthetists, emergency physicians and retrieval doctors) are now being used both in HEMS and ground ambulance operations.[18,19] Nurses are also known to be working in HEMS in South Africa. In the 1970s, the Johannesburg General Hospital HEMS crew included nurses, doctors and paramedics.[20] This was not observed in our study. In South Africa currently, ALS paramedics run most HEMS.

Procedures that were rarely performed included needle decompression of pneumothoraces, defibrillation and non-invasive positive pressure ventilation. The two former are lifesaving procedures that HEMS crew should maintain competence in performing, and thus regular recertification of competence in these skills should be achieved by alternate means such as ACLS and International Trauma Life Support Courses (ITLS). Thrombolysis for ST elevation myocardial infarction was not performed during the study period (although this is within the scope of practice for Emergency Care Practitioners). Cardiac emergencies transported in the primary group did not meet the criteria for thrombolysis and those in the IHT group had thrombolysis done in the referring hospitals.

Although needle decompression of pneumothoraces is a lifesaving procedure, current evidence has shown favour for finger thoracostomy[21] in the prehospital setting. When doing a finger thoracostomy, an incision is made on the skin similar to intercostal chest drain insertion and blunt dissection done to release the pneumothorax, but the tube is not inserted. A finger placed in the incision is used to decompress pneumothorax if it re-accumulates, and the same incision can be used in the placement of an intercostal chest drain in hospital.[22] Currently this procedure is not within the scope of practice of paramedics in South Africa.

This may need to be considered by the HPCSA as it implements new clinical guidelines for EMS.

Flight times and variations

Except for a small decline in flights in December and August, there was not much variation in flight activity from month to month. Similarly, no seasonal variation in flight pattern was demonstrated. Conclusions on the impact of weather patterns on flight patterns could not be drawn. `

Mean on-scene time for primary transfers (31.7 min) was comparable to the urban setting in Western Cape, South Africa (31.4 min) [23] and New South Wales, Australia (34.7)[11] but significantly longer than in Richards Bay (23min).[9] No clear explanation is apparent for a shorter on-scene time in Richards Bay. It has however been noted that during the Richards Bay study only 5% of staff were ALS trained,[9] compared to 99% in our study, which may have resulted in less procedures being done on-scene.

On-scene time for IHT (59.22min) was similar to that seen in the Western Cape (58.7min)[23] but longer compared to Richards Bay (40 min).[9] Although the prolonged on-scene time in IHT is a concern, there is wide variation worldwide.[24] This may be attributed to different handing-over procedures required by different hospitals as well as pre-flight preparation and packaging of the patients. Neonatal, paediatric and medical patients generally take longer to prepare for transport[25, 26] and these together contributed 64% of the IHT in our study and neonatal transfers alone were 11%.

Conclusion

Our study demonstrates that HEMS in the urban setting responds mainly to primary transfers, predominantly transporting young trauma patients to specialized hospitals for care. This shows good utility of service as HEMS improves morbidity and mortality in trauma patients. However, many of these trauma patients already had a good prognosis based on their RTS, signifying a potential over-triage and over-use of the HEMS service in the urban environment. Clear guidelines should be developed for the South African setting to assist in better use of HEMS. A prospective study analysis of ground EMS availability, distance to hospital and patients' severity of injury may be needed to assist in defining these guidelines.

Recommendations

HEMS is an expensive resource that needs careful management to maximize its benefits. Therefore, there is a need to reduce the percentage of patients with low injury score using HEMS, reduce the number of flights that do not transport patients and improve handover systems to reduce average on-scene time, especially in IHT where handover systems may be improved. Local guidelines need to be effective in reducing over-triage. To improve the effective use of the guidelines, there is a need for an improved communication system for use by hospitals, ground EMS and HEMS. Post-transfer feedback to referring teams on suitability of patients for HEMS and patients' outcomes will in turn further assist in improving criteria for call-outs

Due to some life-saving procedures being done infrequently, to maintain competence, HEMS crew need continuous professional training to maintain knowledge and skills. Incorporation of finger thoracostomy in required skills for ALS paramedics should be considered by the

HPCSA. Current evidence supports finger thoracostomy as more effective and safe compared to needle thoracostomy in the prehospital setting.

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Appendix 1: Approved Proposal

1. Introduction

Helicopter Emergency Medical Services (HEMS) are part of emergency medical service (EMS) systems used to move patients swiftly and safely to points of definitive care. HEMS, while not universally available, can be used to respond to the primary scene of an incident, or for inter-facility patient transfer. Medical services are provided by specialized medical personnel who can provide intensive care support on scene and in-flight. Patient transport time is reduced due to the increased flying speed of a helicopter compared to the driving time of a ground ambulance, and this can certainly be viewed as the primary advantage in utilizing a HEMS system.

Provision of HEMS is however expensive compared to ground emergency medical services. A recent study suggests that HEMS needs to provide at least a 15% mortality reduction or a 30% improvement in long-term disability to compare favourably with ground ambulance to be considered cost-effective (1). However it is not clear that HEMS achieves this mortality or disability reduction. To achieve a cost effective status, careful selection of patients using HEMS is essential.

1.1. Criteria for use

There are no definite criteria for patient selection and no definite indication for HEMS use. Over the years, no clear consensus has been developed to describe definite indications for HEMS utilization. As a guide in the USA, the Air Medical Physician Association (AMPA), the American College of Emergency Physicians (ACEP), the National Association of EMS Physicians (NAEMSP), and the American Academy of Emergency Medicine (AAEM) agreed that for appropriate and safe HEMS use, HEMS can be utilized if a clinical benefit can be provided by HEMS. Clinical benefit of HEMS utilization was described as (2):

- Meaningfully shortening the time to delivery of definitive care to patients with time-sensitive medical conditions

- Providing necessary specialized medical expertise or equipment to patients before and/or during transport

- Providing transport to patients inaccessible by other means of transport

1.2. Benefits of HEMS

Clinical benefit of HEMS has been demonstrated for both trauma and non-trauma patients. Current evidence suggests that HEMS improves survival of poly-trauma patients (3, 4) and reduces patient transport time to definitive care (5). For non-trauma patients, controversy exists on the benefit of HEMS. For stroke patients, HEMS has been shown to be slower than ground transport (6) while another study showed HEMS to be quicker resulting in increased rates of thrombolysis among patients transported by HEMS (7). For patients with acute ST segment elevation myocardial infarction HEMS was shown to be faster (8)

1.3. Current HEMS use

Different rates of HEMS use by trauma and non-trauma patients have been shown in different areas. In Turkey (9) trauma patients made up 31% of transported patients while in England (10) these contributed to 51%. In these 2 studies, most transported patients were younger than 40 years. The differences in patient characteristics can be attributed to different disease burdens in different areas as well as the lack of clear indications for HEMS use.

1.4. Service provision by HEMS

HEMS flights are attended to by medical personnel with different levels of training; Paramedic only, paramedic and nurse, or paramedic and doctor crew have all been used. Procedures are done by these crews depending on patients' needs to reduce further injury and prevent death. Tracheal intubation and ventilation, cardiopulmonary resuscitation, establishing intravenous and intraosseus access, patient monitoring and drug administration may be required (11,12). Procedures during flight are however more challenging to perform due to limited space within the helicopter cabin (13). A survey in the United States of America showed that paramedics were at times practicing beyond their scope of practice (11). Availability of doctors in-flight allows a wider range of procedures to be done on scene and in-flight (14). Thus level of training of HEMS crew determines what procedures are possible either on scene or during flight.

1.5. HEMS Safety

While provision of patient care is of utmost importance, safety of the medical personnel as well as the patient is an essential part of HEMS that cannot be overlooked. A flight should not pose unreasonable risk to medical personnel, pilots and/or to the patient. Weather conditions, distance and air traffic patterns should be considered (2). Several reports of helicopter ambulance accidents on account of weather have been reported (15). Pilots have the unquestioned right to decline a mission because of aircraft or weather considerations (16) regardless of patient condition. Safety concerns therefore have an impact on the flights that are undertaken.

1.6. HEMS in South Africa

In South Africa, current evidence suggests that some aspects of HEMS in South Africa are comparable to international trends. In the Western Cape, a comparison of time spent on scene by HEMS crew and ground ambulance crew showed that HEMS crews spend more time on scene compared to ground ambulance crews, 53.2min and 27.9min respectively (17). It was also shown that HEMS reduces mortality of trauma patient in Johannesburg (18) as has been seen worldwide (5). The demographic and clinical characteristics of patients being transported in South Africa have not yet been described, but a high burden of injuries (19) may suggest that a high rate of trauma patients transported by HEMS can be expected.

1.7. Rationale

This study aims to describe service provisions by a HEMS provider in South Africa. Patients' characteristics using HEMS, indications for its use, procedures done by HEMS crew and if there is variation in monthly or seasonal flight activity over a one year period will be reviewed. The study will thus help assess the medical appropriateness of flights undertaken, and provide data to help assist in assessing the appropriateness of HEMS dispatch.

1.8. Objectives

- To describe the demographic characteristics of patients flown on HEMS.
- Describe clinical characteristics of patients flown on HEMS
- Determine average mission and flight times
- Describe dispatch criteria utilized for individual patients for HEMS activation during the study period
- Identify any weekly/monthly/seasonal trends in the dispatch of HEMS services

- To describe clinical procedures undertaken by HEMS medical personnel

2. Methodology

Data for this study will be collected by means of a retrospective review of patient records transported or treated by ER24 HEMS service over a one year period. ER24, a private ambulance emergency service in South Africa who also operate a HEMS service in South Africa in 5 provinces, Western Cape, North West, Eastern Cape Mpumalanga and Gauteng. ER24 has a dedicated team of doctors and paramedics working in the HEMS service capable of providing various levels of patient care.

2.1. Design

This is a retrospective descriptive study.

2.2. Site of Study

ER24 Head office, Johannesburg, South Africa.

2.3. Study Population & Sampling

All medical flights undertaken by ER24 HEMS at all of their five bases during the 2013 calendar year will be reviewed.

Only flights that had no live patient contact will be excluded in terms of clinical data. These cases will be recorded for other purposes, since the HEMS service was initially activated to attend to these patients despite their demise prior to arrival.

Patients who died on scene following treatment and were not transported, but were attended to and treated by HEMS crew will be included.

There is no sample size calculated for this study, however based on historical data, it is expected that 250 case records will be reviewed.

2.4. Measuring Tool or instrument

A data collection sheet will be used for data collection. (Appendix I). Patient demographics, clinical characteristics, clinical dispatch decision making and flight details will be included.

A data number will be assigned per case reviewed. A cross-reference spreadsheet will be utilized to link flight record to data number, to ensure that there are no duplication of case reviews. (Appendix II). Once case and data numbers are assigned, the cross reference sheet will be kept separate to data collection sheets to maintain case anonymity.

2.5. Data Collection

Manual review of clinical case notes will be undertaken with appropriate recording of data on a data collection sheet. This review will be undertaken by the researcher. There will be no reference on the data collection sheet to the particular case notes reviewed, to ensure anonymity and patient confidentiality. A complete list of all cases (by anonymous case number) will be compiled, and note made on the list when a case is reviewed.

2.6. Data analysis

Data analysis will be undertaken by utilizing EPI info and SPSS statistical software. Appropriate descriptive statistical analysis will be utilized to evaluate and describe the data. For age, mean and standard deviations will be calculated. For categorical data (sex, source of funds, indication of flight, procedures done, medical conditions, crew attending to flight) frequencies will be calculated. Chi square will be used to compare state-funded patients to private patients. Graphs and tables will be used to show trends of HEMS activity during the year.

2.7. Sources of Bias

No sources of potential bias have been identified

3. Ethical issues

An application will be made to The University of the Witwatersrand Human Research Ethics Committee (HREC) for ethical approval. No problems are foreseen as this is an anonymous retrospective review of patient records. Permission has been obtained from ER24 to undertake this review of patient records (Annex III). ER24's confidentiality will be maintained, as per agreement, it will not be mentioned in the research report.

4. Timing

The proposed time-frame for the research is as follows:

	Jan-Mar 2014	Apr- Jul 2014	Aug- Oct 2014	Nov –Dec 2014	Jan –Mar 2015
Literature review					
Preparing protocol					
Protocol assessment					
Ethics application					
Collecting data					
Data analysis					
Writing up thesis					
Dissemination					

5. Funding

Funding for the research will be obtained from the Emergency department registrar research fund.

Item	Unit	Number required	Unit cost (ZAR)	Total cost

Plain papers	Ream	5	40.00	200.00
Printing	R1/page	400	1.00	400.00
Photocopying	0.75/page	400	0.75	300.00
Binding	30/cop	6	50.00	300.00
Internet				0.00
Lever arch files	1	5	30.00	150.00
Pens	1	5	15.00	75.00
Transportation	R13/litre	60	13.00	780.00
Phone airtime		160	1.00	160.00
				2365.00

Internet services will be provided by the University of Witwatersrand

6. Problems

Incomplete patient records may affect data quality. The principle of 'not written, not done' will apply for procedures not indicated on patient's case notes.

Transcriptional errors may occur during data collection and entry by the researcher, the data will be verified by the researcher and in case of inaccuracies the cross reference sheet will be used to verify data.

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7. Appendix I: Data Collection sheet

Patient Code:

Date: Time:

Age: Sex:

Pregnant Y / N

Source of finance: Provisional

Private

Attending crew (level of highest qualification)

Mission type:

1. Primary evacuation
2. Inter-facility transfer

Indication of flight: ____

____

Patient Picked Up? Y / N

If N, Give Reason:____

____

Flight times

Time of arrival on scene/facility:

Time of departure from scene/facility:

Time of arrival receiving facility:

Duration of flight:

Past Medical History

Hypertension: Y / N Asthma Y / N

COPD Y /N Diabetes Y/ N

Smoker Y/N

Other ____
______

First Vital Signs recorded

Blood Pressure: Respiratory Rate:

Pulse Rate: Temperature:

Oxygen Saturation: GCS:

12 lead ecg

Procedures by referring facility

Intravenous lines Y / N number:

Central Venous Line: Y / N

Intercostal Drain: Y / N

Intubation: Y/N

Fracture immobilization Y/N

C-spine immobilization Y/N

Inotropes: Y / N

Bag and mask Y / N

Cardiac compressions Y / N

Others: ____

____

Procedures on scene

Intravenous lines Y / N number:

Central Venous Line: Y / N

Intercostal Drain: Y / N

Intubation: Y/N

C-spine immobilization Y/N

Fracture immobilization Y/N

Inotropes: Y / N

Bag and mask Y / N

Cardiac compressions Y / N

Thrombolysis

Others: ____

____

Procedures in-flight

Intravenous lines Y / N number:

Central Venous Line: Y / N Inotropes: Y / N

Intercostal Drain: Y / N

Intubation: Y/N

Fracture immobilization Y/N

C-spine immobilization Y/N

Inotropes: Y / N

Bag and mask Y / N

Cardiac compressions Y / N

Thrombolysis

Others: ____

____

Trauma Patients

Mechanism of injury:

List of suspected injuries:____

____

____

For Burns Patients:

Mechanism of injury

TBSA: Inhalational Burns: Y / N

Medical Patients

Diagnosis if known:

Presenting complaint

Poisoning Y/ N

Venomous Bite: Y / N

Death on arrival at receiving facility Y/ N

8. Appendix II: cross reference sheet

Data number	HEMS code	Data number	HEMS code	Data number	HEMS code	Data number	HEMS code
1001		1039		1077		1115	
1002		1040		1078		1116	
1003		1041		1079		1117	
1004		1042		1080		1118	
1005		1043		1081		1119	
1006		1044		1082		1120	
1007		1045		1083		1121	
1008		1046		1084		1122	
1009		1047		1085		1123	
1010		1048		1086		1124	
1011		1049		1087		1125	
1012		1050		1088		1126	
1013		1051		1089		1127	
1014		1052		1090		1128	
1015		1053		1091		1129	
1016		1054		1092		1130	
1017		1055		1093		1131	
1018		1056		1094		1132	
1019		1057		1095		1133	
1020		1058		1096		1134	
1021		1059		1097		1135	
1022		1060		1098		1136	
1023		1061		1099		1137	
1024		1062		1100		1138	
1025		1063		1101		1139	
1026		1064		1102		1140	
1027		1065		1103		1141	
1028		1066		1104		1142	
1029		1067		1105		1143	
1030		1068		1106		1144	
1031		1069		1107		1145	
1032		1070		1108		1146	
1033		1071		1109		1147	
1034		1072		1110		1148	
1035		1073		1111		1149	
1036		1074		1112		1150	
1037		1075		1113		1151	
1038		1076		1114		1152	

9. Appendix III: Letter of approval

Omitted due to non-disclosure agreement

Appendix 2: Extended Literature Review

List of abbreviations

AAEM	American Academy of Emergency Medicine
ACEP	American College of Emergency Physicians
AMPA	The Air Medical Physician Association
ECP	Emergency Care Practitioner
GCS	Glasgow Coma Score
GEMS	Ground Emergency Medical Service
HEMS	Helicopter Emergency Medical Service
HPCSA	Health Professions Council of South Africa
IHT	Inter-Hospital Transfers
NAEMSP	National Association of EMS Physicians
RR	Respiratory Rate
RTS	Revised Trauma Score
SBP	Systolic Blood Pressure

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Introduction

Emergency Medical Services (EMS) forms an integral part in delivery of medical services. EMS provides patient stabilization and transport to definitive care, and aims to reduce morbidity and mortality. Different modes of transport are used in patient transport including ground, air and water transport. Patient transport has been classified into primary and secondary[1] as defined below:

- Primary transfer: transportation of a patient from the scene of an accident or incident to an emergency facility.
- Secondary (inter-hospital) transfer: transportation of a patient between health care facilities.

Helicopter Emergency Medical Services (HEMS) forms a part of EMS which has been in use since the 1920's. HEMS was initially used in the military to transport injured soldiers[2] and later adopted to transport civilian patients. HEMS is used to transport patients swiftly and safely to hospitals for definitive care. Although not universally available, HEMS is used for both primary and inter-hospital transfers (IHT). Patient transport time is reduced due to increased flying speed of helicopters compared to the travelling speed of ground ambulances.

In South Africa, the first air medical service was established by the South African Red Cross society in 1966[3]. Currently air medical services have expanded to more provinces and provide both fixed wing and HEMS. Private companies have also established fixed wing and HEMS operations, operating both in South Africa as well as the rest of Africa. The operation of air ambulances in South Africa is guided by the Civil Aviation Act of 2009[4], specifically the Civil Aviation Technical Standard part 138 (SA-CATS 138). These regulations and standards are intended to guide air ambulance operators on minimum standards to meet in order to operate a safe and effective service.

Benefits of HEMS

HEMS can only be effective when appropriately integrated into an EMS, maximizing benefit and achieving cost effectiveness[5]. Benefits of HEMS to the patient include:

- HEMS allows the transport of an experienced medical team to the scene of an incident.[6] The arrival of an experienced medical team allows early institution of advanced life saving procedures reducing both morbidity and mortality. Provision of advanced medical care starts on scene and continues in-flight for both primary and inter-hospital transfers. HEMS also allows for the extension of advanced care throughout a region where there are limited services, for example in rural areas.
- HEMS provide rapid transportation of patients to definitive care[6] as patients can be transported over long distances in a short time. HEMS transport time has been estimated to be 75% less than that of ground transport.[1] For trauma patients access to trauma centres is improved as HEMS can bypass other hospitals, transferring patients directly into trauma centres. In this case, patients' access to specialized services is improved and rates of further IHT reduced. HEMS also allow transport of non-trauma patients who are not proximate to advanced or critical care the same survival as patients who have the service immediately available. Thus time sensitive conditions such as cardiac emergencies and stroke benefit from HEMS use.

- HEMS is capable of accessing areas that are otherwise inaccessible by ground emergency medical services (GEMS).[5] In cases where a ground ambulance cannot reach an incident in an appropriate response time due to inhospitable terrain or traffic restrictions and in cases where the patient needs to be transported over a long distance HEMS has proven to be more advantageous to the patient.[7,8]

Impact of HEMS on patient outcomes

There are numerous factors that are taken into account when using a helicopter to transport patients. The benefits of air transportation are usually related to the speed of transport as well as the specialized skills of the HEMS medical crew. Literature suggests that patients with time sensitive diseases benefit the most from HEMS.[9] Time sensitive conditions that have been thought to benefit from HEMS include: ST-elevation myocardial infarction, polytrauma, traumatic haemorrhage, traumatic brain injury, burns, stroke and neonatal emergencies. [9,10]

Different outcomes have been demonstrated for trauma patients using HEMS, some studies have shown a mortality benefit while others have not;

- A retrospective study comparing pediatric trauma patients transported to 2 level 1 trauma hospitals in Colorado between 2003 and 2013 using HEMS and GEMS looked at 14,405 patients of which 3870(26.9%) were transported by HEMS. Multiple regression analyses were performed on drive time/distance, travel time/distance and excluding time/distance. Outcomes of patients were showed that 22.3% of the patients using HEMS were not severe injured and that HEMS does not independently improve outcomes.[11]

- A retrospective review of outcomes of 1073 polytrauma patients treated at scene by GEMS and/or HEMS over a 6 year period that were transported to an academic hospital in Netherlands showed that use of HEMS improved survival in patients by 5.4% especially in patients that were hemodynamically unstable.[12]
- A retrospective cohort study of 223,475 patients older than 15years who had major trauma transported between 2007 and 2009 and whose records were in the American College of Surgeons National Trauma Data Bank showed that patients transported by HEMS had a higher odds of survival compared to GEMS.[13]
- In Maryland, between 2001 and 2011, triage criteria for HEMS use was gradually changed for trauma patients. All trauma patients meeting criteria to use HEMS due either mechanism of injury or comorbid factors but within a 30-minute drive to a trauma center were transported by GEMS. This change in triage showed a decline in HEMS use with an increase in GEMS use and improved trauma patient outcomes.[14]

These examples show that various factors play important roles in affecting patient outcomes. Factors such as the mechanism of injury, age of the patient, and severity trauma also play a role in patient outcome in trauma and thus need to be considered when choosing patient for HEMS.

Similar findings have been demonstrated for non-traumatic conditions:

- An analysis 124 with acute stroke patients that received thrombolysis at Saint Mary's Hospital in Rochester, of which 94 were transported by HEMS showed that HEMS use had no benefit over GEMS.[15]

- An analysis of 16 referring hospital and 6 receiving hospitals to assess the role of HEMS in improving time to percutaneous intervention in ST elevation myocardial infarction, showed that of 179 patients, only 3% had reperfusion within the recommended 90 minutes.[16]
- A prospective, controlled, observational study, of 450 patients in whom STEMI was suspected outside a 30-minute driving distance from the PCI centre showed that HEMS improved time to percutaneous intervention and also reduced mortality at 30 days and 1 year[17]
- A prospective analysis of 32 stroke centres in a 6 year period identified 21,712 ischemic stroke patients, of these 905 patients were transported by HEMS. Shortest hospital arrival times and highest thrombolysis rates were seen in patients transported by HEMS compared to GEMS.[18]

These studies further highlighted the need for careful selection of patients selected for transport by HEMS.

Indications for HEMS use

There are no well-established or definitive criteria for patient selection and thus no specifically defined indications for use of HEMS. As a guide, the Air Medical Physician Association (AMPA), American College of Emergency physicians (ACEP), National Association of EMS Physicians (NAEMSP) and American Academy of Emergency Medicine (AAEM) developed guidelines to help guide in the appropriate and safe use of HEMS.[9] According to these guidelines HEMS can be utilized if a clinical benefit can be provided. Clinical benefit of HEMS utilization was described as;

- Meaningfully shortening the time to delivery of definitive care to patients with time-sensitive medical conditions
- Providing necessary specialized medical expertise or equipment to patients before and/or during transport
- Providing transport to patients inaccessible by other means of transport.

The above guidelines for HEMS use are aimed at improving patient outcomes and activation of HEMS is thus dependent on the clinician's clinical judgement. Regional guidelines are further developed by different HEMS services. Most guidelines stress the importance of clinical judgement in decision making.[19,18] Currently South Africa has no national guidelines to help clinicians identify patients potentially suitable for HEMS transport.

Current HEMS use

With different criteria being used to activate HEMS, a great difference occurs in the types of patients transported by HEMS in different regions. Most research has focused on trauma patients and primary transfers. A few retrospective studies have described the characteristics of patients using HEMS in general.

Trauma has been shown to be the most common reason for HEMS transport in different regions. A study in England showed that 51% of HEMS transfers were trauma.[21]A study conducted in Turkey in 2010 showed that the age group 0-18 years constituted 55% of transfers made; among adults the most common reason for transfer was trauma (31.6%), followed by obstetrics 24.7%.[22]

In contrast, in Richards Bay, a rural area in South Africa, trauma only contributed 15.9% of transfers, obstetric transfers (32%) and paediatric transfers (25%) contributed to majority of the transfers. [23]

Trauma patients

Different indications have been used to activate HEMS for transfer of trauma patients. Some indications for HEMS activation in trauma include: [24]

- High energy trauma
- Multiple injured victims
- Prolonged extrication/entrapment
- EMS travelling time greater than 20min
- Traumatic limb amputation
- Penetrating trauma (stab and gunshot)
- Trauma to airway, shock or coma
- Total burn surface area greater than 15%

An injury severity score can be calculated for trauma patients, the revised trauma score (RTS) being the easiest to calculate on-scene. The RTS is a physiological scoring system that is calculated using the patient's initial vital signs.[25] Systolic blood pressure (SBP), Glasgow coma score (GCS) and respiratory rate (RR) are used. The values are coded as below:

Table 1 RTS Coding[25]

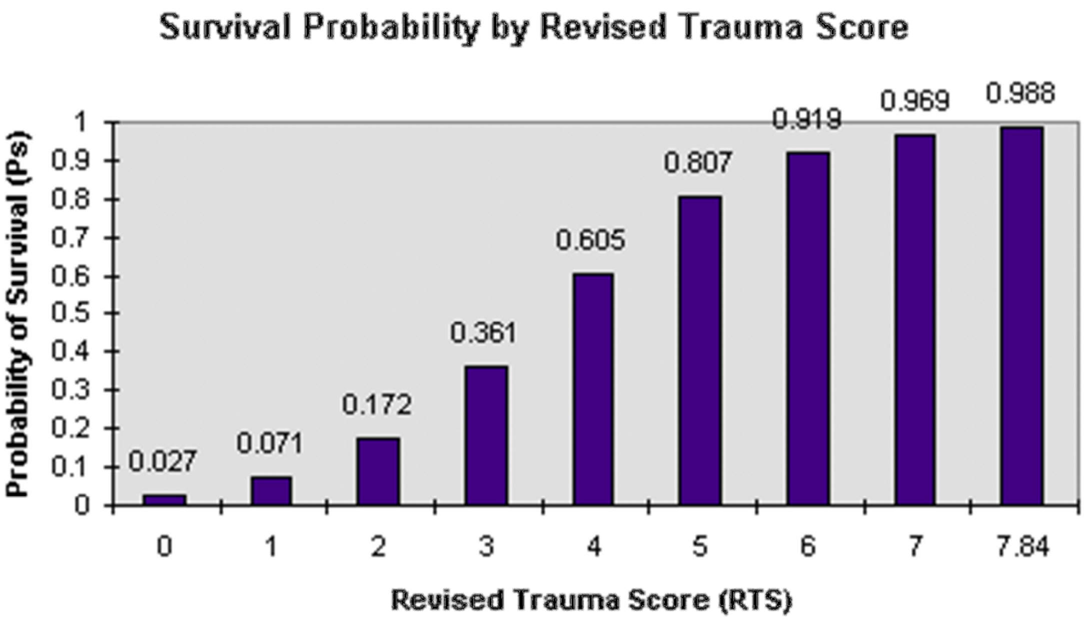
GCS	SBP(mmHg)	RR	CODED VALUE
13-15	>89	10-29	4
9-12	76-89	>29	3
6-8	50-75	6-9	2
4-5	1-49	1-5	1
3	0	0	0

Then the RTS is calculated with the calculated code using the formula:

$$RTS = 0.9368GCS + 0.7326\ SBP + 0.2908RR$$

RTS weights GCS high in its calculation to emphasize the impact of traumatic brain injury on a patient's outcome. RTS has been shown to correlate well with a patient's probability of survival[25] as shown in Figure 1.

Figure 1 Survival Probability by Revised Trauma Score[25]



Other trauma scoring systems exists; the Abbreviated Trauma Scale, Injury Severity Score, Trauma and Injury Severity Score and other scoring systems can be used to grade trauma but they are technically complicated for the EMS setting as every injury is assigned a code according to anatomical site, nature and injury.

HEMS have shown benefit in trauma patients with high injury scores reducing morbidity and mortality. This has also been demonstrated in Johannesburg, South Africa among patients who were transferred by HEMS to a level one trauma centre where a reduction of 21% in mortality was proven.[26]

Non-Trauma patients

Due to its utility in the management of time sensitive conditions, HEMS has an important role in transporting non-trauma patients to definitive care. Use of HEMS allows 'far patients' to achieve the same outcomes as those near hospitals.[10] Although most HEMS studies have concentrated on trauma patients, recent developments have seen an increase in the use of HEMS in non-trauma patients.[10]

Most non-trauma flights are in the inter-hospital transfer category. These patients are referred for specialist care. Cardiac patients, obstetric patients and neonatal patients are the most transported.[22,27, 28] Recent developments have seen the use of primary HEMS in some medical conditions such as ST elevation myocardial infarction and stroke to reduce time to definitive care.[10] Definitive care may be thrombolysis where this is not provided on scene, or primary percutaneous coronary intervention for ST elevation myocardial infarction.

Medical Crew and Procedures

HEMS flights are attended to by medical personnel with different levels of training; Paramedic only, paramedic and nurse, or paramedic and doctor crew have all been used. In South Africa the different combinations are used in HEMS.

In South Africa, 5 levels of paramedic training that are registered under the Health Professions' Council of South Africa (HPCSA). The highest qualified being the Emergency Care Practitioner (ECP). ECP's are allowed to provide the following amongst other procedures; [29]

- adult and paediatric advanced life support
- Intravenous and intraosseous cannulation
- Thrombolysis, fibrinolysis
- Rapid sequence intubation
- On-scene discharge
- Administration of emergency medications as stipulated by HPCSA
- Specialized intensive care unit transport of adults and paediatrics patients.

Different procedures are required to prepare patients for safe transport. Procedures done by different HEMS crew include patient monitoring and drug administration, tracheal intubation and mechanical ventilation, cardiopulmonary resuscitation, establishing intravenous and intraosseous access.[30,31] Procedures provided by HEMS medical crew are done according to the crews' scope of practice. Some paramedics have however performed procedures beyond their scope of practice to stabilize patients.[32] The in-cooperation of doctors in HEMS medical crews has seen a wider scope of procedures being performed on scene with some studies showing no to impact on the time spent on scene in performing these procedures[33] and others showing prolonged on scene time.[34]

Flight logistics

While provision of medical care is of utmost importance, safety of medical and flight personnel as well as that of the patient is an essential component of HEMS that cannot be overlooked. A flight should not pose an unreasonable risk to patient and/or crew. Pilots have the unquestioned right to decline a mission because of aircraft or weather considerations regardless of patient condition.[1] By guideline, a safety management system must be developed, adopted, and adhered to by air medical operators when making decisions to accept and continue every HEMS transport,[9] thus patient condition is not an independent factor to decide when HEMS should be utilized.

The speed at which a helicopter can travel reduces travel time when compared directly to ground ambulance transportation. Helicopters also travel by more direct routes and they can avoid traffic or other obstructions which may delay transport. Factors such as weather conditions, ease of access and a suitable landing zone may delay HEMS services. Thus the time the HEMS crew spends on scene is crucial in reducing out of hospital time for the patient.

For trauma patients, the "Golden Hour," is the first sixty minutes from the occurrence of an emergency in which rapid transfer to an appropriate emergency medical care facility can be potentially lifesaving for the patients.[35] The speed of the helicopter maximizes the portion of the "Golden Hour" that a patient will spend receiving definitive care inside a hospital environment, although current evidence suggests that the concept of "Golden Hour" maybe invalid in current clinical practice[36]. The distribution of deaths is influenced by the mechanism of injury, age of the patient, and body area with severity trauma.[36]

HEMS crew have however been shown to spend more time on scene compared to ground ambulance crews. In the Western Cape,[37] South Africa HEMS spent 53.2 minutes at the scene, whilst the ground ambulance crew spent 27.9 minutes. In the United States of America, HEMS also spent more time on-scene compared to ground crew (35.4 vs. 24.6 minutes).[38] Although the prolonged on-scene times may be due to additional procedures being performed on scene by HEMS crew, the impact of delay to definitive care should not be underestimated.

Rationale

HEMS are an expensive resource that is available in South Africa. HEMS are available to private as well as provincial patients. There is sparse data on the use on HEMS in South Africa. This is poses a challenge to HEMS in South Africa as there is no baseline information on which to base flight dispatch criteria, medical staffing and policy documents.

This study aims to provide an analysis of the situation within a private HEMS operation in Gauteng Province in South Africa. Gauteng is the smallest province in South Africa, it is highly urbanised, containing the country's largest city, Johannesburg and the administrative capital, Pretoria. As of 2015, it has a population of nearly 13.2 million, making it the most populous province in South Africa.[39] Gauteng records a high number of road traffic accidents and interpersonal violence.[40,41]

This research may have an impact on HEMS in South Africa as it will provide a point of reference on the clinical and demographic characteristics of patients treated, the clinical time frames for treatment, indications for HEMS use, the nature of the medical skills performed and flight patterns. This detailed descriptive analysis may help provide information for the development or refinement of current aeromedical policies in the private sector as well as in public health sector with regards to the staffing of medical helicopters. It may also help in the education and training of HEMS medical crew to attain required skills as well as competency in the provision of HEMS services.

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Appendix 3: Ethics Clearance

R14/49 Dr Grace Chatsika

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M140863

NAME: (Principal Investigator)	Dr Grace Chatsika
DEPARTMENT:	Emergency Medicine ER24, Midrand, Johannesburg
PROJECT TITLE:	Demographics and Clinical Profile of Patients Transported by a South African Helicopter Emergency Medical Service
DATE CONSIDERED:	29/08/2014
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr Steven Lunt and Prof Efraim Kramer
APPROVED BY:	Professor P Cleaton-Jones, Co-Chairperson, HREC (Medical)
DATE OF APPROVAL:	01/09/2014

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.**

G Gabike
Principal Investigator Signature

Date 1/10/14

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES