Inter-facility transfers in the Cape Town Metropole by the Western Cape Government Emergency Medical Service: A retrospective, descriptive study

By

Franz Gustav Lemke

MBChB(UFS), Dip PEC (SA), MMED(Stell), FCEM(RSA), FACEM(Aus)

LMKFRA001

SUBMITTED TO THE UNIVERSITY OF CAPE TOWN

In partial fulfilment of the requirements for the degree

Master of Philosophy Emergency Medicine

Faculty of Health Sciences

UNIVERSITY OF CAPE TOWN

Date of submission: 29 January 2023

Supervisors

Dr Sanjeev Rambharose, Division of Emergency Medicine, University of Cape Town, Cape Town, South Africa; Department of Physiological Sciences, University of Stellenbosch, Stellenbosch, South Africa

A/Prof Peter Hodkinson, Division of Emergency Medicine, University of Cape Town, Cape Town, South Africa

DECLARATION

I, Franz Gustav Lemke, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

I empower the university to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

Signature: Signed by candidate …………………………………

Date: ………29 January 2023………………………

Table of Contents

List of Figures

List of Tables

Abbreviations and terms

ALS	Advanced life support
ASAP	As soon as possible
ACEP	The American College of Emergency Physicians
ANTHSA	American National Traffic Highway Safety Administration
BLS	Basic life support
CAD	Computer aided despatch
CDC	Community day centre
CHC	Community health centre
CT	Computed tomography
CTA	Computed tomography angiography
CPR	Cardiopulmonary resuscitation
ECMO	Extracorporeal membrane oxygenation
ED	Emergency department
EMS	Emergency Medical Service
EMDRC	Emergency Medicine Divisional Research Committee
EMT	Emergency medical technician
ECP	Emergency care practitioner
GDP	Gross domestic product
HealthNET	Health non-emergency transport
HREC	Human research ethics committee
ICU	Intensive care unit
IFT's	Inter-facility transfer
KDH	Khayelitsha district hospital
LMIC	Low- and middle-income country
MRC	Medical retrieval specialist
NHS	National Health Service
PICU	Paediatric intensive care unit

RXH	Red Cross War Memorial Children's Hospital
RSA	Republic of South Africa
SAH	Subarachnoid haemorrhage
SATS	South African Triage Scale
UCT	University of Cape Town
UK	United Kingdom
USA	United States of America
VRE	Vancomycin-resistant enterococci
WCGEMS	Western Cape Government Emergency Medical Service

PART 1: LITERATURE REVIEW

1.1 Objectives of literature review

- To review and describe the state of inter-facility transfers in South Africa.
- To review and describe the state of inter-facility transfers internationally, in both high income and low- and middle-income countries.
- To describe definitions, challenges, and the need of inter-facility transfers.
- To identify gaps in the literature and need for further research.

1.2 Literature search strategy

The literature was searched to identify relevant and pertinent literature. The University of Cape Town libraries database, Google scholar, PUBMED, SCOPUS and COCHRANE databases were searched. The key terms searched for in the databases were “inter facility transfers” or “inter hospital transfers”. Relevant articles identified in the references of database articles were also reviewed. Titles and abstracts were initially screened for relevance and were excluded if found to be inadequate or inappropriate. Articles published between 2000 and 31 December 2021 were included in the literature review.

1.3 Background

Inter-facility transfers (IFTs) are key components of the healthcare system. The movement and flow of patients between facilities, especially when escalation of care is needed, is a daily occurrence. In South Africa, most transfers are done by the Emergency Medical Service (EMS), especially when urgent or emergent. South Africa is classed as a middle-income country with significant resource and system challenges. That being said, South Africa boasts the most developed and busiest EMS on the continent(1). At this time there is a paucity of research regarding IFTs in South Africa and the continent as a whole.

Inter-facility transfer is defined by the American National Traffic Highway Safety Administration (NTHSA) as the following: *“Any transfer, after initial assessment and stabilization, from and to a healthcare facility"* (2). The main reasons for the interfacility transfer of patients are that they require either a higher level of clinical expertise or level of institution to manage their underlying condition. Therefore, the level of care the patient receives is usually increased(3), up to the point where the level of care matches the care required by the patient. In some instances, patients are transferred to lower levels of care for example due to financial implications (moving a patient an “in network” health care facility for insurance purposes), physician request (hospital admission privileges as primary care physician) or patient wishes (end-of-life care).

Furthermore, as stated by Kulshreshta(4), IFTs form part of the health risk vs benefit conundrum. IFTs are based on the fact that the benefit of care to the patient outweighs the risk of the transfer. Therefore, IFTs are an integral part of any healthcare system.

As published in the Western Cape Government Annual Report of 2017/2018(5), 31.6 % of the workload of the Western Cape Government Emergency Medical Service (WCGEMS) across the province is in undertaking inter-facility transfers. Inter-facility transfers are carried out by two distinct components within WCGEMS: **Ambulance Operations** and **HealthNET** (Health Non-Emergency Transport). According to the Western Cape website:

> *HealthNET (Health Non-Emergency Transport) provides transport for non-emergency patients between home and facilities, or between multiple facilities. Patients are booked using an online system that ensures that seats are allocated equitably and no patients can be overbooked*(6)*.*

At the time of analysis, there were up to 90 HealthNET vehicles operating across the Western Cape Province. The Ambulance Operations component is responsible for all other inter-facility transfers, including but not limited to all after-hours transfers, all emergency transfers and transporting patients from facilities not covered by HealthNET network, as well as responding to all primary pre-hospital emergency calls.

Primary transfers are defined as those involving moving the patient from the site of illness or injury(7). It has also been called scene transfer and would mean any location outside a healthcare facility. Secondary transfer or interfacility transfer, as discussed in this document, is the movement of patients between facilities.

The World Health Organization defines a healthcare facility as the following(8):

> *Health-care facilities are hospitals, primary health-care centres, isolation camps, burn patient units, feeding centres and others*.

Therefore, for the purpose of this document and research, IFTs between healthcare facilities include all facilities where patients first come into contact with the South African health system, whether it be a nurse-driven community centre, private General Practitioner, or a tertiary/quaternary facility.

1.4 The state of interfacility transfers at the commencement of the study period

The public healthcare needs of the Cape Town metropole are served by three tertiary centres. Groote Schuur Hospital and Red Cross War Memorial Children’s Hospital are based in the southern suburbs, and Tygerberg Hospital is in the northern suburbs of Cape Town. Mental health care needs are served by Valkenberg and Stikland psychiatric institutions, in the southern and northern suburbs respectively. These institutions cater not only for the whole of the metropole, but act as the tertiary and quaternary referral centres for the whole of the Western Cape (population 6.3 million)(9)(10).

The healthcare needs of patients are served by a network of interconnected healthcare facilities. These include secondary and district hospitals (e.g. New Somerset Hospital in Green Point and Victoria Hospital in Wynberg), community healthcare centres (CHCs and day hospitals) and primary health- care facilities (some of which are run by nurses). Currently, there are 33 district hospitals in the Western Cape(11). Of these district hospitals, ten fall in the Cape Town metropole.

The Cape Town metropole encompasses the wider municipality of Cape Town(12)

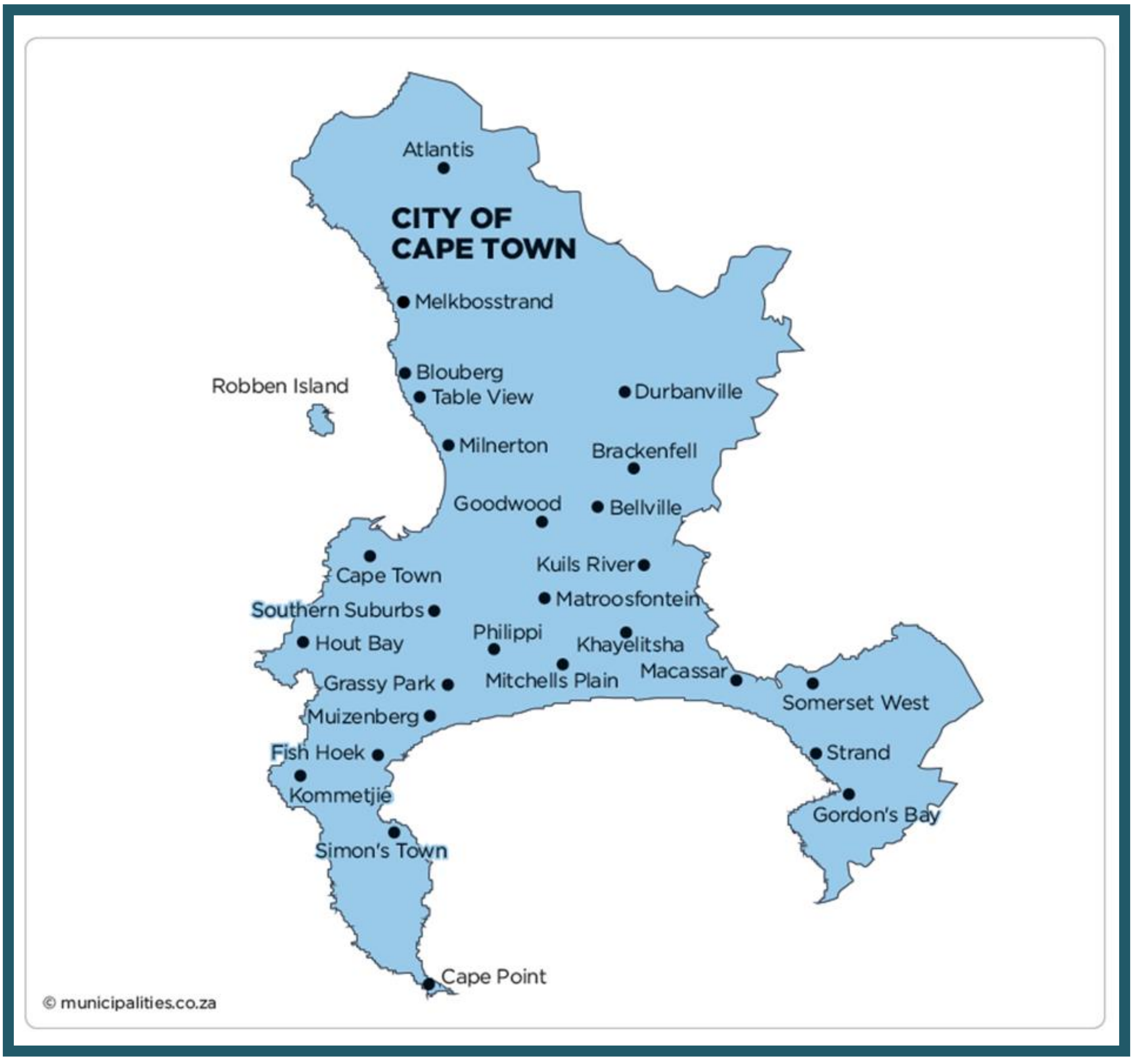

Figure 1: Map of Cape Town Metropole

The institutions that fall within the scope of the Cape Town metropole are shown in Table 1 below.

Table 1. List of facilities in Cape Town metropole

TERTIARY	DISTRICT/SECONDARY	PRIMARY CARE	SPECIALIST SERVICE	PRIVATE FACILITIES	STEP-DOWN/HOSPICE
Tygerberg Hospital	Khayelitsha Hospital	Heideveld CHC	Mowbray Maternity Hospital	Life Esidimeni Intermediate Care	Booth Memorial Step Down Facility
Groote Schuur Hospital	Mitchells Plain Hospital	Macassar CDC	Lentegeur Hospital	Melomed (Mitchells Plain) Hospital	Sarah Fox Step Down Facility
Red Cross War Memorial Children's Hospital	New Somerset Hospital	Mitchells Plain CHC	Valkenberg Hospital	Rondebosch Medical Centre	Living Hope Trust Step Down Facility
	Karl Bremer Hospital	Vanguard CHC	Stikland Hospital	Melomed (Gatesville) Hospital	Helderberg Step Down Facility
	GF Jooste Hospital	Retreat CHC	2 Military Hospital	Khayelitsha Medical Centre - GP	Conradie Care Centre Step Down Facility
	Victoria Hospital	Kraaifontein CHC	Orthotic & Prosthetic Centre	N1 City Hospital	Maitland Cottage Step Down Facility
	Helderberg Hospital	Delft CHC	Salt River Mortuary	Kuilsriver Netcare	Zandvliet Care Facility
	Eerste River Hospital	Khayelitsha (Site B) CHC	Alexandra Hospital	Vincent Pallotti Hospital	Tygerberg Trust Step Down Facility
	False Bay Hospital	Elsies River CHC	Western Cape Rehabilitation Centre	Christiaan Barnard Memorial Hospital	Baphumelele Respite Care Centre Step Down Facility
	Wesfleur Hospital	Bishop Lavis CHC	DP Marais Hospital	Durbanville Mediclinic Hospital	New Beginnings Step Down Facility
	Victoria Hospital	Michael Mapongwana CDC	Brooklyn Chest Hospital	Milnerton Mediclinic Hospital	St Joseph's Step Down Facility
		Hanover Park CHC	Tygerberg Mortuary	Melomed (Tokai) Hospital	
		Guguletu CHC		Constantiaberg Mediclinic Hospital	
		Lentegeur Clinic		Melomed (Bellville) Hospital	
		Du Noon CHC		Vergelegen Mediclinic Hospital	
		Adriaanse Clinic		Blaauwberg Netcare Hospital	
		Guguletu Clinic		Busamed Private Hospital	
		Robbie Nurock CDC		Cape Gate Mediclinic Hospital	

TERTIARY	DISTRICT/SECONDARY	PRIMARY CARE	SPECIALIST SERVICE	PRIVATE FACILITIES	STEP-DOWN/HOSPICE
		Strand CDC		Kingsbury/Claremont Hospital	
		Albow Gardens Clinic		Kuilsriver Hospital	
		Brackenfell Clinic		Louis Leipoldt Mediclinic Hospital	
		Gustrouw CDC		Maitland Medical Centre Clinic -GP	
		Ikhwezi CDC		UCT Private Academic Hospital	
		Matthew Goniwe CDC		Bellville Medical Centre	
		Maitland Clinic		Cape Town Mediclinic Hospital	
		Nomzamo Clinic		Panorama Mediclinic Hospital	
		Ravensmead CDC			
		Scottsdene CDC			
		Seawind Clinic			
		Woodstock CHC			
		Durbanville Clinic			
		Town 2 CDC			
		The Saartjie Baartman Centre			
		Philippi Clinic			
		Ravensmead Clinic			
		Ruyterwacht CDC			
		Khayelitsha Clinic			
		Mamre CDC			
		Grassy Park CDC			
		Heideveld Hospital			

Patients may present primarily to any of these institutions, and their healthcare needs will be addressed at the appropriate level of care. This interconnected system requires a large amount of inter-facility movement, as patients are transferred until their healthcare needs are met by the treating institution. It is not uncommon for a patient to be transferred three times in one acute admission, especially when patients present to the primary care centres with complex medical requirements(13). As described by Majosi et al(14)(15), South Africa faces a quadruple burden of disease in communicable and non-communicable diseases, obstetric disorders and trauma. This high burden of disease leads to the fact that complex, acutely unwell patients commonly present to primary care facilities, requiring emergency transfer to better resourced centres. A patient with a suspicious headache requiring an urgent after-hour computed tomography angiography (CTA) scan to exclude a subarachnoid haemorrhage (SAH) may require transfer as follows:

i. Community health care centre to district hospital for clinical review after presenting to the primary care facility as entry point to the public healthcare system.

ii. District hospital to tertiary centre for emergency imaging.

iii. Transfer back to the initial referring district hospital after CTA imaging excluded an SAH.

These urgent and emergency inter-facility transfers add a significant additional burden to an already stretched EMS system. Not only are ambulances with appropriately trained Emergency Medical Service providers diverted from primary calls to make the transfers, sometimes they may spend most of their shift driving one patient around the metropole, as per the hypothetical patient mentioned above.

As per the white paper on the proposed National Health Insurance policy (16), the South African health system is split into a public and private healthcare service model. The public model is fully funded by the government and covers approximately 84% of the South African population. Private care is a profit driven, fee for service model. The bill is footed by the patient, either through their privately sourced medical aid or through out-of-pocket payments. The private model covers roughly 16% of the population but is responsible for almost 50% of the total health expenditure. South Africa currently spends 4.1% of gross domestic product (GDP) on public health services, much less than the average of 6% for other middle-income countries. This public / private models also extends to the prehospital environment, where often medical aids will have a stated, preferred ambulance provider to facilitate IFTs. In some provinces, the private sector is contracted by the public sector to provide advanced life support (ALS) or critical care IFTs where there are no public ALS resources available.

1.5 South African and African context

The South African health care system is built on a tiered approach. As per the 2010 Comprehensive Service Plan(17), the levels of care in South Africa are defined as follows:

1. Level 1 (*primary)* is delivered by general practitioners (GPs), or primary healthcare nurses, supported by specialist family physicians where available.
2. Level 2 (*secondary)* is led by specialist teams including surgeons, paediatricians, and emergency physicians.
3. Level 3 (*tertiary*) care is delivered by specialists working in sub-specialty fields including nephrology, cardiology and vascular surgery.
4. Level 4 (*quaternary*) care is delivered by teams of sub-specialists. This level of care is at the cutting edge, may be extremely expensive or resource intensive, and is usually only available in one or two institutions nationally. Level 3 and Level 4 are usually grouped together.

Patients are transferred between facilities until their need of care is met by the level of care provided by an institution. This system lends itself to a large number of transfers in order to provide adequate healthcare to all those in need.

Literature on inter-facility transfers in the South African context is limited. Schoon(18) looked at the impact of inter-facility transfers on obstetric patients in the Free State. After an investigation and identifying of a critical gap in 2011, 48 ambulances (18 dedicated to obstetric care), were introduced to the Free State Provincial Emergency Medical Service. The maternal mortality decreased by 44% (279/100 000 live births to 152/100 000); the mean ambulance despatch time interval decreased by +/-30% (32.01-min to 22.47-min) and the number of vehicles despatched within one hour increased by 6.5% (84.2% to 90.7%). Although seemingly impressive results, they were likely due to additional resources (he introduction of more ambulances and crew) in the system rather than optimizing existing services.

In the Western Cape, De Vries et al(19) looked at the impact a dedicated obstetric and neonatal transport service (*'flying squad')* on transport times within the Cape Town metropole. Maternity call response performance (assessed at 30 minutes post call to EMS) increased from 30.3% to 72.9%. (This metric measures the time interval between when a call is received at the metro call centre and an ambulance is dispatched on the job). Furthermore, the flying squad led to a reduction in a total pre-hospital time from 177 to 128 min for neonatal transfers. For primary response in urban centres in the Western Cape, Priority 1 (P1) medical emergency ambulance arrival time targeted to be within 15 minutes or less from time of call, 80% of the time(20)(21). All other incidents targeted response within 60 minutes. Patients were classified as P1 if they were triaged to RED or ORANGE on the South African Triage Scale (SATS)(22). Certain discriminators will automatically assign a value of P1 to a patient, even when their other parameters are within normal range, for instance ‘obstetrics’.

The South African Triage Scale (SATS) classification was created in 2012 by a joint effort between the Peadiatric Triage working group and the South African Triage group(22, 23). The benefit of the implementing SATS according to the investigators is summarized below:

1. Expediting time critical and life-saving care.
2. Ensuring that patients are prioritised according to their medical urgency.
3. Improving patient flow through the ED.
4. Improving patient satisfaction levels.
5. Decreasing overall length of stay of patients.
6. Facilitating streaming of less urgent patients.
7. Providing a user-friendly tool for health care workers at all levels.

SATS has been well validated in the South African context. Rosedale et all(24) analysed 589 patients triaged over 1 month in a rural ED in Kwa-Zulu Natal. They found an over-triage rate of 4.3% and under-triage rate of 4.4%. In a small validation study by Twomey et al(25), 5 emergency physicians and 10 enrolled nursing assistants trained in the SATS retrospectively triaged adult emergency centre vignettes. Sensitivity was 75%, specificity 91% with a positive predictive values of 74% and negative predictive value of 91%. Under triage occurred in 10% and over triage in 15% of cases.

Goldstein et al(26) looked at the accuracy of nurse performed triage in a tertiary hospital using SATS, and found that triage category allocations were correct 68.3% of the time. Of the incorrect category assignments, 44.4% were promoted and 55.6% demoted. Trauma patients were more likely to be incorrectly promoted.

Outside of the Republic of South Africa, the validity of SATS was assessed by Dalwal et al(27) in Afghanistan, Haiti and Sierra Leone. The study was done in four Medecins Sans Frontieres (MSF) supported emergency departments (2 trauma only, one mixed and one paediatric site only). Good validity was found in the trauma sites with ED outcomes for “green” and “red” patients matching the predicted outcomes in 84-99% of patients but in the mixed ED group, 87% of non-trauma and 94% of trauma patients were over triaged. In the paediatric only site76% of non-trauma and 100%

of trauma “green” paediatric cases were under triaged. The investigators noted that in malaria endemic areas (most of South Africa is not), the addition of haemoglobin as a discrete discriminator may improve the under triage of paediatric patients presenting with malaria.

Khayelitsha is a suburb on the Cape Flats, one of the poorest and highest populated areas of Cape Town(10). Hunter, Lahri and Van Hoving(28) published a study with focus on patients treated in the Khayelitsha District Hospital (KDH) resuscitation area during 2016. In their six-month review, they found a male predominance, with male patients outnumbering female patients by 1367 (58.8%) to 957 (41.2%). Most patients fell into the high acuity triage colours, with 641 red patients (27.6%) and 985 orange patients (42.4%), which can be expected in the resuscitation bay. Of note some 511 patients (21.9%) were transferred Tygerberg Hospital, the tertiary centre. Another study by Moller et al(29) in 2015 looked at the mode of arrival of patients in the KDH resuscitation bay, and found that 27.7% (n=61) arrived by ambulance from another facility (so were IFTs) and the rest primary responses 72.3% (n=159).

In 2007, Wallis and Twomey(30) conducted an eight-week prospective, observational study in Cape Town, describing the nature of patients presenting to four community health centres. On the whole, the clinics sent home 91.5% (13,047/14,253) of their patients, and only referred 7.6% (1,088/14,253) onwards, which nevertheless represents a substantial number of patients requiring IFT on a daily basis – around 30 patients a week from each facility (and there are 12 similar sized CHC in the metropole).

In the eThekwini Health District in Kwazulu-Natal, Ashokcoomar and Naidoo analysed inter-healthcare facility transfer of neonates(31). They found that in 30.8% of the inter-facility transfers there were deficiencies with equipment noted.

Elsewhere on the continent, Tanzania had an embryonic EMS at the time of writing. A small study by Kuzma et al(32) looked at the pre-hospital experience of trauma patients in Tanzania. Theoretically, the health service in Tanzania includes free ambulance service for the interfacility transfer of patients, but in practice there were many obstacles including limited number of ambulances and high fuel costs. Patients reported that transfer times varied from less than an hour to several days (45 min to five days, with most within the first 24 hours of injury). Furthermore, care was found to be sub-optimal while patients were in transit: clinical personnel rarely accompanied patients, and when a nurse did accompany the patient, they sat in the front of the ambulance.

Sultan et al(33) performed a descriptive study in Ethiopia, looking at the patient demographics and reasons for IFTs in Addis Ababa. They reviewed ambulance data for a six-month period and found that IFTs accounted for the highest ambulance use in Addis Ababa (n = 702, 87.6%). The most common reasons for IFTs were pregnancy related (n = 446, 63.5%). The authors bemoaned the disproportionate use of ambulances for inter-facility transfer and suggested increasing the number of ambulances available on shift, allocating ambulances to either IFT or primary response, and improving the infrastructure and roads to allow more ambulances to be available for primary response. This is against the background of Ethiopia being amongst the worst country in healthcare accessibility in sub-Saharan Africa, with 30% of the population [30-million people] living more than two hours away from a hospital(34).

There is a glaring lack of research on the African continent when related to IFTs. Outside of the Republic of South Africa, the EMS and IFTs systems are largely still in the development phase, with all the expected teething challenges (training, staff retention and equipment) and competing priorities (primary response vs transfer of stabilized patients between institutions). There is strong evidence that a robust IFT systems are required in Africa, especially in assisting to overcome the so-called “tyranny of distance”, a challenge most of the continents’ rural inhabitants face daily. Furthermore, there is good evidence that shows where IFTs do occur the service is suboptimal. Delays in transport, equipment failures and inadequate number of available ambulances, compounded by staffing challenges (inadequate qualifications and training, shortage of skills, vacancies in critical areas) lead to sub-optimal patient care enroute when IFTs do occur.

1.6 International context

Farther afield, Robinson et al(35) made a descriptive examination of IFT in Ontario, Canada. They found that there are more than 1000 IFT journeys daily (almost 400 000 annually) in the Province of Ontario, and more than 80% of them are non-urgent. This may not relate directly to the South African context, where many more IFTs are likely for urgent and emergency patients. Furthermore, they found that 24.3% of IFTs, amounting to 85 000 patients annually, at a cost of C$283 million (in 2003), were used for dialysis and physician appointments, and return trips home. As the personnel employed for the IFTs were despatched via the same system used by the 911 emergency calls, the resources used for IFTs were fully equipped ambulances and highly trained EMS personnel. The authors conclude with the following problem statement: “*These results call into question the use of sophisticated, highly trained, expensive patient transfer resources to provide routine medical services in Ontario.”*

In a further study from Canada, Bergeron et al(36) found that 28% (n = 125/444) of their IFTs from a rural hospital were to a referral facility with access to a CT-scanner. The authors conclude that having a CT-scanner at the rural facility would significantly decrease the number of IFTs, thereby reducing the workload on the local EMS. Where to place key resources such as CT scanners in an international problem facing healthcare systems(37).

Katsaragakis et al described IFTs in Greece(38). They looked at IFTs of trauma patients in the absence of a formal trauma setting, as Greece does not have a formalised trauma system. They found that 86.3% (7359/8524) of patients were treated at the initial facility, and only 13.7 (1165/8524) transferred. Of note is that only 0.7% were double transferred (60/8524). The needs for IFTs were assessed according to each facility's availability of the following five resources: CT-scanner, ICU, neurosurgical, orthopaedic, and vascular surgeons. Facilities with none of the resources were responsible for 34.3% of all the IFTs. Interestingly, facilities with three or less were responsible for the most transfers, at 43.2%. Due to the fact that Greece is fairly urbanised, and more than 40% of the Greek population live in only two cities [Athens (pop 3,753,783) and Thessaloniki (pop 1,084,001)](39), it would appear that IFTs are not a large burden to the Greek health system (only 13.7% of patients are transferred).

Alexopoulos et al(40) described the state of IFTs in the western part of Greece through a descriptive study over a nine-year period (2003–2011). In this time period there were more than 20,000 IFTs, and ambulances travelled more than 1.5 million kilometres annually. The most commonly transferred patients were internal medicine (16.7%). Cardiology (13.4%) and surgery (11.9%) were the other top reasons for transfer. Interestingly, ten percent of journeys were made in order for patients to receive diagnostic imaging (mostly CT scans, followed by MRIs and ultrasounds).

The National Health Service (NHS) in the United Kingdom (UK) broadly categorizes IFTs into the following four categories(41):

- IFT Level 1 is reserved for exceptional circumstances where a patient is in need of acute, life- saving assistance from EMS as well as the need for emergency transportation. Examples would be cardiac arrest, anaphylaxis or obstetric emergencies.

- IFT Level 2 is called on the basis of the clinical condition of the patient and the likelihood of the patient requiring further care at a referral centre, rather than on a set clinical diagnosis. This includes life, limb or sight threatening conditions requiring transfer, or patients requiring specific interventions not available at their local institution, including stroke thrombolysis, mechanical thrombectomy or emergency surgery.

- IFT Level 3 is categorised as patients who do not require life or limb saving interventions but require transfer to a higher level of care urgently. The timeframe for the response is set between 30 minutes to two hours. Examples would be patients undergoing an acute mental health crisis or transfers to create critical care beds.

- The IFT Level 4 designation is for patients who do not fit the definitions of Level 1 to 3 above, but still require urgent, not emergency, transfer. Patients transferred to inpatient wards for further management, undergoing elective procedures or further diagnostic investigations fall into this group. Repatriation, or transfer to step-down facilities, are not included in this framework.

The Lebanese approach was described by El Sayed et al(42). After the set-up of a transfer centre at one of the largest tertiary centres in Beirut, Lebanon, a retrospective review over four years was done by the researchers. Some 4100 transfer requests were managed by the centre over the four-year period: about three transfers per day. Most IFTs were referrals from peripheral facilities, 56.5% (2317/4100). Of these, 71% were adult patients. There is no mention made of the level of training of the personnel facilitating the IFTs, but 61.6% (1414/2317) of the incoming patients were referred for ICU admission.

In Taiwan, IFT is exclusively performed by the private sector, on a fee-for-service basis: primary response is by the public ambulance service for free. Huang et al(43) looked into the IFT of patients in Taiwan and found that the care was inadequate. They found that more than half of their patient sample (n=486) met the criteria for ALS transfer, but none were treated by ALS providers. Furthermore, of those that were transferred meeting the BLS criteria, 5.4% of them deteriorated en-route. They postulate that the lack of paramedics in the private sector leads to inadequate care on IFTs.

Hernandez-Boussard et al(44) looked at IFT nationwide in the USA. The researchers looked at 1,397,712 transferred patients compared to 31,692,211 non-transferred patients using a nationally representative sample of US hospitalisations. Their analysis showed that patients transferred between facilities had inferior outcomes to non-transferred patients. Patients that were transported had higher risk-adjusted mortality, longer hospitalisation (13.3 vs 4.5 days) and more complications, including pressure ulcers, respiratory failure, thrombo-embolic events and sepsis than non-transferred patients. The authors state that deterioration and failure to improve may be the reasons for the IFTs, which would bias the transferred group with more complications. Interestingly, males were more likely to be transferred than females. Iwashyna(45) has likened the IFT system in the USA as a so-called ‘Facebook’ network, described as a complex, intermeshed system, where hospitals commonly transfer critically ill patients to a median of four other referral healthcare facilities in their region(46). This is in stark comparison to the South African health system described above where most facilities have only one higher level referral centre.

As discussed, IFTs are a conundrum shared by healthcare systems worldwide. Some of the specific challenges may be easier to fix, for example adding a CT-scanner to a small regional hospital in Canada may reduce the amount of IFTs by almost a third (28%). Would taking the patient to the “right” institution initially save the IFT of critically ill patients to a median of four hospitals, as mentioned in the US study? Or is the UK on the right track where urgent and emergent IFTs are flagged on the same level as primary calls, decreasing IFT waiting times and improving care? Each healthcare system faces their own unique IFT challenges, and only by digging down into the local specifics will it be possible to identify and implement system wide improvements.

1.7 Inherent risks of IFTs

IFTs are not without risk of morbidity. Suicide by jumping out of the ambulance has been well described(47), and transporting patients with altered sensorium or behavioural disturbances could put both the ambulance crew and the patient at risk. An increasing number of papers question the value of IFTs – both from their therapeutic impact and drain on resources: Janiak et al(48) found in a small study done in Kansas, United States of America, looking at radiological imaging in a tertiary centre of patients transferred from a smaller institution, that 26.5% (9/34) of the repeated imaging was deemed inappropriate. Bertrand et al(49) looked at the inappropriateness of both repeated laboratory and radiological tests, in a tertiary care emergency department (ED) in Switzerland. He found that 99.5% (197/198) of the laboratory and 73.6% (39/53) of the radiological tests were inappropriately repeated. They found that over half (53.7%) of the patients that had an IFT from another ED had a repeat procedure within eight hours of arrival, and in most cases (94%) the repeated procedure was unnecessary. This may also reflect the problem of data sharing between health care institutions, where different hospitals are unable to access imaging across different health records, leading to repeat of radiological imaging, rather than caused by IFTs. Furthermore, there is a risk of spreading an infectious disease, even more relatable in the

Covid era. Trick et al(50) described how vancomycin-resistant enterococci (VRE) was spread to multiple regional facilities in the USA due to inter-facility transfer of colonised patients.

The American College of Emergency Physicians (ACEP) endorses the following guiding principles regarding IFTs(51).

- Patient wellbeing and health is the overriding goal.
- Applicable laws should be followed, and patients should be stabilised within the capacity of the facility before transfer.
- The transferring facility should obtain documented informed consent for the transfer whenever possible and should inform the patient of the risk vs benefits of transfer.
- Mode of transportation used of IFT should be at the discretion of treating provider, and be based on clinical scenario, assets available and patient preference.
- There should be an accepting physician at the receiving facility.
- All pertinent medical records and investigations should accompany the patient or be transferred digitally ASAP.

Mueller et al(52) performed a retrospective cohort study in United States, comparing 53,420 patients who required inter-facility transfer, to 53,420 propensity-score matched patients who were managed at a single institution. The cohort transferred, had higher healthcare costs, increase length of stay and lower odds of being discharged home. Not only are IFTs costly in time and manpower, but there is also a distinct probability of increased patient morbidity and causing harm with each transfer and should therefore not be decided lightly.

Finally, Blakeman(53) and Iwashyna(45) summarised the risks and benefits of IFT as follows:

Major risks during IFT:

- Complications that occur during transport.
- Handover to a new team at receiving facility.
- Loss of continuity of care.
- Anxiety related to new environment.
- Family often far away.

Benefits of IFT:

- Access to higher levels of care, definitive treatment and equipment.
- Access to specialised hospitals i.e., dedicated burn centres or paediatric hospitals.
- Review and optimization of treatment plans.
- Peace of mind that the care received is the best possible.

As patients traverse their individual journeys through the healthcare system, the overarching goal should be to deliver adequate and appropriate care, at whatever level of care required for the patient. IFTs are not without risk, but in order to treat all patients appropriately and effectively, they are absolutely unavoidable and a cornerstone of most health systems, both in the developing and developed world.

1.8 Inter-facility transfers in the critical care setting

Critical care IFTs are uncommon and due to their inherent complexity, adverse events are common. Blakeman(53) found that the most common adverse events with IFTs were equipment malfunctions, echoing Ashokcoomar's study in Kwazulu-Natal (31). Singh et al(54) looked at critically ill intubated patients undergoing IFT in Canada. They found that new hypotension was the most common new symptom to occur (11.8%) on IFTs, with additional vasopressor requirement (8.8%) and new episodes of hypoxia [saturations less than 88%] occurring in 5.7%. There were also 55 major resuscitative procedures noted in 25 of the IFTs, including CPR, needle thoracostomy, cardioversion and pacing. Singh also states that critical events occurred once in every 15 transfers (6.7%)(55). Srithong(56) found that in a review of critically ill patients undergoing IFT in Thailand, almost a third (28.7%) of patients transferred deteriorated. The authors classified the clinical deterioration into haemodynamic and respiratory instability or neurological alteration.

Eiding et al(57) looked at the reporting of serious adverse events occurring during IFTs in Norway. The authors sampled the clinical notes of two separate transport services after completion of each IFT, screening for adverse events. An expert group evaluated the incidents and decided on whether the event had to be reported in the hospitals reporting system. After one year, the authors sampled the hospital records to confirm whether the adverse events were reported. The results were dismal. Of 455 IFTs of critically ill patients, there were 294 incidents rated as requiring reporting. The breakdown was medical (15%), technical (25%), missing equipment (17%) and communication difficulties (42%). Only three (1%) of these incidents were formally noted in the hospital reporting system. The authors bemoaned the potential loss of learning, and resulting errors repeated with no improvements.

Making the case for specialist retrieval teams, Kang et al(58) described their experience transferring patients with cardiogenic shock on extracorporeal membrane oxygenation (ECMO) between facilities. In their case series, albeit a small one (n= 11), there were no adverse events and no power or equipment issues. Pranzy Oza(59) describes the Indian experience with ECMO and breaks down the potential adverse events to be expected with ECMO IFTs into: ECMO related (equipment issues, bleeding, leakage and disconnection), patient related (including haemodynamic instability, aspiration, hypothermia) and technical issues (including oxygen failure, vehicle breakdown, human and drug errors).

Eiding(60) performed a qualitative study by interviewing the clinicians undertaking IFTs in Norway, including doctors, nurses and ambulance personnel and found that personnel felt pressured by senior colleagues to participate in transports. Staff expressed anxiety at the common situation of being alone on transports with ill patients, and that there was a lack of procedures and checklists for support. Furthermore, IFTs were described as time-consuming, resource-intensive, with challenging logistics and potentially unsafe for patients. Eiding strongly motivated for a national transport standard, built on consensus from experienced personnel, and demanding appropriate levels of competence for each patient and improving patient safety.

Although critical care transports make up a small part of all IFTs done, due to their inherent complexity and intensive resource requirements they utilise significantly more staff and equipment than general IFTs. The risk of adverse events also exponentially increases due to the higher complexity of patients (patients requiring critical care transfers are usually more acutely unwell and may be unstable) and high pressure environment the crew members need to function in. One way to mitigate the inherent risk posed by critical care IFTs is by utilizing dedicated critical care transport teams for high-risk IFTs. These high-performance teams are at the cutting edge of knowledge, skills and training and are equipped with all required equipment. Another mitigating factor is organisational quality control. This could be medical oversight, for example having relevant specialists available for trouble shooting via phone or telemedicine if needed by the team doing the IFT. Less clinical but just as important are audits and robust risk reporting systems which are crucial in learning from mistakes and increasing an organizations institutional knowledge.

1.9 Inter-facility transfers in the paediatric setting

Unsurprisingly, using specialised teams to transport children for IFTs decreases the number of adverse events(53).

Orr et al(61) showed that specialised transport teams made a large difference to the outcomes of paediatric IFTs. In a study looking at 1085 IFTs, 94% by specialist retrieval teams vs six % by non-specialised teams, they found that adverse events were more common with the non-specialist team (61% vs 1.5%). This included hypotension, the need for CPR and airway-related events. Mortality was also lower in patients transferred by the specialist retrieval team (9% vs 23%). According to Blakeman(53):

> *"The point of specially trained teams is to take the ICU to the patient in a controlled fashion, not rushing the patient to the ICU*."

The Canadian Paediatric Society has a positional statement on IFTs of critically ill new-borns(62). Their recommendations are as follows:

- Creation and support of dedicated neonatal and paediatric retrieval teams based at tertiary hospitals, with expertise in the care of new-borns.
- The optimal new-born transport team is described as a registered nurse working together with either another registered nurse, or an EMT/paramedic with expertise in neonatal transport. Medical oversight is by a neonatologist with retrieval experience.
- Appropriate training including airway treatment should be undertaken.
- Transport teams should be adequately equipped and supplied to provide critical care.
- Clear lines of control and communication should be present.
- A database should be kept of all cases for benchmarking, quality improvement and research.

In a study done on neonatal transfers in Johannesburg, South Africa by Thwala(63) found that most inter-facility transfers were carried out by ALS paramedics, either from public or private institutions. Only 3% were transferred by ALS/doctor combinations. There are no dedicated specialist neonatal retrieval teams in the Johannesburg metropole. The mortality rate was found to be 7%. This is in context of all but one of the neonates retrieved having a birth weight of more than 1000g and gestation of more than 28 weeks, as based on local standards of care. A number of adverse events were also reported, with over a fifth of patients arriving with hypoxia (21/96) and 19% with hypotension (7/36). [Only 36 of the 96 transported patients had blood pressure measured on admission]. Furthermore, a total of 21% (20/96) of infants were found to be hypothermic on admission, which may speak to either inadequate equipment (incubator) or inadequate training of the transport teams. Interestingly, Haydar et al(64) wrote a literature review looking at adverse events during *intrahospital* transport, and found that up to 48% of neonatal intensive care patients became hypothermic while being transported within the hospital for either diagnostic or therapeutic interventions.

Ashokcoomar(65) did a qualitative survey of ALS paramedics to better understand the neo(natal transfer process and challenges faced by ALS providers in South Africa. One of the main themes to come out of the survey is that dedicated neonatal and specialised teams need to be developed. Furthermore, lack of equipment and obsolete or malfunctioning equipment is commonplace. In the words of one of the ALS paramedics:

> *"Most of our incubators do not work properly. They don't retain heat . . .Sometimes we put a hot water bottle inside, I don't know if that's allowed but we try and keep the heat . . . It's not only the incubator, our ventilator does not work properly either. Often the battery just dies, modes go off and we cannot do the settings according to the hospitals . . ."(60)*

The authors highlight the need for development of a standardised approach to neonatal IFT in South Africa, by creating dedicated neonatal retrieval teams who are adequately equipped and supplied to perform their life-saving work.

Vincent-Lambert and Wade(66) performed a qualitative study, interviewing multiple role-players involved in IFT role in Johannesburg. The study investigators interviewees included paediatricians at both a primary care facility and tertiary institution, an ALS paramedic, nurse practitioner, and both an EMS manager and facility manager. Once again, a major theme from the study was lack of appropriate equipment. Not only was the lack of functioning equipment highlighted, it was stated by the EMS manager that "We're insufficiently equipped to deal with paediatric emergencies on a daily basis". Other issues highlighted by the study were poor communication between the different role players, time delays and low levels of education and training of ambulance attendants.

The issue of having dedicated paediatric critical care teams was discussed by a task team from the Society of Critical Care Medicine and the World Federation of Paediatric Intensive and Critical Care Societies(67). A Delphi statement that motivated for each paediatric intensive care unit (PICU) to have its own dedicated retrieval team, with its own equipment and rigs did not meet consensus agreement, with less than 33% of the panel in agreement. The panel felt that quaternary and specialised PICUs should have a dedicated critical care retrieval team, but that tertiary and regional PICUs could choose to outsource the service to a retrieval service with paediatric emergency and critical care skills.

Two qualitative studies looked at the experience of caregivers accompanying their ill children on IFTs. Davies at al(68) looked at whether parents should accompany their critically ill children during transfers in the UK. They did two audits (2002 and 2004), totalling 279 paediatric transfers, collecting relevant data using questionnaires. Interestingly, most staff members were not at all or minimally stressed by the presence of a caregiver (96% in 2002 and 98% in 2004). They also reported no or little difficulty in performing interventions during transfer. The most common interventions were noted as administration of sedation (26%) or a fluid bolus (10%), initialising an inotrope infusion (7%) and endotracheal tube suctioning (5%). The rate of adverse events was impressively low at 3.9% (11/279), and interestingly over 50% of the events were not patient related. Thrice equipment failed (monitor and ventilator, and infusion pump batteries). Mother-related adverse events were the most common and related to travel sickness, verbal abuse and a panic attack. This would go to show that as in the resuscitation room, allowing the caregivers to be present is generally a good idea.

Jones et al(69) looked at the patient experience during referral and transfer in Cape Town. The investigators wanted to understand what caregivers' experiences of care were, in order to identify barriers to timely and good quality care. Interestingly, caregivers seemed to be more dissatisfied with delays to transfer when it was an inter-facility transfer than a primary call and felt that their children were not appropriately prioritised according to the severity of their illness.

The following is an excerpt from Jones et al, with a caregiver stating that both she and a nurse had identified the need for urgent transfer of her child, but to no avail.

> *I asked the sister, "When is the ambulance coming?" [She said] "No, they're on their way. They're on their way." Every time an ambulance would arrive, but they wouldn't take me . . . Okay, the one [nurse] checked on him a lot and they said. . . "Mummy don't worry, but this child isn't well. Can't they send an ambulance quickly or if the next one comes, send you with it?" I said, "I don't know sister. . ." (>5 years, septic shock, died prior to PICU admission).*

As stated by Horowitz(70) "Providing critical care to patients in a transport environment is very different from providing this care in the intensive care unit or the emergency department". Just as important as retrieval teams are the logistics around them. Clear paediatric related guidelines and referral pathways are critical. Genovesi et al(71) looked at paediatric transfer policies in emergency departments in the United States of America in 2013 and found that a third of hospitals (2623/3792) surveyed did not have any written inter-facility transfer guidelines or agreements, and only half of the institutions had appropriate comprehensive paediatric guidelines. Yock-Corralles et al(72) looked at critical care paediatric transfers in Latin America, via surveys covering 19 countries. Most physicians surveyed (67.45%) stated that there was no standardised paediatric critical care transfer system. Only 30.7% of those surveyed reported the exclusive use of paediatric critical care retrieval teams. Specific, targeted paediatric critical care transport training was only reported in 55.6% of responses, and availability of required equipment in 67.7%. This would evidence the fact that lack of communication and standardised care is not just a South African problem, but universal.

As with critical care transfers, paediatric IFTs are inherently more challenging than general IFTs. This complexity exponentially increases when *paediatric critical care* IFTs are required, as the margin of error is so small when dealing with critically unwell children. Once again, it is shown that dedicated, high performance teams make an immense difference in facilitating these high risk IFTs, not only in mortality and morbidity, but in cutting down the sheer number of adverse events occurring. Dedicated transfer teams are also expected to be intimately familiar with their critical care equipment, and in this case, familiarity breeds excellence, as it follows that the equipment would be well maintained and fit for purpose. Once again, the importance of quality control is highlighted, with clear written guidelines and medical oversight sorely lacking in most jurisdictions. As we know, when dealing with paediatric patients it is critical to take into account the needs of the caregivers. Keeping the parents / guardians up to date with the evolving situation, treating them with the respect required and addressing their needs and/or concerns is extremely important in facilitating safe and efficient transfers.

1.10 Optimising interfacility transfers

It is clear that there are multiple variables involved in transferring patients between institutions. Bosk et al(73) and Iwashyna(45) broke down the process of IFT into the following four components.

1. *Identifying transfer-eligible patients*

   This included chief complaints, triage and knowing the capabilities and deficiencies of the local institution. Also included is the probability of patient deterioration and the requirement for higher level of care later in the admission. Patients' ages may also be relevant, as some facilities do not admit paediatric patients for example.

2. *Identifying a destination*

   Transfer policies and written transfer guidelines between institutions are critical, and as discussed earlier as shown by Genovesi(71), not always in place. Patient preferences and pre-existing patient/doctor relationships may also result in a change to the normal referral pathway. Interestingly, Unnikrishnan et al(74) looked at the spatio-temporal structure of the US critical care network, trying to ascertain how often and to what degree institutions need to divert from their 'primary transfer destination'. If patients are diverted, for example when the primary ICU is full, they would divert to their secondary institution (which is likely to be a primary transfer destination for other institutions). This results in a so-called 'cascade' of multiple institutions unable to use their primary transfer facility due to the single, initial event. In their data, the total number of cascades accounted for 10,208 transfers (1.33%). Further analysing will look at the reasons and the nature of the cascades.

3. *Negotiating the transfer*

   Communication is the major component when negotiating transfers. Ensuring closed loop communication with the appropriate clinicians communicating directly at both ends of the IFT route is vital. Communicating with the appropriate person is crucial. Thakur et al(75) showed that 97% of inappropriate orthopaedic referrals to a Level 1 trauma centre in the USA were not discussed with the admitting on-call orthopod, but only with the ED. This meant that in 52% (112/216) of the transfers to the trauma centre, resources were wasted by doing unnecessary transfers, which could have been prevented with effective communication.

4. *Accomplishing the transfer*

   This is the nitty gritty of the IFT. Staff availability, skill level and equipment are important variables in order to get the IFT accomplished safely and effectively.

Iwashyna et al(76) has described the likely next step in IFT for large metropolitan areas is by using so called 'guided' inter-facility transfers. Iwashyna describes guided transfers as those following: "a strategy of 'guided transfer' that integrates public quality information into the critical care transfer decisions". This would mean incorporating, for example, the 30-day mortality, available for acute myocardial infarctions and pneumonia, or the 'Leapfrog evidence-based survival predictor for surgeries' in referral decision making. No longer would inter-facility transfers be a hierarchal system. When there is more than one appropriate higher-level institution available, the decision on which facility to refer to might rest on their published statistics and proven success in dealing with the relevant pathology afflicting the patient. This would mean that an institution with excellent 30-day mortality rates in for example the management of pneumonia would be the preferable receiving institution instead of another institution with less impressive outcomes. We can only wonder how much this would influence the so called 'cascades' described by Unnikrishnan(74) in the paragraph above.

Currently, the dispatching of IFTs is mostly still under human control. Most ambulance services are using a computer aided despatch system(77)(78). This modality results in the dispatcher being able to have a 'helicopter view' of the status and location of all 'assets' under their control. The CAD provides data displays and relevant tools to assist the human despatcher in assigning assets to complete appropriate jobs as efficiently and effectively as possible. Attanasio et al(79) describes a despatch management system used by a courier company in London. Real-time fleet management systems dramatically reduce the requirements of human supervisors, leading to increased courier efficiency and decreased cost. It is generally accepted that human controllers are able to manage a maximum number of 30 couriers at one time, due to the massive informational complexity posed by the system. Some of the constraints listed by Attanasio can be extrapolated to healthcare, as below

- Compatibility between the job and the vehicles.
- Pick-up deadlines.
- Pick-up time windows.
- Vehicle capacity.

As can be seen in the Figure 2 below published by Attanasio (79), the larger a company scales with more assets to despatch, the cheaper and more cost-effective the despatch management system becomes.

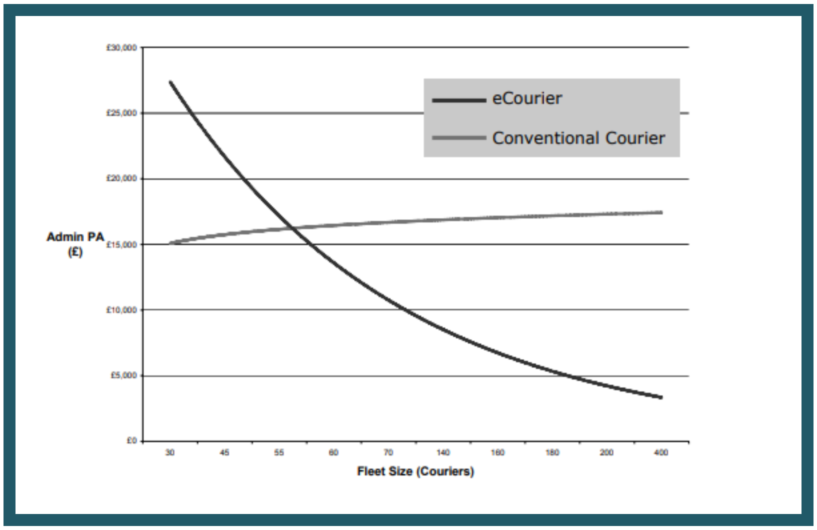

Figure 2. Administration cost per courier per year. From Attanasio et al, Real-time fleet management at EcourierLTD

The healthcare system may have a lot to learn from the private courier business in efficient management of allocating available assets, because in essence that is what an IFT is—a dedicated, reliable, and appropriately skilled resource to ensure safe transfer of a valuable commodity between two responsible and held-accountable entities. IFTs are not going away, and the faster we find a safe, effective, and efficient universal standard, the better for the commodities transported—our patients.

1.11 Discussion

The premise behind IFTs is pretty simple and straightforward. In essence, it comes down to moving a precious cargo from point A to point B, with the cargo arriving in the same condition as when the mission commenced. The trick to IFT is managing the multitude of variables faced with each transfer. Matching patient need with the correct vehicle type, with the appropriately trained staff and skill mix onboard, further ensuring that the vehicle is well equipment with necessary functioning equipment and doing this at any time of day or night, while racing against the clock; and finally doing it in a resource efficient way to maximize the number of transfers required; therein lies the challenge.

The literature describes how common equipment issues are. From having to work with faulty equipment, to the human factor of forgetting crucial instrumentation or batteries, there is a myriad of different ways that equipment issues impact transfers. This makes the case for rigorous and protocolised approach to transfers and equipment logistics, using checklists and sealed pre-packed bags for procedures less commonly done (eg. RSI bag, intercostal catheter bag).

Evaluating the evidence that we have described in this review, it is difficult to justify not having specialised critical care retrieval teams, especially for neonates and critically unwell children. This should be the gold standard. Financial cost is a significant factor, but as has been shown in Cape Town, South Africa, with the success of a dedicated obstetric and neonatal transfer service, it is possible to introduce dedicated teams in low- and middle-income countries, to good effect.

Optimising the various transfer routes is very important. Charting the high volume, high activity routes and identifying the 'low hanging fruit' interventions may result in easy wins. This might be as easy as installing a CT scanner at a regional facility. Using local radiographers and tele-reporting the images may result in substantially fewer IFTs undertaken for the purpose of diagnostic imaging. Having clear, formalised referral pathways and a protocolised approach to transfers adds immense value and saves time when the minutes count with critically ill patients.

As always, communication has been shown to be critical. Not only is it crucial for clinicians to communicate at either end of the transfer spectrum, but the crew facilitating the transfer needs to be in the know at all times. Better communication between healthcare providers may be able to divert or avoid some IFTs directly. For example, a patient transferred for an orthopaedic opinion may be accessed remotely by an orthopaedist utilizing telemedicine, and if deemed appropriate the IFT may be delayed or even cancelled. Furthermore, the crew should have access to medical direction if needed, in the event of acute patient deterioration for advice and support.

Weeding out unnecessary IFTs may be low hanging fruit in some overstretched healthcare systems. We have seen that many patients are transferred when not really required, either through human factors (no healthcare provider of required skill at the referring facility) or institutional factors (healthcare clinic is closing at 17h00 and therefore all patients who are not able to be sent home are transferred). The utilization of medical retrieval consultants (MRC) may add significant value. Currently, most MRCs (specialist doctors with interest in pre-hospital and retrieval medicine, and whom are critically care trained – emergency physicians, critical care physicians and anaesthetists) are working in the medical aviation space, co-ordinating and providing medical oversight on retrievals done by helicopter or fixed wing retrieval teams. Potentially incorporating the MRC system in making complex IFT decisions would add significant value and avoid unnecessary transfers. This would also add medical oversight for support to clinical teams en-route and enhance the training and quality control aspects of IFT systems.

Training has been highlighted as a core component of safe and efficient IFTs. Not only do the staff need the correct level of qualifications, but ongoing on-the-job professional development is crucial in order to run a high-performance environment. Especially with critical care transfers, crew members need to be able to carry out emergency procedures quickly and effectively, ranging from CPR to intubation and emergency surgical airways. Skills erode if not practised. It is therefore very important for EMS services to have formal ongoing training for their crews, to both upskill and uphold their expertise.

Quality control processes and clinical review meetings (previously called mortality and morbidity meetings) are crucial to ensure a standardised approach in organisations. As discussed, the gap between what needs to happen and what does happen reporting-wise, needs to be closed, not only for institutional learning and improvement to occur, but for improvement in the one overarching goal, namely patient safety.

1.12 Summary and motivation for study

IFT is an integral part of the Healthcare system. It ensures "continuity and proper levels of care" according to Heaton(80). However, whether these services are as effective and efficient as required, whether they are sufficiently staffed and equipped, and whether they take away resources from the primary role of the ambulance service, needs to be determined. There have not been any studies in Cape Town or the broader South Africa, describing the nature of IFT journeys. The motivation for this study is to rectify this deficiency and describe the number and state of inter-facility transfers in the Cape Town metropole, as a first step in framing the South African IFT scenario.

References

1. Mould-Millman N, Dixon JM, Sefa N, Yancey A, Hollong BG, Hagahmed M, Ginde AA, Wallis LA. 2017. The state of emergency medical services (EMS) systems in Africa. *Prehospital Disaster Medicine*. 2017;32(03):273–83.

2. National Highway Traffic Safety Administration. 2017. *Guide for interfacility patient transfer.* [cited 23 March 2020] Available from https://www.ems.gov/pdf/advancing-ems-systems/Provider-Resources/Interfacility_Transfers.pdf

3. Lamond F. 2004. Interfacility transfer of patients in South Africa: What you need to know and how to make it happen. *CME*. July 2004;22(7):374–7.

4. Kulshrestha A, Singh J. 2018. Inter-hospital and intra-hospital patient transfer: Recent concepts. *Indian J Anaesth*. 2018;60(7):451–7.

5. Western Cape Government Health. c2018. *Annual Report 2017–2018*. [cited 2018, Nov 2020]. Available from www.westerncape.gov.za

6. Western Cape Department of Health. c2018. *Emergency services: Medical emergency transport and rescue* [homepage on the internet]. [updated 2017, 12 Dec; cited 2018, 24 Nov]. Available from https://www.westerncape.gov.za/service/medical-emergency-transport-and-rescue-metro%20

7. Davies G, Chesters A. Transport of the trauma patient. *Br J Anaesth*. 2015;115(1):33–7

8. World Health Organization. 2019. *Health-care facilities*. [homepage on the internet].c2019 [cited 2019 Mar 17]. Available from https://www.who.int/environmental_health_emergencies/services/en/

9. Statistics South Africa. [*homepage on the internet*]. c2019 [cited 2019 March 21]. Available from http://www.statssa.gov.za/

10. *District development tool*: *City of Cape Town, profile and analysis*. 2020. [Internet]. cited 2022 Dec 1. Available from: https://www.cogta.gov.za/ddm/wp-content/uploads/2020/11/City-of-CT-September-2020.pdf

11. Mash RJ, Presence M, Adeniji A, Christoffels R, Doubell K, Eksteen L, Hendrikse A, Hutton L, Jenkins L, Kapp P, Lombard A, Marais H, Rossouw L, Stuve K, Ugoagwu A, Williams B. 2021. Evaluation of patient characteristics, management, and outcomes for

COVID-19 at district hospitals in the Western Cape, South Africa: A descriptive observational study. *BMJ Open*, 2021; 1–10.

12. City of Cape Town. 2020. *Municipalities of South Africa*. Internet. [cited 2020 Feb 2]. Available from https://municipalities.co.za/map/6/city-of-cape-town-metropolitan-municipality

13. Hodkinson P, Argent A, Wallis L, Reid S, Perera R, Harrison S, et al. Pathways to Care for Critically Ill or Injured Children: A Cohort Study from First Presentation to Healthcare Services through to Admission to Intensive Care or Death. PLoS One. 2016;11(1):e0145473.

14. Mayosi BM, Flisher AJ, Lalloo UG, Sitas F, Tollman SM, Bradshaw D. 2009. The burden of non-communicable diseases in South Africa. *Lancet* [Internet]. 2009;374(9693):934–47. Available from: http://dx.doi.org/10.1016/S0140-6736(09)61087-4

15. Achoki T, Sartorius B, Watkins D, Glenn SD, Kengne AP, Oni T, Wiysonge CS, Walker A, Adetokunboh OO, Babalola TK, Bolarinwa OA, Claassens MM, Cowden RG, Day CT, Ezekannagha O, Ginindza TG, Iwu CD, Iwu CJ, Karangwa I, Katoto P, Kugbey N, Kuupiel D, Mahasha PW, Mashamba-Thompson TP, Mensah GA, Ndwandwe DE, Nnaji CA, Ntshekhe M, Nyirenda TE, Odhiambo JN, Asante KO, Parry CDH, Pillay JD, Schutte AE, Seedat S, Sliwa K, Stein DJ, Tanser FC, Useh U, Zar HJ, Liesl JZ, Mayosi BM, Hay SI, Murray CJL, Naghavbi M. 2019. *Health trends, inequalities and opportunities in South Africa's provinces, 1990–2019: Findings from the global burden of disease.* 2019. Study. 2022;471–81

16. National Health Act, 2003. Government gazette, 30 June 2017. [Internet] Available from https://www.gov.za/sites/default/files/gcis_document/201707/40955gon627.pdf

17. *Comprehensive service plan for the implementation of healthcare, 2010.* 2007. Cape Town: Western Cape Department of Health. [cited 2022 July 1]. Available from https://www.westerncape.gov.za/text/2007/7/may15,2007-csp_2.pdf

18. Schoon MG. 2013. Impact of inter-facility transport on maternal mortality in the Free State Province. 2013. *SAMJ.* August 2013;103(8):534–7.

19. De Vries S, Wallis LA, Maritz D. 2011. A retrospective evaluation of the impact of a dedicated obstetric and neonatal transport service on transport times within an urban setting. *International Journal of Emergency Medicine,* 2011;2–7

20. Western Cape Government. *Emergency Care.* [Internet] Available from: https://www.westerncape.gov.za/general-publication/emergency-medical-care

21. Stein C, Wallis L, Adetunji O. 2015. Meeting national response time targets for priority 1 incidents in an urban emergency medical services system in South Africa: More ambulances won't help*. South African Medical Journal.* 2015;105(10):840–4.

22. Paediatric triage working group (PTWG) of the Western Cape Government. 2012. *The South African triage scale training manual 2012.* [Internet]. 2012;1–34. Available from: https://emssa.org.za/wp-content/uploads/2011/04/SATS- Manual-A5-LR-spreads.pdf

23. Twomey M, Cheema B, Cohen K, de Sa A, Louw P, Ismail M, Finlayson H, Cunningham C, Westwood A. Vital signs for children at triage: A multicentre validation of the revised South African Triage Scale for children. SAMJ. 2013. Vol 103. No 5.

24. Rosedale K, Smith ZA, Davies H, Wood D. The effectiveness of the South African Triage Score in a rural emergency department. SAMJ. 2011. Vol 101, No 8

25. Twomey M, Wallis L, Thompson ML, Myers JE. The South African Triage Scale provides valid acuity ratings when used by doctors and enrolled nursing assistants. African Journal of Emergency Medicine. 2012;2;3-12.

26. Goldstein LN, Morrow LM, Sallie TA, Gathoo K, Alli K, Mothopeng TMMM, Samodien F. The accuracy of nurse performance of the triage process in a tertiary hospital emergency department in Gauteng Province, South Africa. SAMJ, March 2017, vol. 107, No 3

27. Dalwai M, Valles P, Twomey M, Nzomukunda Y, Jonjo P, Sasikumar M, Nasim M, Razaaq A, Gayraud O, Jecrois PR, Wallis L, Taylor-Smith K. Is the South African Triage Scale valid for use in Afghanistan, Haiti and Sierra Leone? BMJ Global Health 2017;**2**

28. Hunter LD, Lahri S, Van Hoving DJ. 2017. *African Journal of Emergency Medicine*: Case mix of patients managed in the resuscitation area of a district-level public hospital in Cape Town. *African Journal of Emergency Medicine* [Internet]. 2017;7(1):19–23. Available from: http://dx.doi.org/10.1016/j.afjem.2017.01.001

29. Möller A, Hunter L, Kurland L, Lahri S, Van Hoving DJ. 2018. The association between hospital arrival time, transport method, prehospital time intervals and in-hospital mortality in trauma patients presenting to Khayelitsha Hospital, Cape Town. *African Journal of Emergency Medicine* [Internet]. 2018;8(3):89–94. Available from: https://doi.org/10.1016/j.afjem.2018.01.001

30. Wallis LA, Twomey M. 2007. Workload and case mix in Cape Town emergency departments. *SAMJ* 2007, December;97(12)p1276-1280.

31. Ashokcoomar P, Naidoo R. 2016. An analysis of inter-healthcare facility transfer of neonates within the eThekwini Health District of KwaZulu-Natal, South Africa. *SAMJ.* May, 2016;106(5):514–8.

32. Kuzma K, Lim AG, Kepha B, Nalitolela NE, Reynolds TA. 2015. The Tanzanian trauma patients' prehospital experience: A qualitative interview-based study. *BMJ Open*. 2015;5(4):e006921.

33. Sultan M, Abebe Y, Tsadik AW, Jennings CA, Mould-Millman NK. 2018. Epidemiology of ambulance utilized patients in Addis Ababa, Ethiopia. *BMC Health Serv Res.* 2018;18(1):1–7

34. Falchetta G, Hammad AT, Shayegh S. 2020. Planning universal accessibility to public health care in sub-Saharan Africa. *Proc Natl Acad Sci* U S A. 2020;117(50):31760–9.

35. Robinson V, Goel V, Maconald RD, Manuel D. 2009. Inter-facility patient transfers in Ontario : Do you know what your local ambulance is being used for? *Toronto: Healthcare Policy*. Vol.4 No.3.

36. Bergeron C, Fleet R, Tounkara FK, Bourget IL, Pelchat CT. 2017. Lack of CT scanner in a rural emergency department increases inter-facility transfers: A pilot study. *BMC Res Notes* [Internet]. 2017;1–6. Available from: https://doi.org/10.1186/s13104-017-3071-1

37. Adegboyega G, Zolo Y, Sebopelo LA, Dalle DU, Dada OE, Mbangtang CB, Tetinou F, Kanmounye US, Alalade AF. The burden of traumatic brain injury in Sub-Saharan Africa: a scoping review. World neurosurgery. 2021 Dec 1;156:e192-205.

38. Katsaragakis S, Drimousis PG, Kleidi ES, Toutouzas K, Lapidakis E, Papadakis G, Daskalakis K, Larentzakis A, Theodoraki M, Theodorou D. 2010. Interfacility transfers in a non-trauma system setting: An assessment of the Greek reality. *Scandinavian Journal of Trauma Resuscitation Emergency Medicine.* 2010;18(1).

39. The biggest cities in Greece. *World atlas*. Internet [cited Jan 2021]. Available from https://www.worldatlas.com/articles/the-biggest-cities-in-greece.html

40. Alexopoulos EC, Kalyva A, Merekoulias G, Niakas D. 2015. Monitoring interhospital transfers in Western Greece during 2003–2011: Its role in health policy. *Rural Remote Health*. 2015;15(4):1–12.

41. *National framework for inter-facility transfers.* 2019. NHS England; 24 July 2019. Available from www.england.nhs.uk/publication/inter-facility-trasnfers-framework/

42. El Sayed M, El Sibai R, Bachir R, Khalil D, Dishjekenian M, Haydar L, Aguehian R, Mouawad R. 2019. *Interfacility patient transfers in Lebanon: A culture-changing initiative to improve patient safety and outcomes.* Baltimore: Medicine. 2019;98(25):e15993.

43. Huang SP, Lin YY, Kuo YS, Huang YF, Wu SC, Huang KT, Chien-Hsin L, Po-Wei C, I-Chen L, Ying-Hsin C, Chao-Wei C, Hung-Chieh C, Chih-Hao L. 2022. Adequacy of care during interfacility transfer in Taiwan: A pilot study. *J Formosa Med Assoc*. 2022;121(9):1864–71. Available from: https://doi.org/10.1016/j.jfma.2022.03.018

44. Hernandez-Boussard T, Davies S, McDonald K, Wang NE. 2017. Inter-hospital f*acility transfers in the United States. J Patient Saf.* 2017;13(4):187–91.

45. Iwashyna TJ, Christie JD, Moody J, Kahn JM, Asch DA. 2009. The structure of critical care transfer networks. *Med Care.* 2009;47(7):787–93

46. Iwashyna TJ. 2012.The incomplete infrastructure for interhospital patient transfer*. Crit Care Med.* 2012;40(8):2470–8.

47. Greenwood, MJ. 2006. Self-inflicted death during interfacility transfer. *Annals of Emergency Medicine.* Volume 47, no. 2.

48. Janiak BD, Rawson J V., Clayton SK. 2015. Unnecessary repeat radiologic examinations in the emergency department after interfacility transfer. 2015. *Journal of American Coll Radiol* [Internet]. 2015;12(10):1079–81. Available from: http://dx.doi.org/10.1016/j.jacr.2015.05.015

49. Bertrand J, Fehlmann C, Grosgurin O, Sarasin F, Kherad O. 2019. Inappropriateness of repeated laboratory and radiological tests for transferred emergency department patients. *Journal of Clinical Medicine.* 2019;8(9):1342.

50. Trick WE, Kuehnert MJ, Quirk SB, Arduino MJ, Aguero SM, Carson LA, Hill B, Banerjee SN, Jarvis WR. 2021. *Regional dissemination of vancomycin-resistant enterococci resulting from interfacility transfer of colonized patients.* Oxford University Press. Stable URL : https://www.jstor.org/stable/30111023

51. American College of Emergency Physicians. 2016. Appropriate interfacility patient transfer. *Ann. Emerg Med*. 2016;67(5):690. Available from https://www.annemergmed.com/article/S0196-0644(16)00211-0/full

52. Mueller S, Zheng J, Orav EJ, Schnipper JL. 2018. Inter-hospital transfer and patient outcomes: a retrospective cohort study. BMJ Qual Saf 2018;28:e1.

53. Blakeman TC, Branson RD. 2013. Inter- and intra-hospital transport of the critically ill. *Respiratory Care*. 2013;58(6):1008–23.

54. Singh JM, Ferguson ND, MacDonald RD, Stewart TE, Schull MJ. 2009.Ventilation practices and critical events during transport of ventilated patients outside of hospital. *Prehospital Emergency Care*. 2009;13(3):316–23.

55. Singh JM, MacDonald RD, Ahghari M. 2014. Critical events during land-based interfacility transport. *Ann Emerg Med* [Internet]. 2014;64(1):9-15.e2. Available from: http://dx.doi.org/10.1016/j.annemergmed.2013.12.009

56. Srithong K, Sindhu S, Wanitkun N, Viwatwongkasem C. 2020. Incidence and risk factors of clinical deterioration during inter-facility transfer of critically ill patients: A cohort study. *Arch Academy of Emergency Medicine*. 2020;8(1):e65.

57. Eiding H, Røise O, Kongsgaard UE. 2022. Potentially severe incidents during interhospital transport of critically ill patients, frequently occurring but rarely reported: A prospective study. *Journal of Patient Safety.* 2022;18(1):E315–9.

58. Kang TS, Ko BS, Drakos SG, Stehlik J, Bott SI, Koliopoulou A, Tonna, JE, Bowen ME, Stoddard K, Selzman CH, McKellar SH. 2018. Safety of long-distance transfers of patients on acute mechanical circulatory support. *J Surg Res* [Internet]. 2018;224(801):18–22. Available from: https://doi.org/10.1016/j.jss.2017.11.037

59. Oza P, Goyal V. 2017. Portable ECMO and transport. Symposium. *Journal of Pediatric Critical Care.* 2017;4(2):82–92.

60. Eiding H, Kongsgaard UE, Braarud AC. 2019. Interhospital transport of critically ill patients: Experiences and challenges, a qualitative study. *Scandinavian Journal of Trauma Resuscitation Emergency Medicine*. 2019;27(1):1–9.

61. Orr RA, Felmet KA, Han Y, McCloskey KA, Dragotta MA, Bills DM, Kuch BA, Watson RS. 2009. Pediatric specialized transport teams are associated with improved outcomes. *Pediatrics* (2009) 124 (1): 40–48. Available from https://doi.org/10.1542/peds.2008-0515

62. Whyte HEA, Jefferies AL, Lacaze T, Newhook LA, Hendson L, Lemyre B. 2015. The interfacility transport of critically ill newborns. *Paediatric Child Health.* 2015;20(5):265–9.

63. Thwala MD. 2018. The quality of neonatal inter-facility transport systems within the Johannesburg metropolitan region. *Stud Syst Decis Control*. 2018;121:1–10.

64. Haydar B, Baetzel A, Elliott A, MacEachern M, Kamal A, Christensen R. 2020. Adverse events during intra-hospital transport of critically ill children: A systematic review. *Anesth Analg.* 2020;131(4):1135–45.

65. Ashokcoomar P, Bhagwan R. 2021. Towards a safer and more efficient neonatal transfer system in South Africa: A qualitative inquiry with ALS paramedics. 2021. *Australasian Journal of Paramedicine*. 2021;18:1–9.

66. Vincent-Lambert C, Wade G. 2017. Challenges relating to the inter-facility transport of high acuity paediatric cases. 2018. *African Journal of Emergency Medicine* [Internet]. 2018;8(1):29–33. Available from: https://doi.org/10.1016/j.afjem.2017.12.001

67. Frankel LR, Hsu BS, Yeh TS, Simone S, Agus MSD, Arca MJ, Coss-Bu JA, Fallat ME, Foland J, Gadepalli S, O Gayle M, Harmon LA, Hill V, Joseph CA, Kessel AD, Kissoon N, Moss M, Mysore MR, Papo ME, Rajzer-Wakeham K, Rice TB, Rosenberg DL, Wakeham MK, Conway E. 2010. Criteria for critical care infants and children: PICU admission, discharge, and triage practice statement and levels of care guidance. Vol. 20, *Pediatric Critical Care Medicine*. 2019.p. 847–887.

68. Davies J, Tibby SM, Murdoch IA. 2005. Should parents accompany critically ill children during inter-hospital transport? *Arch Dis Child*. 2005;90(12):1270–3.

69. Jones CHD, Ward A, Hodkinson PW, Reid SJ, Wallis LA, Harrison S, Argent A. 2016. Caregivers' experiences of pathways to care for seriously Ill children in Cape Town, South Africa: A qualitative investigation. *PLoS One*. 2016;11(3):1–15.

70. Horowitz R, Rozenfeld RA. 2007. Pediatric critical care interfacility transport. *Clinical Pediatric Emergency Medicine*. 2007;8(3):190–202.

71. Genovesi AL, Olson LM, Telford R, Fendya D, Schenk E, Morrison-Quinata T, Edgerton EA. 2019.Transitions of care: The presence of written interfacility transfer guidelines and agreements for pediatric patients. *Pediatric Emergency Care.* 2019;35(12):840–5.

72. Yock-Corrales A, Casson N, Sosa-Soto G, Orellana RA. (N.D.) Pediatric critical care transport : Survey of current state in Latin America. Latin American Society of Pediatric Intensive Care Transport Committee. *Pediatric Emergency Care*. 2022;38(1):E295–9

73. Bosk EA, Veinot T, Iwashyna TJ. 2011.Which patients and where. *Medical Care*. 2011;49(6):592– 8.

74. Unnikrishnan KP, Patnaik D, Iwashyna TJ. 2011. Spatio-temporal structure of US critical care transfer network. *American Medical Informatics Association Joint Summits Translational Science Proceedings.* 2011;2011:74–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22211183%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC3248748

75. Thakur NA, Plante MJ, Kaviaros S, Reinert SE, Ehrlich MG. 2010. Inappropriate transfer of patients with orthopaedic injuries to a Level 1 trauma center: A prospective study. *Journal of Orthopedic Trauma*. June. 2010. 24(6): p.336–9.

76. Iwashyna TJ, Courey AJ. 2011. Guided transfer of critically ill patients: Where patients are transferred can be an informed choice. *Curr Opin Crit Care*. 2011;17(6):641–7.

77. Computer-aided dispatch [Internet]. Wikipedia. [cited 1 Aug 2022]. Available from: https://en.wikipedia.org/wiki/Computer-aided_dispatch

78. Technote [Internet]. *Homeland Security, science and technology*. September 2011. [cited 1 Aug 2022]. Available from https://www.dhs.gov/sites/default/files/publications/CAD_TN_0911-508.pdf

79. Attanasio A, Bregman J, Ghiani G, Manni E. 2007. Chapter 10. Real-time fleet management at Ecourier Ltd.. In: Zeimpekis V, Tarantilis CD, Giaglis G, Minis I. 2007. *Dynamic fleet management*. First edition. P.218–236 Athens: Springer.

80. Heaton J, Kohn MD. c.2022. *EMS Inter-facility transport*. 4–7. Available from https://www.ncbi.nlm.nih.gov/books/NBK555916/

PART 2: MANUSCRIPT IN ARTICLE FORMAT

Formatted for submission to South African Medical Journal (SAMJ) – instructions available here http://www.samj.org.za/index.php/samj/about/submissions

Title page:

Inter-facility transfers in the City of Cape Town metropole by the Western Cape Provincial Emergency Medical Service: A retrospective, descriptive study.

Authors:

Dr Franz Gustav Lemke, Emergency Physician, Royal Darwin and Palmerston Hospitals, Northern Territory, Australia

Dr Sanjeev Rambharose, Division of Emergency Medicine, University of Cape Town, Cape Town, South Africa; Department of Physiological Sciences, University of Stellenbosch, Stellenbosch, South Africa

A/Prof Peter Hodkinson, Division of Emergency Medicine, University of Cape Town, Cape Town, South Africa

Corresponding author:

Dr Franz Gustav Lemke: gustavlemke@yahoo.com

Word count:

Abstract: 400

Article: 3,630

Table count: 3

Figure count: 3

Supplementary: 4 tables

Inter-facility transfers in the Cape Town metropole by the Western Cape Government Emergency Medical Service: A retrospective, descriptive study.

Abstract

Background

The South African health service is built upon a three-tier system, with the result that inter-facility transfers (IFTs) are a cornerstone of a functional health ecosystem. Patients are transferred between facilities until their needs are met by the level of care provided. The Western Cape Government annual report of 2017/2018 states that 31.6 % of the workload of the Western Cape Government Emergency Medical Service (WCGEMS), is inter-facility transfers.

Objectives

This study describes the inter-facility, road-based transfers undertaken by the WCGEMS in the Cape Town metropole. We describe the number and type of transfers between health facilities as well as identifying the most common routes, prioritisation, crew make-up and acuity levels of patients transferred.

Methods

A retrospective, descriptive, observational study was conducted using the Cape Town Emergency Medical Service inter-facility transfer electronic database for the study period of 1 January 2017 to 31 December 2018. The existing database provided information logged routinely by EMS staff during each transfer and has been analysed using the statistical software Stata.

Results

Some 231,340 IFTs were included, of which two-thirds were undertaken by the day shift: 160,068 (69%) vs 71,272 (31%). Most emergency transfers were conducted for female patients [50,468 (62%) vs 31,468 (38%)]. Intermediate Life Support (ILS) crew facilitated most of the transfers 106,747 (51%) with Basic Life Support (BLS) crew in 53,165 (26%) and 48,534 (23%) by Advanced Life Support (ALS). The busiest route in the metro was identified as Khayelitsha (Site B) Community Health Centre (CHC) to Khayelitsha Hospital n=12,053, with some 17 transfers conducted per 24-hour period. The busiest routes, Khayelitsha CHC to Khayelitsha Hospital and

Mitchells Plain CHC to Mitchells Plain Hospital were also the shortest, at 4.53 km and 2.78 km respectively. In totality, less than a third if IFTs [67,061 (30%)] required the use of stretchers.

Conclusion

IFTs are an integral part of the South African healthcare system, but the use of a frontline, EMS-driven model to provide IFTs is resource intensive and likely detrimental to overall EMS service delivery given the low acuity of the majority of patients transferred. Consideration should be given to creating, equipping, and adequately funding a separate service to take over responsibility for routine IFTs. This so-called ‘second leg’ of EMS should be a dedicated, 24-hour, seven-day-week, low fidelity service, lessening the load on the frontline EMS resources and allowing first responders to focus on their main task—primary medical response.

Inter-facility transfers in the Cape Town metropole by the Western Cape Government Emergency Medical Service: A retrospective, descriptive study.

2.1. Introduction

Inter-facility transfers (IFTs) are key components of the healthcare system. The movement and flow of patients between facilities, especially when escalation of care is needed, is a daily occurrence. In South Africa most transfers are made by the Emergency Medical Service, especially (but not only) when urgent or emergent. South Africa is a low-and middle-income country (LMIC) country with significant resource and system challenges. That said, South Africa boasts the most developed emergency medical services on the continent(1).

The South African health service is built upon a three-tier level-of-care system. In the 2010 comprehensive service plan, the levels of care defined as follows(2):

- Level 1 (primary) is delivered by general practitioners (GPs) or primary healthcare nurses, supported by specialist family physicians where available.
- Level 2 (secondary) is led by specialist teams, including surgeons, paediatricians, and emergency physicians.
- Level 3 (tertiary) is delivered by specialists working in sub-specialty fields such as nephrology, cardiology, or vascular surgery.
- Level 4 (quaternary) is delivered by teams of sub-specialists. This level of care is at the cutting edge. It may be extremely expensive or resource intensive and is usually only available in one or two institutions nationally. (Level 3 and Level 4 are usually grouped together)

Inter-facility transfer (IFT) is well defined by the United States of America National Traffic Highway Safety Administration (NTHSA) as: *"Any transfer, after initial assessment and stabilization, from and to a healthcare facility*(3)*"*. The main reasons for the interfacility transfer of patients are that they require either a higher level of clinical expertise or level of institution to manage their underlying condition. Therefore, the level of care the patient is receiving is always increasing(4), up to the point where the level of care matches that required by the patient. This allows the patient to navigate the tiered healthcare system, resulting in patients being treated “at the level of care that is most appropriate to their need within a seamless service”, as per the Comprehensive Service Plan(2). In some instances, patients are transferred to lower levels of care for example due to financial implications (moving a patient an “in network” health care facility for insurance purposes), physician request (hospital admission privileges as primary care physician) or patient wishes (end-of-life care).

IFTs form part of the health risk vs benefit conundrum(5). IFTs are based on the fact that the benefit of care to the patient outweighs the risk of the transfer. As published in the Western Cape Government annual report of 2017/2018(6), 31.6 % of the workload of the Western Cape Government Emergency Medical Service (WCGEMS), across the province, consists of inter-facility transfers (the remainder being primary calls from the scene of accident or illness, residence, workplace etc). IFTs are carried out by two distinct components within WCGEMS— Ambulance Operations and Health Non-Emergency Transport **(**HealthNET). HealthNET (Health Non-Emergency Transport) provides transport for non-emergency patients. Patients are prebooked for transport in advance, and may be from home or a health facility(6). At the time of analysis, there were up to 90 HealthNET vehicles operating across the Western Cape Province(7). Of note, the criteria for these pre-booked HealthNet patients are that they should be able to walk and sit, rather than being stretcher bound. The Ambulance Operations component is responsible for all other inter-facility transfers, including but not limited to all after-hours transfers, all emergency transfers and transporting patients from facilities not covered by the HealthNET network, as well as responding to all primary pre-hospital emergency calls. Ambulances conducting IFTs are crewed by either basic life support (BLS), intermediate life support (ILS) or paramedics qualified as advanced life support providers (ALSP), emergency care providers (ECP) or emergency care technicians (ECT), depending on the specific skill mix required for the transfer.

For the purposes of this paper, IFTs include all ambulance transfers between healthcare facilities within the South African health system, whether it be a nurse-driven community centre, private general practitioner, or a tertiary/quaternary facility. This review describes the number and type of transfers between health facilities in Cape Town, as well as identifying the most common routes used and the prioritisation, crew make-up and acuity levels of patients transferred.

2.2. Methodology

2.2.2 Study design

A retrospective, descriptive, observational study was conducted to assess road inter-facility transfers, data-captured on the Cape Town Emergency Medical Service database during the study period of 1 January 2017 to 31 December 2018. All inter-facility transfers by the Provincial Emergency Medical Service captured on the database were assessed. All patients that were transferred from one institution to another were included. Aeromedical transfers, incomplete data, primary calls (being those from the scene of accident or home / workplace) and cancelled or non-completed calls during the study period were excluded.

2.2.3 Setting of study

All ambulance IFTs are directed by Cape Town Metro Control, which serves a total area of 129,526 square kms, with an estimated total population of 5,400,000 people(8). When the decision is made by an attending clinician to initiate an IFT, a call is made to the Cape Town Metro Control Centre and classified by a call taker for acuity as either P1 or P2, prior to dispatch of an ambulance from the pool of all available ambulances in the area. This is based on the South African Triage Scale (SATS) classification of the patient, as stated by the caller. If the patient is classified as RED or ORANGE by SATS(9), they are captured as P1. Certain discriminators will automatically assign a value of P1 to a patient even when not red/orange, such as obstetrics. For primary response in urban centres, the target response times for P1 medical emergency ambulance arrival time should be within 15 minutes or less, 80 % of the time(10) and all other incidents should be responded to within 60 minutes. Of note: ambulances are always crewed by at least two crew members, and typically an ‘ILS crew’ will comprise one ILS and one BLS crew member, with the highest qualification delivering patient care. Dispatch is prioritized so that P1 primary calls are first priority, and then a balance of the other calls, based on acuity, waiting time and available resources. Of note the South African health system is split into a public and private healthcare service model, and this study examines only the larger, public-sector EMS which is primarily engaged in IFT between public sector healthcare facilities (which serve some 84% of the population) (11).

2.2.4 Data collection and capturing

Following ethics approval from the University of Cape Town Human Research Ethics Committee (HREC reference number 375/2019), the study was approved by the Western Cape Provincial EMS for access to the electronic data in the Western Cape Government Emergency Medical Service registry on all inter-facility transfers initiated under the direction of Cape Town Metro Control during the study period. The de-identified data were received and kept in password–protected, Microsoft Excel spreadsheet by the primary investigator.

2.2.5 Data analysis

The database was analysed using the statistical software Stata©, summarised across priority level and shift using frequencies and percentages.

2.3. Results

The database, as received, consisted of 350 215 total EMS transports. Cases that were not completed [outsourced (n=67), cancelled (n=16,832) or redeployed before completion of transfer (n=55,409)] were excluded. So too were response units (ie. non-ambulances) (n=2621) or where IFTs were actioned by call centres and districts (n=85) not in the Cape Town metropole region. Double entries and data lines missing more than two datapoints were also excluded (n=43,834). The final data analysed consisted of n=231,340 patient transfers, (Table 1).

Table 1: Patient and incident characteristics, by priority level and night versus day shift

		Priority level		Shift	
	Total sample - n (%)	P1 – n (%)	P2 – n (%)	Night shift -n(%)	Day shift - n (%)
Number of transfers	231,340	81,968 (35%)	149,372 (65%)	71,272 (31%)	160,068 (69%)
Patient gender					
Female	127,315 (55%)	50,468 (62%)	76,847 (51%)	39,096 (55%)	88,219 (55%)
Male	103,951 (45%)	31,468 (38%)	72,483 (49%)	32,150 (45%)	71,801 (45%)
Age					
Overall Median [IQR]	29 [18, 43]	25 [3, 36]	31 [21, 47]	29 [20, 42]	29 [16, 44]
<1 day N (%)	2,504 (1%)	2,054 (3%)	450 (0.3%)	1,017 (1%)	1,487 (1%)
1-30 days	6,193 (3%)	2,423 (3%)	3,770 (3%)	757 (1%)	5,436 (3%)
1-12 months	15,734 (7%)	10,334 (13%)	5,400 (4%)	2,785 (4%)	12,949 (8%)
1-12 years	24,532 (11%)	9,349 (11%)	15,183 (10%)	6,901 (10%)	17,631 (11%)
13-18 years	11,013 (5%)	4,035 (5%)	6,978 (5%)	4,151 (6%)	6,862 (4%)
19-29 years	58,906 (25%)	22,887 (28%)	36,019 (24%)	21,533 (30%)	37,373 (23%)
30-39 years	44,245 (19%)	13,757 (17%)	30,488 (20%)	14,283 (20%)	29,962 (19%)
40-49 years	22,973 (10%)	5,333 (7%)	17,640 (12%)	6,589 (9%)	16,384 (10%)
50-59 years	19,388 (8%)	4,776 (6%)	14,612 (10%)	5,621 (8%)	13,767 (9%)
60-69 years	14,164 (6%)	3,854 (5%)	10,310 (7%)	4,200 (6%)	9,964 (6%)
70 years or older	11,688 (5%)	3,166 (4%)	8,522 (6%)	3,435 (5%)	8,253 (5%)
Triage colour					
Red	15,004 (7%)	12,272 (15%)	2,732 (2%)	5,613 (8%)	9,391 (6%)
Orange	57,912 (25%)	38,761 (47%)	19,151 (13%)	18,653 (26%)	39,259 (25%)
Yellow	120,575 (52%)	24,673 (30%)	95,902 (64%)	37,065 (52%)	83,510 (52%)
Green	36,889 (16%)	5,892 (7%)	30,997 (21%)	9,642 (14%)	27,247 (17%)
Blue	87 (0.1%)	44 (0.1%)	43 (0.1%)	35 (0.1%)	52 (0.1%)

P1 and P2: priority 1 and 2. Day shift and night shift hours are from 07h00 – 19h00 and 19h00 – 07h00 respectively. Triage colour is as declared by referring clinician according to South African Triage Scale (SATS).

Almost two-thirds of transfers were made by day shifts, 160,068 (69%) vs 71,272 (31%) but of note the time reflects the time of booking (calling for) a transfer, rather than the time the transfer took place. Of P1 transfers, 62% were female patients and 38% were male, compared to P2 transfers where 51% were female and 49% were male. Female patients were 1.51 times [95% CI: 1.49, 1.54] more likely than male patients to be P1 transfers. No difference was observed in patient gender by day versus night shift (OR: 0.99; 95% CI: 0.97, 1.01). As expected, most neonates are classified and transferred as P1 (2054 vs 450). IFTs increase and then subsequently decrease by age except for a drop between the ages of 13 and 18. Some 21,883 IFTs were classified as P2 but incorrectly captured as red or orange (2,732 and 19,151 respectively). Roughly 23 % (5041/21883) of these were under the age of 18 (red P2 427, orange P2 4614) but may also reflect an error in data capturing. The higher transport rate in the 19-29 age group may be attributed to trauma/accidents being more common in this age group. As transfers to mortuary were excluded, it is unclear why there are 87 patients classified as blue and this is likely also erroneous data capture.

Table 2: Transfer details, by priority level and night versus day shift

		Priority level		Shift	
	Total sample-n(%)	P1 – n (%)	P2 – n (%)	Night shift - n(%)	Day shift – n (%)
Number of transfers	231,340	81,968 (35%)	149,372(65%)	71,272 (31%)	160,068 (69%)
Referring facility:					
Tertiary	18,946 (8%)	787 (1%)	18,159 (12%)	2,582 (4%)	16,094 (10%)
District /secondary	60,100 (26%)	21,337 (26%)	38,763 (26%)	21,944 (31%)	38,156 (24%)
Primary	145,926 (63%)	57,271 (70%)	88,655 (59%)	44,333 (62%)	101,593 (63%)
Specialist	4,238 (2%)	1,563 (2%)	2,675 (2%)	1,067 (2%)	3,171 (2%)
Private	1,920 (1%)	968 (1%)	952 (1%)	1,005 (1%)	915 (0.6%)
Step-down/hospice	210 (0.1%)	42 (0.1%)	168 (0.1%)	71 (0.1%)	139 (0.1%)
Receiving` facility:					
Tertiary	87,473 (38%)	38,892 (47%)	48,581 (33%)	32,253 (45%)	55,220 (35%)
District/secondary	115,253 (50%)	34,157 (42%)	81,096 (54%)	31,041 (44%)	84,212 (53%)
Primary	4,816 (2%)	840 (1%)	3,976 (3%)	1,824 (3%)	2,992 (2%)
Specialist	22,327 (10%)	8,007 (10%)	14,320 (10%)	5,960 (8%)	16,367 (10%)
Private	835 (0.4%)	69 (0.1%)	766 (0.5%)	93 (0.1%)	742 (0.5%)
Step-down/hospice	636 (0.3%)	3 (<0.1%)	633 (0.4%)	101 (0.1%)	535 (0.3%)
Response unit:					
Ambulance	213,168 (92%)	78,632 (96%)	134,536(90%)	65,616(92%)	147,552(92%)
HealthNET	15,377 (7%)	732 (0.9%)	14,645 (10%)	4,660 (7%)	10,717 (7%)
PICU Ambulance	2,728 (1%)	2,572 (3%)	156 (0.1%)	963 (1%)	1,765 (1%)
Crew (n=208,451):					
ALS/ECP/ECT	48,534 (23%)	29,843 (40%)	18,691 (14%)	16,803 (26%)	31,731 (22%)
ILS	106,747 (51%)	32,041 (43%)	74,706 (56%)	32,505 (50%)	74,242 (52%)
BLS	53,165 (26%)	12,404 (17%)	40,761 (30%)	15,868 (24%)	37,297 (26%)
Doctor	5 (<0.1%)	1 (<0.1%)	4 (<0.1%)	1 (<0.1%)	4 (<0.1%)
Mobility (n=221,511):					
Child in arms	32,298 (15%)	16,641 (22%)	15,657 (11%)	6,817 (10%)	25,481 (17%)
Incubator	2,598 (1%)	1,693 (2%)	905 (1%)	670 (1%)	1,928 (1%)
Stretcher	67,061 (30%)	37,440 (49%)	29,621 (20%)	25,813 (38%)	41,248 (27%)
Walker	48,047 (22%)	1,758 (2%)	46,289 (32%)	11,481 (17%)	36,566 (24%)
Wheelchair	71,507 (32%)	19,103 (25%)	52,404 (36%)	23,634 (35%)	47,873 (31%)

P1 and P2; Priority 1 and Priority 2. Day shift and night shift hours are from 07h00–19h00 and 19h00–07h00 respectively. Basic life support (BLS), Intermediate life support (ILS), Advanced life support (ALS), Emergency care provider (ECP), Emergency care technician (ECT)

As shown in Table 2, the bulk of IFTs are from primary care (145,926 63%). Unsurprisingly, district/secondary level facilities are also the institutions receiving the most patients. Of the 81,968 P1 IFTs, 12,404 or 17 % were transferred by a BLS crew.

Table 3: Transfer details of 20 most common transfer routes

	Route	Number of transfers	Priority: P1	Triage colour				Crew		
				Red	Orange	Yellow	Green	ALS / ECP / ECT	BLS	ILS
1	Khayelitsha (Site B) CHC–Khayelitsha Hospital	12,053	25%	4%	21%	64%	12%	12%	25%	63%
2	Mitchells Plain CHC–Mitchells Plain Hospital	10,666	34%	4%	22%	57%	17%	22%	23%	56%
3	Khayelitsha Hospital–Tygerberg Hospital	7,707	44%	14%	30%	47%	9%	27%	17%	57%
4	Vanguard CHC–New Somerset Hospital	7,702	37%	5%	23%	51%	21%	20%	48%	32%
5	Kraaifontein CHC–Karl Bremer Hospital	6,929	35%	5%	29%	52%	14%	28%	21%	51%
6	Helderberg Hospital–Tygerberg Hospital	6,214	44%	11%	28%	51%	10%	27%	11%	62%
7	Mitchells Plain Hospital–Groote Schuur Hospital	5,694	50%	17%	31%	44%	9%	41%	16%	43%
8	Mitchells Plain Hospital–Lentegeur Hospital	5,423	0.4%	1%	5%	52%	41%	5%	39%	57%
9	Delft CHC–Tygerberg Hospital	5,188	41%	8%	31%	50%	11%	32%	25%	43%
10	Retreat CHC–Victoria Hospital	4,859	33%	5%	30%	52%	13%	23%	25%	52%
11	Du Noon CHC–New Somerset Hospital	4,840	28%	6%	24%	52%	18%	13%	50%	37%
12	Elsies River CHC–Tygerberg Hospital	4,582	41%	8%	32%	50%	10%	34%	19%	47%
13	Heideveld Hospital–Groote Schuur Hospital	4,512	43%	11%	34%	44%	10%	33%	19%	48%
14	Karl Bremer Hospital–Tygerberg Hospital	4,297	53%	10%	31%	45%	14%	40%	20%	41%
15	Macassar CDC–Helderberg Hospital	4,059	53%	3%	25%	56%	16%	20%	11%	69%
16	Victoria Hospital–Groote Schuur Hospital	3,995	24%	8%	17%	61%	14%	26%	22%	52%

17	Eerste River Hospital–Tygerberg Hospital	3,820	41%	12%	30%	46%	12%	43%	19%	38%
18	Michael Mapongwana CDC–Khayelitsha Hospital	3,818	37%	3%	21%	62%	14%	13%	31%	57%
19	Delft CHC– Eerste River Hospital	3,420	17%	3%	28%	53%	15%	30%	24%	46%
20	New Somerset Hospital–Groote Schuur Hospital	3,318	33%	10%	19%	21%	49%	27%	37%	36%

CHC–community health center. CDC–community day center. P1–priority 1. Basic life support (BLS), Intermediate life support (ILS), Advanced life support (ALS), Emergency care provider (ECP), Emergency care technician (ECT). Triage colour as per SATS.

Of the top 20 busiest IFT routes in the metropole, half (10) were transfers from secondary to tertiary hospitals, and most of the remainder (7/20) from primary to secondary health facilities (Table 3). The busiest route in the metro was Khayelitsha (Site B) CHC to Khayelitsha Hospital (a distance of some 4.5km) with 12,053 transfers during the study period. This amounts to an average of 17 transfers per 24-hour period, from primary healthcare to secondary level. Both tertiary centres (GSH and TBH) are represented on the busiest routes, but KDH has 26 % more IFTs to its tertiary referral complex (TBH) than MPH (7707 vs 5694). Furthermore, even though the transfers between KDH and MPH are seem to be similar acuity, 41 % of patients were transferred from MPH via ALS vs 27 % from KDH, perhaps suggesting higher acuity in MPH transfers.

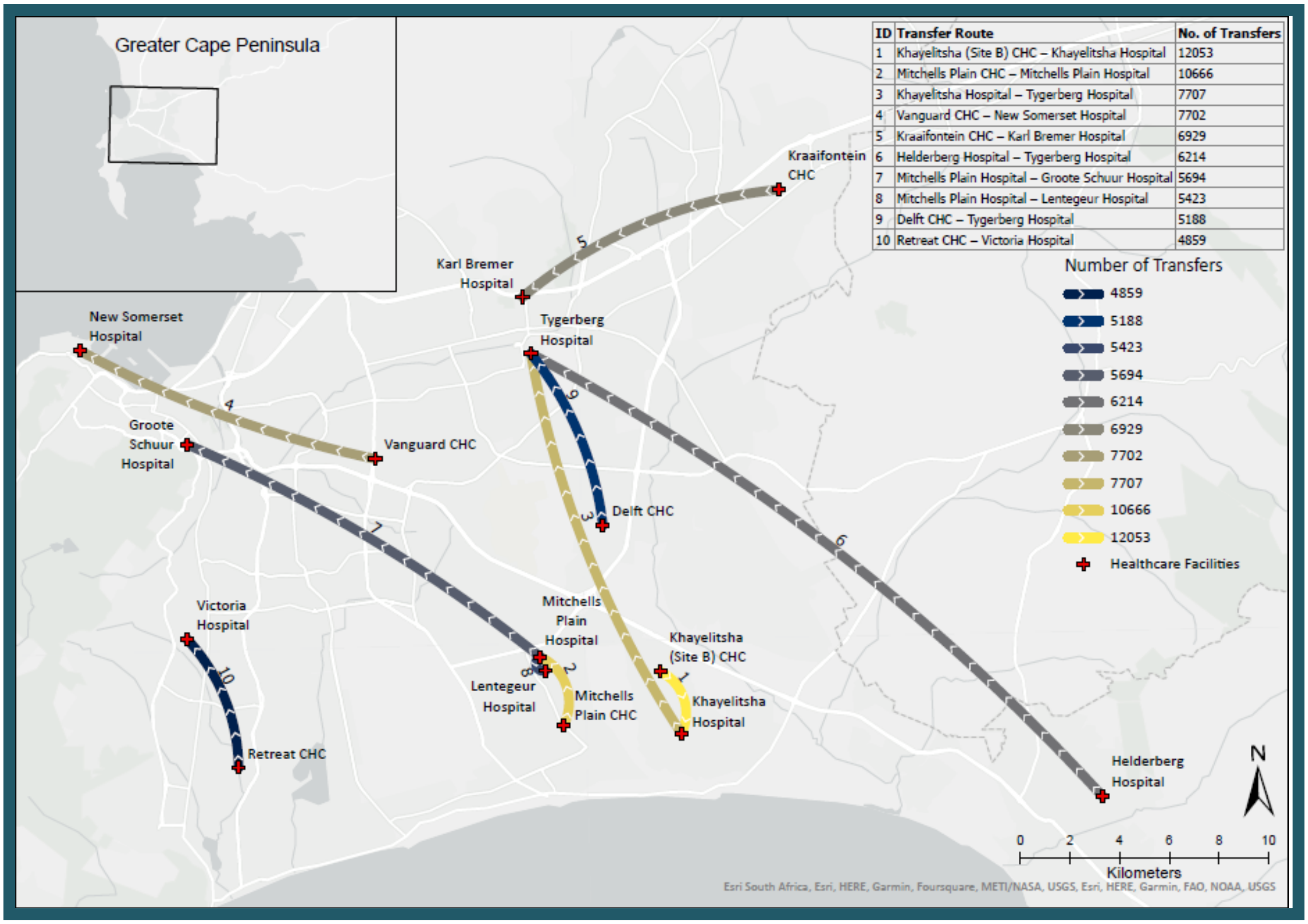

Figure 1. Map of the top ten IFT routes in the Cape Town metropole with transfer numbers for the study period

By visually representing the ten busiest IFT routes in the metropole (Figure 1), it is interesting to note that the two busiest routes (K CHC Site B–KDH [1] and MP CHC–MPH [2]) are also the shortest, at 4.53km and 2.78km respectively (as the crow flies).

ILS crew facilitated most of the transfers 106,747 (51%) with BLS crew doing 53,165 (26%) and 48,534 (23%) by ALS (Figure 2). Furthermore, 74,288 (36%) were classified as P1 and 134,158 (64%) as P2; 13,429 (6%) were classified as red; with 52,079 (25%) orange; 107,513 (52%) yellow; and 34,554 (17%) green (Figure 2). P1 transfers were less likely to occur for patients triaged as orange compared with red, OR 0.45 [0.43, 0.47 95% CI]

Further breaking down the numbers to P1 and P2 transfers per crew level and triage colour (Figure 3), it can be seen that ILS is responsible for the vast majority of IFTs, and that ILS make more P1 IFTs than ALS/ECP/ECT. Tables are available in supplementary text.

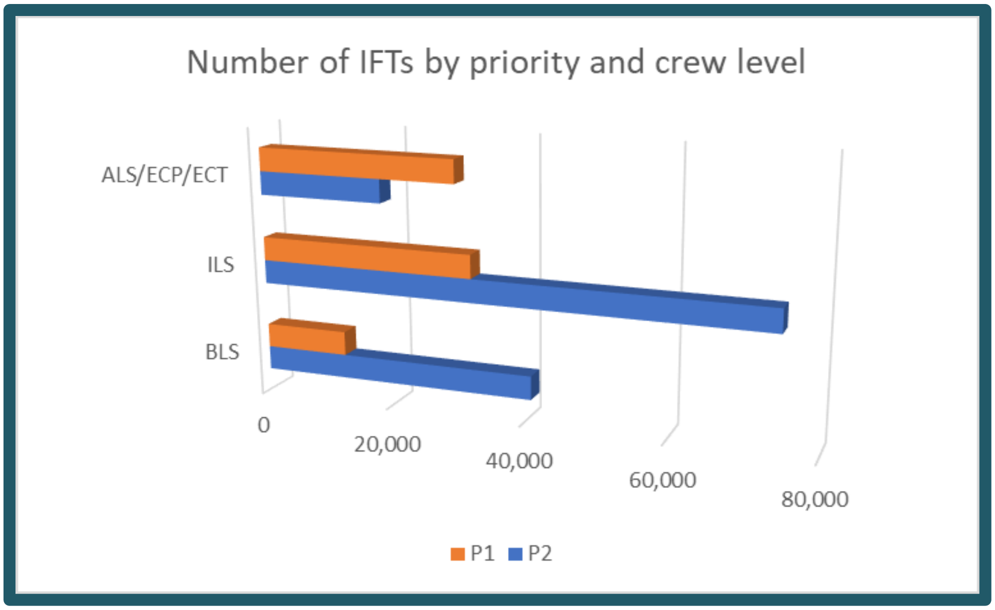

Figure 2: Number of interfacility transfers by priority and crew level

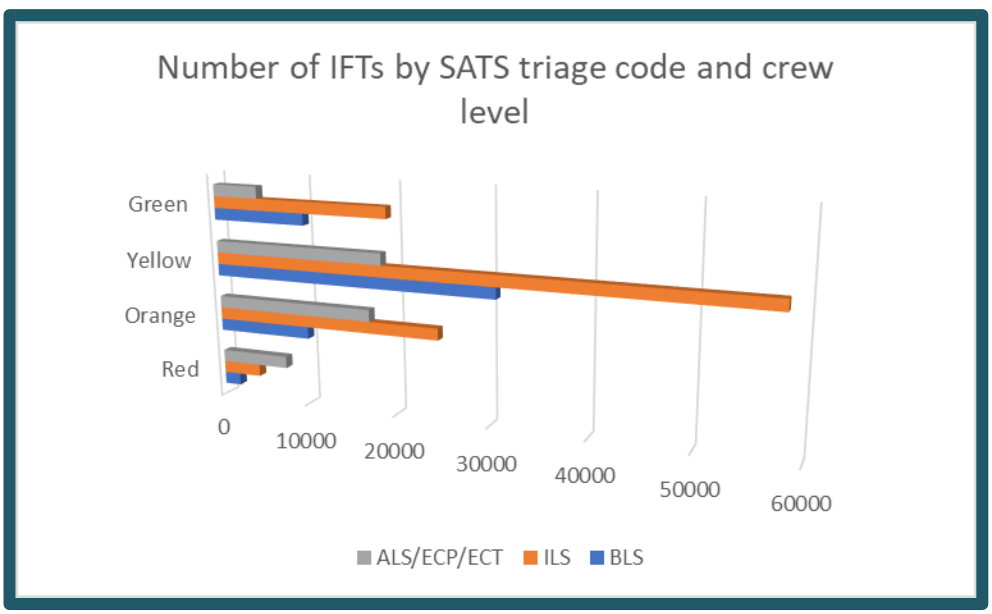

Figure 3: Number of interfacility transfers s by South African Triage Scale triage code and crew level

2.4. Discussion

2.4.1 General

In the two-year study period, there were 292 IFT patients transferred per day, or 12 every hour (around one-third of the total transfers performed by ambulance per day). Even assuming some of these patients were transferred with two patients to a vehicle, this is a huge proportion of the demand on an already stretched ambulance service, facing the quadruple burden of disease in South Africa (communicable and non-communicable diseases, obstetric disorders, and trauma)(12-13). The number of IFTs should not come as a surprise. The South African healthcare system is built on a three-tier system (primary, secondary and tertiary/quaternary) compounded by an apartheid legacy of multiple health facilities sited more for political and historical reasons rather than modern population density and demand (14). This leads to many patients requiring IFT which we would argue is inevitable but should not be to the detriment of EMS service delivery as it is currently.

The busiest two routes for IFTs, Khayelitsha (Site B) CHC to Khayelitsha Hospital [1] and Mitchells Plain CHC to Mitchells Plain Hospital [2], are both under five km in distance, yet are responsible for almost 12,000 IFTs annually. This does beg the question whether having the facilities housed separately (primary and secondary) was the correct decision. Historically, there has been a lot of inequality in South Africa, and the health-care system was not spared. The relatively recent addition of the MPH (2013) and KDH (2012) district (or secondary) hospitals have added a lot of resources to the ‘lack-of-access’ narrative. The fact that the tertiary institutions are geographically located away from the higher density population zones of, for example, Khayelitsha leads to a system built on a tiered approach, and critically dependent on IFTs(15).

2.4.2 Prioritisation

IFTs are prioritised according to the initial call received from the clinician booking the patient for an IFT. Since all these patients will have been triaged, assessed, and stabilised (as much as possible) in a health facility, SATS classification is provided by the referring clinician. The South African Triage Scale(9) is a locally developed in-hospital triage tool for the Emergency Department. It has not been validated for the pre-hospital environment, nor for use with IFTs. An attempted to validate the SATS in the pre-hospital environment in Cape Town found that the final SATS colour was correct in 56.5 % of cases; under-triaged in 29.5 % and over-triaged in 13.1 % (16). In hospital triage with SATS has a validated sensitivity of 75 % and specificity of 91 % when used by physicians or enrolled nurses (17). The rate of under- and over-triage was 10 and 15 %

respectively As the IFT SATS colour is assigned by facility-based clinicians, the discrepancy between pre-hospital and institutional SATS accuracy should have limited impact on the accuracy of the database.

The Cape Town EMS system is continuously under strain, with a backlog of calls. P2 calls often face a 12-hour delay to the arrival of EMS. Under these circumstances, P1 calls are prioritised, and largely serviced within reasonable time spans (under an hour), but there is an appropriate assumption that patients calling for EMS from home or place of accident/illness (primary calls) should be prioritised over those already in health facilities. Thus, IFT calls will usually wait longer than primary calls. Although the vast majority of IFT calls are P2, the data shows that some 32 % of IFT transfers are for red or orange classified patients, including seven percent red. These include critical transfers where there is a balance of speed vs quality of care (for example managing the patient with a cord prolapse vs the ventilated patient) and the despatch and resource allocation decisions are key for these patients. Some two thirds of IFT transfers are booked in the daytime (07h00–19h00), the time period when the majority of patients present, and also when most referral decisions are made, but many of these are only transferred at night due to system lag.

2.4.3 Motivations for transfers

Interestingly, the top three reasons for IFTs by incident type are neurological 35,004 (15%), musculoskeletal 34,229 (15%), and respiratory 33,818 (15%). Unstable epilepsy has been shown to increase the frequency of emergency department visits, both for all diagnoses (25.5% vs. 37.4% had ≥1 ED consult) and for epilepsy-related diagnoses (12% vs. 21.2%), compared to stable epilepsy(18). The anecdotally high rate of postictal patients, and patients transferred to higher institutions for stroke management and further imaging, may explain the high number of transfers in this category. Musculo-skeletal could signify patients transferred for further management of fractures or dislocations, as many primary healthcare facilities are not able to manage fractures. The dual burden(12-13) of tuberculosis and HIV-induced immunocompromise, leading to respiratory disease, may explain the respiratory component.

Strikingly, less than a third (30%) of IFTs are patients requiring stretchers—for which ambulances are designed. This raises the question of what more efficient means of transport could accommodate the multiple walking and wheel chaired patients, which could be better accommodated in other vehicles since ambulances are designed to fit one and at most two stretcher patients primarily.

Since most maternity services are offered at primary health care level, obstetric transfers are also quite common comprising some 12% of IFTs (28,761). But they made up 21% (17,394) of P1 transfers. This would be expected as most obstetrics transfers would immediately be classified as P1 when booked.

2.5. Routes and destinations

2.5.1 Busy routes

As expected, with the population density of Cape Town being the highest in the so called 'Cape Flats' area serviced by MPH and KDH(15), the top two routes are primary to secondary care: Khayelitsha CHC to Khayelitsha Hospital, and Mitchells Plain CHC to Mitchells Plain Hospital. Most of these transfers are low acuity with 75% and 66% P2s for the CHC to KDH and CHC to MDH respectively. Using ILS crewed ambulances to transfer large numbers of low acuity patients over short distances seems like a non-ideal situation. Consideration could be given to a multi-seat vehicle, in order to transfer large numbers of low acuity patients together, thereby taking the load off the ambulances and more skilled crews. An 2007 prospective observational study looking at Primary Health Clinics in Cape Town showed some four patients transferred per day (19). Our data shows 16 IFTs per day which may reflect the increase in patient load over 11 years.

Hunter, Lahri and Van Hoving(20) described the patients managed in the Khayelitsha District Hospital (KDH) resuscitation area in 2016. In their six-month review, they found that some 511 patients (21.9%) of the high acuity "resuscitation bay" patients were transferred to a higher level of care, which would be Tygerberg Hospital via the third busiest route. Another study by Moller et al(21), in 2015 looked at the mode of arrival of patients in the KDH ED resuscitation bay and found that 27.7% (n=61) arrived by IFTs and the other 72.3% by primary responses (n=159), lending further evidence to the large number of transfers in (predominantly from the nearby CHC).

2.5.2 EMS qualifications

ILS moves the most patients, facilitating 106,747 (51%) of the IFTs.

Ambulances are always crewed by at least two crew members, and typically an 'ILS crew' will comprise one ILS and one BLS crew member, with the highest qualification delivering patient care. This fits very neatly with the Comprehensive Service Plan of 2010(2), which aimed for a departmental crew skill mix of 20% Advanced Emergency Care practitioner (ECP), 50% Intermediate ECP and 30% ECP.

Critical care transfers are already managed primarily by a dedicated critical care retrieval team (SPRINT) in the metropole. This is an example of identifying a resource-intensive operation and optimising it through dedicated staff and vehicles(22).

2.6. Recommendations

Further studies would be useful to examine the appropriateness of the many inter-facility referrals in the metropole (and what could be done to limit some, for example on-site laboratory or radiology services, or decentralise some services) since our data only allows us to postulate for example that non-stretcher patients do not require ambulance driven transfers. Delving into the specific routes would possibly yield more effective transfers and find where the creation of specific IFT services might produce the most benefit. Finally, are IFTs a clinical duty or a logistical necessity? Yes, there are many ill patients requiring skilled personnel during their transfer, but do we really need highly trained and scarce personnel transferring the 30,997 (21% of total) green patients (who are more than likely not stretcher bound) between facilities? The Cape Town metropole, and all of South Africa, requires and deserves a so-called ‘second leg’ of EMS—a dedicated low-fidelity service for IFTs, to lighten the load of the frontline EMS personnel and resources. This is arguably a situation replicated across the continent and other LMIC settings, where access to healthcare is via the closest facility and not necessarily the most appropriate, as we have learnt through the COVID pandemic(23).

2.7. Limitations

This is a two-year snapshot of the health system pre-COVID-19. This research and publication have been delayed for various reasons, not least the COVID-19 pandemic and its impact on healthcare providers (and authors). Although much has changed with the ongoing COVID-19 pandemic, with some reorganization of EMS systems already in place, there is no reason to believe that the findings of this study are not still representative and relevant. There were a large number of incomplete data lines that were consequently excluded from analysis, but without any clear pattern or obvious bias from these exclusions. The incident type classification in use we found to be obscure and difficult to categorize, with both symptom- and diagnosis-based categorisation, leading to inconsistency in classification. Example in case: a fractured femur may be classified under accident, assault, haemorrhage, musculoskeletal or pain (non-cardiac) and made detailed analysis of reasons for and appropriateness of transfers impossible. It is noted that sometimes more than one patient is transferred on an transfer. Unfortunately, it is unclear in the database when and how often this occurs. The study describes IFTs in the Cape Town metropolitan area, arguably one of the best resourced and managed public health services on the continent. It would be interesting to compare it to other metropoles in South Africa, and the continent as a whole, although we would argue that the findings are useful in SA, and in other developing EMS systems across the continent, facing similar urban populations and healthcare burdens.

2.8. Conclusion

IFTs are an integral part of the South African healthcare system. The use of a frontline, EMS-driven model to provide IFTs is inefficient, and consideration should be given to creating, equipping, and adequately funding a separate service to take over responsibility for the inter-facility transfer of lower acuity patients. This so-called ‘second leg’ of EMS should be a dedicated, 24-hour, seven-day week, low fidelity service, to undertake the transfer of patients between facilities, thus lessening the load on frontline EMS personnel and resources and allowing the first responders to focus on their main task –rapid primary medical response, not IFTs.

References

1. Mould-Millman N, Dixon JM, Sefa N, Yancey A, Hollong BG, Hagahmed M, Ginde AA, Wallis LA. 2017. The state of emergency medical services (EMS) systems in Africa. *Prehosp Disaster Med*. 2017;32(03):273–83.

2. Cape Town: Western Cape Department of Health. *Comprehensive service plan for the implementation of healthcare 2010* 2007 [cited 1 July 2022]. Available from https://www.westerncape.gov.za/text/2007/7/may15,2007-csp_2.pdf

3. Guide For Interfacility Patient Transfer*. National Highway Traffic Safety Administration*. 2017. [cited 23 March 2020] Available from https://www.ems.gov/pdf/advancing-ems-systems/Provider-Resources/Interfacility_Transfers.pdf

4. Lamond F. Interfacility transfer of patients in South Africa: What you need to know and how to make it happen. 2004. *CME.* July 2004;22(7):374–7.

5. Kulshrestha A, Singh J. Inter-hospital and intra-hospital patient transfer: Recent concepts. *Indian J Anaesth*. 2018;60(7):451–7.

6. Western Cape Government Health. *Annual Report 2017– 2018*. 2018. Available from www.westerncape.gov.za

7. Western Cape Department of Health. *Emergency Services: Medical Emergency Transport and Rescue* [homepage on the internet]. c.2018 [updated 2017 Dec 12; cited 2018 24 Nov]. Available from https://www.westerncape.gov.za/service/medical-emergency-transport-and-rescue-metro%20

8. Statistic South Africa. [homepage on the internet]. c2019 [cited 2019 March 21]. Available from http://www.statssa.gov.za/

9. Paediatric Triage Working Group (PTWG) of the Western Cape Government. *The South African Triage Scale Training Manual 2012. South African Triage Scale Train Man* 2012 [Internet]. 2012;1–34. Available from: https://emssa.org.za/wp-content/uploads/2011/04/SATS- Manual-A5-LR-spreads.pdf.

10. Western Cape Government. *Emergency Care.* [Internet] Available from: https://www.westerncape.gov.za/general-publication/emergency-medical-care

11. National Health Act, 2003. Government gazette, 30 June 2017. [Internet] Available from https://www.gov.za/sites/default/files/gcis_document/201707/40955gon627.pdf

12. Achoki T, Sartorius B, Watkins D, Glenn SD, Kengne AP, Oni T, Wiysonge CS, Walker A, Adetokunboh OO, Babalola TK, Bolarinwa OA, Claassens MM, Cowden RG, Day CT, Ezekannagha O, Ginindza TG, Iwu CD, Iwu CJ, Karangwa I, Katoto P, Kugbey N, Kuupiel D, Mahasha PW, Mashamba-Thompson TP, Mensah GA, Ndwandwe DE, Nnaji CA, Ntshekhe M, Nyirenda TE, Odhiambo JN, Asante KO, Parry CDH, Pillay JD, Schutte AE, Seedat S, Sliwa K, Stein DJ, Tanser FC, Useh U, Zar HJ, Liesl JZ, Bongani M, Hay SI, Murray CJL, Naghavbi M. 2019. *Health trends, inequalities and opportunities in South Africa's provinces , 1990–2019: Findings from the global burden of disease.* 2019 Study. 2022;471–81

13. Mayosi BM, Flisher AJ, Lalloo UG, Sitas F, Tollman SM, Bradshaw D. 2009.The burden of non communicable diseases in South Africa. *Lancet* [Internet]. 2009;374(9693):934–47. Available from: http://dx.doi.org/10.1016/S0140-6736(09)61087-4

14. Coovadia H, Jewkes R, Barron P, Sanders D, McIntyre D. The health and health system of South Africa: historical roots of current public health challenges. The lancet. 2009 Sep 5;374(9692):817-34.

15. *District development tool*: *City of Cape Town, profile and analysis*. 2020. [Internet]. cited 2022 Dec 1. Available from: https://www.cogta.gov.za/ddm/wp-content/uploads/2020/11/City-of-CT-September-2020.pdf

16. Mould-Millman N, Dixon JM, Burkholder T, Pigoga JL, Lee M, De Vries S, Moodley K, Meier M, Colborn K, Patel C, Wallis L. 2021.Validity and reliability of the South African triage scale in prehospital providers. *BMC Emergency Medicine*. 2021;6:1–9.

17. Twomey M, Wallis L, Thompson ML, Meyers JE. 2012. The South African triage scale (adult version) provides valid acuity ratings when used by doctors and enrolled nursing assistants. *African Journal of Emergency Medicine* 2012;2, 3-12.

18. Cramer JA, Wang ZJ, Chang E, Powers A, Copher R, Cherepanov D, Broder MS. Epilepsy & behaviour: Healthcare utilization and costs in adults with stable and uncontrolled epilepsy. *Epilepsy Behav*. 2014;31:356–62. Available from: http://dx.doi.org/10.1016/j.yebeh.2013.09.046

19. Wallis LA, Twomey M. 2007. Workload and case mix in Cape Town emergency departments. 2007. *SAMJ* 2007, December; 97(12)p1276-1280.

20. Hunter LD, Lahri S, Van Hoving DJ. 2017.. Case mix of patients managed in the resuscitation area of a district-level public hospital in Cape Town. *African Journal of Emergency Medicine.* African J Emerg Med [Internet]. 2017;7(1):19–23. Available from: http://dx.doi.org/10.1016/j.afjem.2017.01.001

21. Möller A, Hunter L, Kurland L, Lahri S, Van Hoving DJ. 2018. The association between hospital arrival time, transport method, prehospital time intervals and in-hospital mortality in trauma patients presenting to Khayelitsha Hospital, Cape Town. *African Journal of Emergency Medicine* [Internet]. 2018;8(3):89–94. Available from: https://doi.org/10.1016/j.afjem.2018.01.001

22. De Vries S, Wallis LA, Maritz D. 2011. A retrospective evaluation of the impact of a dedicated obstetric and neonatal transport service on transport times within an urban setting. *International Journal of Emergency Medicine,* 2011;2–7

23. Geldsetzer P, Reinmuth M, Ouma PO, Lautenbach S, Okiro EA, Bärnighausen T, Zipf A. Mapping physical access to healthcare for older adults in sub-Saharan Africa: A cross-sectional analysis with implications for the COVID-19 response. medRxiv. 2020. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7386521/pdf/nihpp-2020.07.17.20152389.pdf

Supplementary information

Supplementary Table 1. Patient and incident characteristics, by priority level night versus day shift

		Priority level		Shift	
	Total sample - n (%)	P1 – n (%)	P2 – n (%)	Night shift- n (%)	Day shift – n (%)
Number of transfers	231,340	81,968 (35%)	149,372 (65%)	71,272 (31%)	160,068 (69%)
Incident type					
Abdominal complaint	15,147 (7%)	2,440 (3%)	12,707 (9%)	4,043 (6%)	11,104 (7%)
Accident	3,321 (1%)	1,209 (1%)	2,112 (1%)	1,282 (2%)	2,039 (1%)
Allergic reaction	346 (0.2%)	114 (0.1%)	232 (0.2%)	75 (0.1%)	271 (0.2%)
Assault	13,089 (6%)	4,502 (5%)	8,587 (6%)	7,306 (10%)	5,783 (4%)
Bleeding (non-traumatic)	3,017 (1%)	1,188 (1%)	1,829 (1%)	1,006 (1%)	2,011 (1%)
Cardiac	9,526 (4%)	5,403 (7%)	4,123 (3%)	2,527 (4%)	6,999 (4%)
Dermatological	1,697 (1%)	143 (0.2%)	1,554 (1%)	402 (0.6%)	1,295 (1%)
Environmental	340 (0.2%)	95 (0.1%)	245 (0.2%)	114 (0.2%)	226 (0.1%)
Fever	1,063 (0.5%)	429 (0.5%)	634 (0.4%)	201 (0.3%)	862 (0.5%)
Gynaecological	9,573 (4%)	2,057 (3%)	7,516 (5%)	2,906 (4%)	6,667 (4%)
Haemorrhage	661 (0.3%)	282 (0.3%)	379 (0.3%)	189 (0.3%)	472 (0.3%)
Musculoskeletal	34,229 (15%)	4,078 (5%)	30,151 (20%)	8,962 (13%)	25,267 (16%)
Neurological/ seizures	35,004 (15%)	10,329 (13%)	24,675 (17%)	10,983 (15%)	24,021 (15%)
Obstetric	28,791 (12%)	17,394 (21%)	11,397 (8%)	10,870 (15%)	17,921 (11%)
Pain (non-cardiac)	11,644 (5%)	1,509 (2%)	10,135 (7%)	3,717 (5%)	7,927 (5%)
Psych/ self-harm	14,812 (6%)	1,283 (2%)	13,529 (9%)	3,726 (5%)	11,086 (7%)
Respiratory	33,818 (15%)	16,872 (21%)	16,946 (11%)	7,788 (11%)	26,030 (16%)
Specialised service	11,707 (5%)	11,560 (14%)	147 (0.1%)	4,351 (6%)	7,356 (5%)
Vomiting/ diarrhoea	3,555 (2%)	1,081 (1%)	2,474 (2%)	824 (1%)	2,731 (2%)

P1 - priority 1. P2 – priority 2. Day shift and night shift hours are from 07h00–19h00 and 19h00–07h00 respectively.

Supplementary Table 2. Transfers from Khayelitsha (Site B) CHC to Khayelitsha Hospital

		Priority level		Shift	
	Total sample – n (%)	P1 – n (%)	P2 – n (%)	Night shift – n (%)	Day shift – n (%)
Number of transfers	12,053	2,980 (25%)	9,073 (75%)	4,531 (38%)	7,522 (62%)
Patient gender					
Female	7,047 (58%)	1,920 (64%)	5,127 (57%)	2,565 (57%)	4,482 (60%)
Male	5,001 (41%)	1,060 (36%)	3,941 (43%)	1,963 (43%)	3,038 (40%)
Median age [IQR]	27 [14,37]	20 [1, 30]	29 [19, 39]	26 [16, 35]	27 [11, 38]
<1 day	112 (1%)	88 (3%)	24 (0.3%)	49 (1%)	63 (1%)
1-30 days	208 (2%)	124 (4%)	84 (1%)	28 (1%)	180 (2%)
1-12 months	1,035 (9%)	649 (22%)	386 (4%)	326 (7%)	709 (9%)
1-12 years	1,617 (13%)	386 (13%)	1,231 (14%)	648 (14%)	969 (13%)
13-18 years	584 (5%)	138 (5%)	446 (5%)	249 (6%)	335 (4%)
19-29 years	3,401 (28%)	809 (27%)	2,592 (29%)	1,472 (32%)	1,929 (26%)
30-39 years	2,472 (21%)	399 (13%)	2,073 (23%)	889 (20%)	1,583 (21%)
49-49 years	1,118 (9%)	142 (5%)	976 (11%)	375 (8%)	743 (10%)
50-59 years	692 (6%)	105 (4%)	587 (6%)	199 (4%)	493 (7%)
60-69 years	456 (4%)	76 (3%)	380 (4%)	165 (4%)	291 (4%)
70 years or older	358 (3%)	64 (2%)	294 (3%)	131 (3%)	227 (3%)
Triage colour					
Red	431 (4%)	299 (10%)	132 (1%)	195 (4%)	236 (3%)
Orange	2,500 (21%)	1,678 (56%)	822 (9%)	974 (22%)	1,526 (20%)
Yellow	7,641 (64%)	777 (26%)	6,864 (76%)	2,786 (62%)	4,855 (65%)
Green	1,447 (12%)	216 (7%)	1,231 (14%)	561 (12%)	886 (12%)
Blue	5 (<0.1%)	1 (<0.1%)	4 (<0.1%)	3 (0.1%)	2 (<0.1%)
Response unit					
Ambulance	10,407 (86%)	2,826 (95%)	7,581 (84%)	3,809 (84%)	6,598 (88%)
HealthNET	1,622 (13%)	133 (4%)	1,489 (16%)	712 (16%)	910 (12%)
PICU Ambulance	21 (0.2%)	21 (1%)	0 (0%)	9 (0.2%)	12 (0.2%)
Crew (n=8,829)					
ALS/ECP/ECT	1,072 (12%)	637 (28%)	435 (7%)	531 (14%)	541 (11%)
ILS	5,538 (63%)	1,308 (57%)	4,230 (65%)	2,536 (67%)	3,002 (59%)
BLS	2,219 (25%)	332 (15%)	1,887 (29%)	694 (18%)	1,525 (30%)
Doctor	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

PICU – paediatric intensive care unit. P1 - priority 1. P2 – priority 2. Basic life support (BLS), Intermediate life support (ILS), Advanced life support (ALS), Emergency care provider (ECP), Emergency care technician (ECT). Triage colour as per SATS. Day shift and night shift hours are from 07h00–19h00 and 19h00–07h00 respectively.

Supplementary Table 3. Transfers from Khayelitsha Hospital to Tygerberg Hospital

		Priority level		Shift	
	Total sample – n (%)	P1 – n (%)	P2 – n (%)	Night shift – n (%)	Day shift – n (%)
Number of transfers	7,707	3,355 (44%)	4,352 (56%)	2,989 (39%)	4,718 (61%)
Patient gender					
Female	3,523 (46%)	1,617 (48%)	1,906 (44%)	1,219 (41%)	2,304 (49%)
Male	4,179 (54%)	1,735 (52%)	2,444 (56%)	1,767 (59%)	2,412 (51%)
Median age [IQR]	29 [19, 41]	26 [3, 36]	32 [23, 46]	28 [18, 38]	30 [20, 43]
<1 day	21 (0.3%)	13 (0.4%)	8 (0.2%)	7 (0.2%)	14 (0.3%)
1-30 days	176 (2%)	139 (4%)	37 (1%)	61 (2%)	115 (2%)
1-12 months	586 (8%)	459 (14%)	127 (3%)	248 (8%)	338 (7%)
1-12 years	795 (10%)	347 (10%)	448 (10%)	322 (11%)	473 (10%)
13-18 years	291 (4%)	131 (4%)	160 (4%)	124 (4%)	167 (4%)
19-29 years	1,986 (26%)	906 (27%)	1,080 (25%)	841 (28%)	1,145 (24%)
30-39 years	1,740 (23%)	728 (22%)	1,012 (23%)	692 (23%)	1,048 (22%)
40-49 years	870 (11%)	277 (8%)	593 (14%)	293 (10%)	577 (12%)
50-59 years	653 (8%)	199 (6%)	454 (10%)	218 (7%)	435 (9%)
60-69 years	377 (5%)	102 (3%)	275 (6%)	114 (4%)	263 (6%)
70 years or older	212 (3%)	54 (2%)	158 (4%)	69 (2%)	143 (3%)
Triage colour					
Red	1,092 (14%)	954 (29%)	138 (3%)	524 (18%)	568 (12%)
Orange	2,273 (30%)	1,572 (47%)	701 (16%)	920 (31%)	1,353 (29%)
Yellow	3,650 (47%)	694 (21%)	2,956 (68%)	1,298 (44%)	2,352 (50%)
Green	665 (9%)	122 (4%)	543 (13%)	235 (8%)	430 (9%)
Response unit					
Ambulance	6,847 (89%)	3,135 (93%)	3,712 (85%)	2,705 (91%)	4,142 (88%)
HealthNET	666 (9%)	28 (1%)	638 (15%)	190 (6%)	476 (10%)
PICU Ambulance	194 (3%)	192 (6%)	2 (0.1%)	94 (3%)	100 (2%)
Crew (n=6,554)					
ALS/ECP/ECT	1,763 (27%)	1,471 (51%)	292 (8%)	756 (30%)	1,007 (25%)
ILS	3,709 (57%)	1,228 (42%)	2,481 (68%)	1,418 (56%)	2,291 (57%)
BLS	1,082 (17%)	214 (7%)	868 (24%)	350 (14%)	732 (18%)
Doctor	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

PICU – paediatric intensive care unit. P1 - priority 1. P2 – priority 2. Basic life support (BLS), Intermediate life support (ILS), Advanced life support (ALS), Emergency care provider (ECP), Emergency care technician (ECT). Triage colour as per SATS. Day shift and night shift hours are from 07h00–19h00 and 19h00–07h00 respectively.

Supplementary Table 4. Priority levels and triage colours by crew

	Total sample – n (%)	**ALS/ECP/ECT**	**BLS**	**ILS**
Number of transfers	208,446	48,534 (23%)	53,165 (26%)	106,747 (51%)
Priority				
P1	74,288 (36%)	29,843 (61%)	12,404 (23%)	32,041 (30%)
P2	134,158 (64%)	18,691 (39%)	40,761 (77%)	74,706 (70%)
Triage colour				
Red	13,429 (6%)	7,457 (15%)	1,764 (3%)	4,208 (4%)
Orange	52,079 (25%)	17,221 (36%)	10,202 (19%)	24,656 (23%)
Yellow	107,513 (52%)	18,668 (39%)	30,760 (58%)	58,085 (55%)
Green	34,554 (17%)	4,991 (10%)	10,197 (19%)	19,366 (18%)
Blue	68 (<0.1%)	30 (0.1%)	12 (<0.1%)	26 (<0.1%)

P1 - priority 1. P2 – priority 2. Basic life support (BLS), Intermediate life support (ILS), Advanced life support (ALS), Emergency care provider (ECP), Emergency care technician (ECT). Triage colour as per SATS.

APPENDICES

Appendix I - Letter of ethical approval

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

HUMAN RESEARCH ETHICS COMMITTEE
16 AUG 2022
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

FHS017: Annual Progress Report / Renewal

Record Reviews/Audits/Collection of Biological Specimens/Repositories/Databases/Registries

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
☑ Approved	Annual progress report	Approved until/next renewal date	30-6-23
☐ Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee	[signature]	Date Signed	16/8/2022

Note: Please note that incomplete submissions will not be reviewed.
Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za.

Please clarify your plan for research-related activities during COVID-19 lockdown

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	3 June 2022		
HREC REF Number	375/2019	Current Ethics Approval was granted until	30/6/2022
Protocol title	Inter-facility transfer in the Cape Town Metropole by the Western Cape Government Emergency Medical Service – A retrospective, descriptive study		
Principal Investigator	Dr S Rambharose		
Department / Office Internal Mail Address	F51, Old Main Building, Groote Schuur Hospital, Observatory, Cape Town		
1.1 Does this protocol receive US Federal funding?		☐ Yes	✓ No

2. Protocol status (tick ✓)

☐	Research-related activities are ongoing
✓	Data collection is complete, data analysis only
Please indicate (in the block below) the titles and HREC reference numbers of any projects currently making use of the Database/registry/repository.	

3. Protocol summary

Total number of records or specimens collected, reviewed or stored since the original approval	1	
Total number of records or specimens collected, reviewed or stored since last progress report	1	
Have any research-related outputs (e.g. publications, abstracts, conference presentations) resulted from this research? If yes, please list and attach with this report.	☐ Yes	✓ No

4. Signature

Signature of PI	[signature]	Date	3 June 2022

16 February 2022 Page 1 of 1 FHS017
(Note: Please complete the Closure form (FHS019) if the study is completed within the approval period)

Appendix II - Research Protocol

Inter-facility transfers in the Cape Town Metropole

by the Western Cape Government Emergency Medical Service

– A retrospective, descriptive study

Protocol for MPHIL in Emergency Medicine

Division of Emergency Medicine, University of Cape Town

Dr Franz Gustav Lemke

LMKFRA001

May 2019

Research Supervisor: Dr S Rambharose

Co-Supervisor: A/Prof. P Hodkinson

- I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.
- I have used the required convention for citation and referencing. Each contribution to and quotation in this assignment from the work(s) of other people has been attributed and has been cited and referenced.
- This assignment is my own work.
- I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.
- I acknowledge that copying someone else's assignment or essay, or part of it, is wrong, and declare that this is my own work.

May 2019

Contents

Title

Inter-facility transfers in the Cape Town Metropole by the Western Cape Government Emergency Medical Service - a retrospective, descriptive study.

Introduction

Inter-facility transfers (IFTs) are key components of the healthcare system. The movement and flow of patients between facilities, especially when escalation of care is needed, is a daily occurrence. In South Africa, most transfers are done by the Emergency Medical Service (EMS), especially when urgent or emergent. South Africa is an upper middle-income country with significant resource and system challenges. That been said, South Africa boasts the most developed and busiest Emergency Medical Service on the continent(1).

The World Health Organization defines a healthcare facility as the following(2): *"Health-care facilities are hospitals, primary health-care centres, isolation camps, burn patient units, feeding centres and others"*. For the purpose of this document and research, IFTs between healthcare facilities include all facilities where patients first encounter the South African health system, whether it be a nurse driven community centre, private General Practitioner, or a tertiary/quaternary facility.

Inter-facility transfer is defined by the American National Traffic Highway Safety Administration (NTHSA) as the following: *"Any transfer, after initial assessment and stabilization, from and to a healthcare facility*(3). The main reasons for the IFT of patients are that they require either a higher level of clinical expertise or level of institution to manage their underlying condition. Therefore, the level of care the patient is receiving is always increasing(4), up to the point where the level of care matches the care required by the patient.

Patients can also be moved down the level of care value chain. This occurs when their respective needs have been met and they require a lower level of care (e.g. stepdown to a rehabilitation centre from the Critical Care Unit (CCU) after a spinal injury). Once again, the EMS forms a critical part of this process as patients need to be transported between various institutions.

Furthermore, as stated by Kulshreshta(5), IFTs form part of the health risk vs benefit conundrum. IFTs are based on the fact that the benefit of care to the patient outweighs the risk of the transfer. Therefore, IFTs are an integral part of any Healthcare system.

As published in the Western Cape Government Annual report of 2017/2018(6), 31.6% of the workload of the Western Cape Government Emergency Medical Service (WCG-EMS) across the province is inter-facility transfers. Inter-facility transfers are carried out by two distinct components within WCG-EMS. Ambulance Operations and HealthNET (Health Non-Emergency Transport). According to the Western Cape government, *"HealthNET (Health Non-Emergency Transport) provides transport for non-emergency patients between home and facilities, or between multiple facilities. Patients are booked using an online system that ensures that seats are allocated equitably and no patients can be overbooked"*(7). There are currently up to 90 HealthNET vehicles operating across the Western Cape Province. Ambulance operations is responsible for all other inter-facility transfers, including but not limited to all after-hours transfers, all emergency transfers and transporting patients from facilities not covered by HealthNET network, as well as responding to all primary pre-hospital emergency calls.

Literature on IFTs in the South African context is limited. Schoon(8) looked at the impact of IFTs on obstetric patients in the Free State. After an investigation and identifying of a critical gap in 2011, 48 ambulances (18 dedicated to obstetric care), where introduced to the Free State Provincial Emergency Medical Service. The maternal mortality decreased by 44% (279/100 000 live births to 152/100 000), the mean ambulance dispatch time interval decreased by +-30% (32.01min to 22.47min) and the number of vehicles dispatched within 1 hour increased by 6.5% (84.2% to 90.7%).

In the Western Cape, De Vries et al(9) looked at the impact a dedicated obstetric and neonatal transport service (*"flying squad")* would have on transport times within the Cape Town metropole. In the 30-min performance category maternity calls response time increased from 30.3% to 72.9%. Furthermore, the flying squad led to a reduction in a total pre-hospital time from 177 to 128 min for neonatal transfers.

In the eThekwini Health District in Kwazulu-Natal, P Ashokcoomar and R Naidoo did an analysis of inter-healthcare facility transfer of neonates(10). They found that in 30.8% of the IFTs there were inadequate availability of equipment noted.

Farther afield, Robinson et al(11) did a descriptive examination of IFTs in Ontario, Canada. They found that there are more than 1000 IFTs daily (almost 400 000 annually) in the Province of Ontario, and more than 80% of them are non-urgent. (The study investigators believe that in the South African context many more of these transfers are urgent and emergent patients. A secondary objective of this study is to assess the acuity level of IFTs done in the Cape Town Metropole). Furthermore, they found that 24.3% of IFT's, amounting to 85 000 patients annually at a cost of C$283 million (in 2003) were utilised for dialysis and physician appointments, and return trips home. As the personnel utilised for the IFTs were dispatched via the same system utilised by the 911 emergency calls, the resources used for IFTs were fully equipped ambulances and highly trained EMS providers. The authors conclude with the following problem statement: *"these results call into question the use of sophisticated, highly trained, expensive patient transfer resources to provide routine medical services in Ontario"*. In a further study from Canada, Bergeron et al(12) found that 28% (n = 125/444) of their IFTs from a rural hospital were to a referral facility with access to a CT scanner. The authors conclude that having a CT scanner at the rural facility would significantly decrease the amount of IFTs done, thereby reducing the workload on the local EMS. This problem could be extrapolated to the Cape Town metropole, where the lack of a CT-scanner at Khayelitsha hospital (district hospital in Cape Town Metropole) has a significant impact on the amount of IFTs between Khayelitsha and Tygerberg Hospital.

The public healthcare needs of the Cape Town metropole are served by three tertiary centers. Groote Schuur and Red Cross War Memorial Children's Hospital are based in the Southern Suburbs, and Tygerberg Hospital is located in the Northern Suburbs. The mental health care needs are serviced by Valkenberg and Stikland Psychiatric institutions respectively. These institutions cater not only for the whole of the Metropole, but act as the tertiary and quaternary referral centers for the whole of the Western Cape (population 6.3 million(13)).

The health needs of patients are served by a network of interconnected health care facilities. This includes secondary and district hospitals (e.g. New Somerset Hospital in Green Point and Victoria Hospital in Wynberg), Community Health Care centers (CHC's and day hospitals) and primary health care facilities (some of which are nurse run). Patients may present primarily to any of these institutions, and their healthcare needs will be addressed at the appropriate level of care. This interconnected system requires a large amount of inter-facility movement, as patients are transferred until their healthcare needs are met by the treating institution. It is not uncommon for a patient to be transferred three times in one acute admission, especially when patients present to the primary care centers with complex medical requirements. A patient with a suspicious headache requiring an urgent after-hour computed tomography angiography (CTA) scan to exclude a subarachnoid hemorrhage (SAH) may require transfer as follows:

- Community health care center to district hospital for clinical review after presenting to the primary care facility as entry point to the public healthcare system.
- District hospital to tertiary center for emergent imaging.
- Transfer back to the initial referring district hospital after CTA imaging excluded a SAH.

These urgent and emergent inter-facility transfers add a significant additional burden to an already stretched EMS system. Not only are ambulances with appropriately trained Emergency Medical Service providers diverted from primary calls to do the transfers, sometimes they may spend most of their shift driving one patient around the metropole, as per the hypothetical patient mentioned above.

Motivation

IFTs are an integral part of the Healthcare system. However, whether these services are utilised as effective and efficient as required, whether it is sufficiently staffed and equipped, and whether it takes away resources from the primary role of the ambulance service needs to be determined. At this present time not much is known on the specific workload IFTs add to the WCG-EMS. The motivation for this study is to describe and quantify inter-facility transfers in the Cape Town metropole by the WCG-EMS to ascertain whether resources are optimally utilized. The study results will hopefully assist in identifying challenges in the system and could enhance the system by adequately utilising precious pre-hospital resources and improving patient care.

Research question

What was the nature and indication of all inter-facility road transfers performed by the WCPEMS in the Cape Town Metropole between January 2017 and December 2018?

Aim and objectives

Aim

The aim of the study is to describe the inter-facility transfers done by road by the Western Cape Government Emergency Medical Service in the Cape Town metropole over the study period.

Objectives

Primary objective

- To describe the number and type of transfers done between health facilities in the Cape Town metropole.

Secondary objectives

- To identify the most common inter-facility routes.
- To examine the prioritization and acuity of inter-facility transfers.
- To assess the crew qualifications and skillset allocated for inter-facility transfers.
- To describe the acuity level of the transferred patients by identifying their initial triage code at the time that the transfer is initiated
- To ascertain the number of patients transferred to a lower level facility as step-down of care.

Methodology

Study design

The study is a retrospective, descriptive, observational study consisting of two components:

- Requesting and collecting the data relating to inter-facility transfers from the WCG-EMS service.
- Analysing the data and stratifying it into categories. The proposed categories are the following but may be modified for clarity if deemed necessary by the study investigators needed:
  - Critical care
  - Trauma
  - Cardiology
  - Paediatric and neonatal
  - Obstetric
  - After hours vs business hours
  - Public to private and vice versa

Inclusion criteria

- All road inter-facility transfers data-captured on the Cape Town metropole Emergency Medical Service database.
- All inter-facility transfers transporting a patient from one healthcare facility to another healthcare facility will be included.

Exclusion criteria

- Incomplete data.
- Primary calls will be excluded.
- Cancelled inter-facility transfer for whatever reason.
- Inter-facility transfers not done by road i.e. Aeromedical transfers.
- Inter-facility transfers not completed for whatever reason for example: Ambulance turned back en-route.

Time period

- 1 Jan 2017- 31 Dec 2018. The study period was decided on by the investigators as a convenient period following the inception of a new electronic database.

Study setting and population

- All ambulance directed IFT's by Cape Town Metro control. Cape Town Metro Control serves a total area of 129,526 km2 with an estimated total population of 5,400,000 people(9).
- All interfacility transfers done by the Provincial Emergency Medical Service captured on the database will be assessed.
- Therefore, all patients that are transferred from one institution to another will be included. This would include community health centre transfers.

Data collection and capturing

Following ethics approval, a formal request will be submitted by the researcher to the Director of the WCG-EMS. The researcher will request the following information:

- Access to data on all inter-facility transfers done under the direction of Cape Town Metro Control over the study period of two years in the Western Cape Government Emergency Medical service registry.
- The investigator will request access to all the IFT's during the study period captured in the registry.

The data will be received in Microsoft Excel spreadsheet format by the primary investigator, from WCG-EMS. The data will be digitally saved in a password-protected file that is only accessible to the lead investigator. If the received data in the excel spreadsheet is not yet de-identified by the WCG-EMS, it will be de-identified by the primary investigator.

Data protection

The data will be kept on a password protected laptop belonging to the primary investigator. The computer will be kept behind a locked door at the primary investigators' residence. No third parties will have access to either the computer or the data. The primary researcher and the research supervisors will be the only persons with full access to the database.

Dissemination of findings

This research paper will be submitted for publication in a peer-reviewed journal. It will also be submitted to the University of Cape Town as a 90-credit dissertation as part of the requirements for the MPHIL Patient Safety. Furthermore, the findings of this review will be shared with Dr de Vries and relevant managers at the WCG-EMS.

Strengths and limitations

Strengths

- A single database will be utilized.
- Data from the past two years is available.
- The database is already registered with HREC which should expedite ethical approval.
- Novel study that has not been done in South Africa before.

Limitations

- There is a single researcher who will be both the data capture and lead investigator.
- The primary researcher is currently based in Australia.
- It is a retrospective review of a database; therefore, we can assume that there will be gaps in the data.

Ethics

- Approval for this research study will be sought from UCT HREC and the Western Cape Department of Health, Emergency Medical Services.
- The EMS electronic databases are already registered with UCT HREC, and this will expedite the ethics approval since all data analysed will be from this database.

Autonomy

There are no personal risks or benefits involved to participate in the study. The data is collected from the WCG-EMS database. All data will be collected anonymously. The data will be received in Microsoft Excel spreadsheet format by the primary investigator, from WCG-EMS. If the received data in the excel spreadsheet is not yet de-identified by the WCG-EMS, it will be de-identified by the primary investigator. No personal or identifying details will be collected. The data will only be accessible on a password protected personal computer in the personal care of the primary researcher. The computer will be kept behind a locked door at the primary investigators' residence. No third parties will have access to either the computer or the data. Access to this information was restricted to senior members of the research team.

Beneficence

The benefit of this study will be to give the decision makers of the WCG-EMS and staff involved in IFTs done in the Cape Town metropole a birds-eye view of what is happening in the system at the present moment. Hopefully, challenges brought to light by this study can be addressed and resources allocated to improve system deficiencies if found. Improving IFTs in the CT metropole will directly improve patient care and outcomes and improve the working conditions of the staff doing IFTs.

Justice

As this study is retrospective, database driven research there will be equitable selection across all sectors of the community due to including all the database data (minus data meeting the study exclusion criteria, stated above). There will be no unfair coercing of certain vulnerable population groups to participate in the study. The benefits of the study will be equal and apply to all population. The researchers do not foresee any controversial or major ethical issues to be raised by this research study.

Time frame

2019	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Summary Development	X											
Proposal Development		X	X									
EM-DRC				X								
Ethics					X	X						
Data Collection							X					
Data Analysis								X	X			
Write-up										X	X	
Submission												X

Budget

Budget	Unit cost	Total
Stationary - Pens - Print paper - Print cartridges - Copying	 R 20 x 5 10c per page x 250 R 190 per cartridge x 4 50c per page x 100	 R 100 R 25 R 760 R 50
Telephone and internet - Internet, broadband, uncapped - Mobile phone	 R 750 per month x 6 R 1200 per month x 6	 R 4500 R 7200
Total:		**R 12 635**

This study will be self-funded by the primary researcher.

References

1. Hagahmed M et al. The State of Emergency Medical Services (EMS) Systems in Africa. Prehosp Disaster Med. 2017;32(03):273–83.

2. World Health Organization. Health-care facilities. [homepage on the internet].c2019 [cited 2019 Mar 17]. Available from https://www.who.int/environmental_health_emergencies/services/en/

3. National Highway Traffic Safety Administration. Guideline for Interfacility transfer. C2006 [cited 2019 Feb 13] Available from https://www.ems.gov/pdf/advancing-ems-systems/Provider-Resources/Interfacility_Transfers.pdf.

4. Lamond F. Interfacility transfer of patients In South Africa—What you need to know and how to make it happen. Continuing Medical Education 2004;22(7)374-377.

5. Kulshrestha A, Singh J, Care I, Hospital VM, Sikrod G, Road M, et al. Inter-hospital and intra-hospital patient transfer : Recent concepts. Indian J Anaesth. 2016 Jul; 60(7): 451–457.

6. Western Cape Government Annual Reports. Health. Annual report [homepage on the internet]. C2018 [cited 2018 Nov 20]. Available from https://www.westerncape.gov.za/documents/annual_reports/2018.

7. Western Cape Department of Health. Emergency Services. Medical Emergency Transport and Rescue [homepage on the internet]. c2018 [updated 2017 Dec 12; cited 2018 24 Nov]. Available from https://www.westerncape.gov.za/service/medical-emergency-transport-and-rescue-metro%20.

8. Schoon MG, Mmed O, Sciences H, Africa S. Impact of inter-facility transport on maternal mortality in the Free State Province. 2013;103(8):534–7.

9. Vries S De, Wallis LA, Maritz D. A retrospective evaluation of the impact of a dedicated obstetric and neonatal transport service on transport times within an urban setting. 2011;2–7.

10. Ashokcoomar P, Emergency M, Care M, Naidoo R. An analysis of inter-healthcare facility transfer of neonates within the eThekwini Health District of KwaZulu-Natal , South Africa. 2016;106(5):514–8.

11. Robinson V, Goel V, MacDonald RD, Manuel D. Inter-facility patient transfers in Ontario: Do you know what your local ambulance is being used for? Healthcare Policy. 2009 Feb;4(3):53.

12. Bergeron C, Fleet R, Tounkara FK, Lavallée-Bourget I, Turgeon-Pelchat C. Lack of CT scanner in a rural emergency department increases inter-facility transfers: a pilot study. BMC research notes. 2017 Dec;10(1):772.

13. Statistic South Africa. [homepage on the internet]. c2019 [cited 2019 March 21]. Available from http://www.statssa.gov.za/.

Appendix III – Acknowledgements

Acknowledgements to my supervisors Peter Hodkinson and Sanjeev Rambharose for their patience and invaluable guidance.

To my editor Anne Taylor for assistance in creating the final manuscript.

To my family for their support.

A big thanks to Thomas Slingsby at the UCT GIS Lab, (UCT Libraries) for his assistance in creating the map, figure 1

The authors acknowledge the contributions of Kirsty Brittain, Division of Epidemiology & Biostatistics, School of Public Health & Family Medicine, University of Cape Town.