A comparison of critical care transportation modules taught in bachelor's degrees in emergency medical care in South Africa

by

Nathan John Conradie

Master of Philosophy in Emergency Medicine, University of Cape Town

CNRNAT001

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Supervisors: Dr Willem Stassen and Prof Craig Vincent-Lambert

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Declaration

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Dedication

- To my family, for your constant support and encouragement through this process. Special thanks to my Dad for helping with the editing.

- To my beautiful fiancé for holding my hand through all the highs and lows of this master's degree. Without you I would not have been able to do this.

- To Dr Willem Stassen, thank you for your guidance, not only on this project, but in life. I would not be at this point without you.

- To Prof Craig Lambert, thank you for being a mentor to me on this project and in my career. Your impact on the field and on me has been immense.

- Finally, I would like to dedicate this degree to the memory of my friends Garth van Niekerk and Chad Townley. To Garth for inspiring me to follow in your footsteps. To Chad for being a friend like no other.

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Abbreviations

ANT – Ambulance Emergency Technician

BEMC – Bachelor in Emergency Medical Care

CCA – Critical Care Assistant

CCAT AL - Clinical Considerations in Aeromedical Transport Advanced Level

CCAT FL - Clinical Considerations in Aeromedical Transport Foundation Level

CCP-C – Critical Care Paramedic – Certification

CCR – Critical Care Retrieval

CME – Continuous Medical Education

DHET – Department of Higher Education

ECP – Emergency Care Practitioner

EMS – Emergency medical services

FAST – Focused Assessment with Sonography in Trauma

HERO – Health Emergency Response Offices

HMFC – Helicopter Medical Flight Crew

HPCSA – Health Professions Council of South Africa

IBTPHEM – Inter-collegiate Board for Training in Pre-Hospital Emergency Medicine

IFT - Inter-Facility Transfers

IPE – Inter-Professional Education

MeSH – Medical Subject Heading

NQF – National Qualifications Framework

PCG – Post-Graduation Certificate

SAQA – South African Qualification Authority

PART A: LITERATURE REVIEW

Background

The aim of this literature review was to collect and appraise literature related to curricula in critical care transportation and retrieval, pre-hospital care, and aeromedical transportation. The search strategy was twofold. Firstly peer-reviewed published literature was sourced from established platforms. Secondly, grey literature was sourced from internet sources. An assessment of reliability and validity was performed on peer-reviewed literature in the appraisal process.

The results of the literature review show that there is a paucity of literature describing critical care modules of pre-hospital educational programmes in South Africa. This lack of literature has led the authors of this review to conclude that there is a potential for insufficient benchmarking and standardisation of the critical care module between universities. The results of this study could allow stakeholders to begin the process of academic standardisation.

To provide a comprehensive background on the field of critical care transportation and retrieval and specifically education and training, this literature review starts by describing the field locally. It then attempts to outline the risks associated with critical care retrieval and thereby demonstrating the importance of quality education and regulation that can guide practitioners who perform retrievals. It then seeks to understand the importance of standard-setting within education broadly and the role of curricula in standard-setting. Finally, it provides an overview of methods for comparing curricula. After the background sections, the gathered literature was grouped into themes according to the types of curricula included in the literature. All these types of curricula form part of the critical care transportation and retrieval field, as graduates from these programmes are usually involved in the transportation of critically ill patients between facilities.

Critical care retrieval

Critical care retrieval and patient transportation is a developing field, with ever new technologies and systems used to move critically ill patients between facilities. (1) As with other fields in medicine, there are vast differences in resources between healthcare systems. Access to critical care is a key component of the continuum of care, from when critically ill patients access the healthcare system to when they are discharged. Each component in the

continuum should work together for the patient's benefit in order to produce the best outcomes.

Data from the Global Burden of Disease study shows that patients were less likely to receive mechanical ventilation in low-income countries, in contrast to upper-middle to higher-income countries (all $p<0.0001$). The results also show that low and lower-middle income countries have significantly fewer ICU beds, 352 (200–600), as opposed to upper-middle income countries, with 550 (200–1200), and high-income, with 642 (400–950). (2)

These data show that the burden on critical illness is most acutely felt in lower- and middle-income countries. In South Africa, with an ailing public healthcare system and a large proportion of the population living without healthcare insurance, this has the potential to impact the most vulnerable in society. (3) The burden of disease is highest in low- to middle-income countries and these countries have the least capacity, and critical care resources to deal with this. For that reason, the potential for transfer is high, which burdens an already stretched EMS system.

A systematic review done in 2015 by Murthy and colleagues shows that access to critical care facilities is limited in low- to middle-income countries. They reviewed 1759 citations which included 43 studies from 15 low-income countries, which described 36 ICUs in 31 cities. Of these cities, 16 had populations greater than 500 000. (4)

Their study concluded that in general low-income countries lack ICU beds and that more than half of low-income countries do not have any published data on their critical care capacity. Additionally, within lower-income countries, most ICUs were situated in large regional facilities, potentially necessitating the need for frequent movement of patients between facilities. Although South Africa was not represented in the study, owing to the heterogeneity in resource distribution, some (especially rural) areas in South Africa may have similar structural healthcare problems as the low-income counties in the study. (5)

South Africa, like other middle-income countries, has a relative shortage of ICU beds. This is seen most prominently in peri-urban and rural areas. An audit, done by Scribante and Bhagwanjee and published in 2007, showed that, of the ICU beds in the country, there was a total of 4168 beds in both the private and public sectors. They had a 100% sample. Most of the beds are in Gauteng, KwaZulu-Natal, and the Western Cape. The other provinces have less than 300 beds each. (6) A further breakdown of the ICU beds in South Africa shows that

only 23% of state healthcare facilities have ICUs or high-care units. This is in contrast to 84% of private facilities having access to these units.

The public sector has a bed-to-population ratio in the Free State, Gauteng, and Western Cape of less the 1:20 000; in other provinces, the ratio is between 1:30 000 and 1:80 000. The ICU bed to total hospital bed ratio is 1.7% in public hospitals, compared to 8.9% in private. Only around 1 in 5 ICU beds are dedicated to paediatric and neonatal populations. These data show that, along with a shortage of medical specialists, there is a potential need for patients to be transferred for further management. (6)

Another analysis of ICU beds done in South Africa, by Naidoo and colleagues and published in 2013, showed similar findings to that those of Scribante and Bhagwanjee. They conducted a desktop audit of all public- and private-sector ICUs. They found there were 4719 ICU beds in the country, with 75% being in the private sector and 25% in the public. They also found that most of the ICU beds were located in Gauteng, KwaZulu-Natal, and the Western Cape, together representing 78% (3703/4719) of the ICU beds in the country. However, the population in those provinces is only 54% of the total population of the country. They also found all the other provinces have less than 300 hundred beds each. Some, like Limpopo and the Northern Cape, have only 66 and 47 respectively. (7)

The lack of ICU beds and the incidence of life-threatening disease of critically ill and injured patients are some of the reasons why patients are commonly moved between facilities. Unfortunately, the burden of moving critically ill patients is borne by the emergency medical services (EMS), which further stretches resources away from primary responses. (8)

The healthcare system works on a delicate balance between demand and supply of resources. Since the emergence of critical care units in the 1950s, demand has grown steadily for this resource. (9) Whenever demand outstrips supply for critical care beds in hospitals, patients require movement to facilities able to provide this service. In the US, around 5% of all patients requiring critical care are transferred. (10) It is estimated that the numbers are similar or even higher for the South African setting.

In addition to the high rates of transfers, centralisation of specialities has been shown to reduce mortality and morbidity. (10) The movement to the centralisation of specialities will necessitate the movement of patients between facilities. For these reasons, it is likely that the high rates of transferred patients will not reduce in the short term.

Critical care retrieval has been defined in different ways, according to the healthcare system in which it is performed. A current definition specific to South Africa, made by members of a working group within the critical care and pre-hospital fields, distinguishes between patients transferred between facilities (inter-facility transfer) and a critically ill, highly dependent patient, requiring specialised resources to be moved between facilities. They have defined the second type of transfer as critical care retrieval. Their definition of this type of transfer is as follows: critical care retrieval (CCR) is the stabilisation and transport of a critically ill or injured patient from a facility where the healthcare requirements of the patient outweigh the diagnostic or treatment abilities, and expertise available, to an appropriate facility where these are available. (11)

The working group went further to identify key aspects of critical care retrieval that distinguish it from inter-facility transfers, differentiating it from standard inter-facility transfers and the normal operations of the emergency medical services. They prescribe that critical care retrieval teams should have specialised knowledge and skills to match the patient populations and clinical requirements. There should be specific criteria that match the patient's clinical features to the critical care retrieval team. They prescribe that services offering critical care retrieval should have an integrated specialised coordinating centre. Finally, regardless of the mode of transportation, be it road or air, critical care retrieval units should have the same specialised equipment and carry practitioners of adequate knowledge to safely transport critically ill patients. (12)

Before this definition there was no accepted South African definition of critical care retrieval. There is an alignment between the South African definition and an international definition. A definition made by the Oxford Specialist Handbook of Retrieval Medicine describes retrieval medicine as "the inter-hospital transfer of critically ill patients using specialised clinical staff, transport platforms and equipment." (13) The alignment of these definitions shows that healthcare systems distinguish between critical care retrieval and critical care inter-facility transportation, and the normal functions of emergency medical services. It shows that this specialised area of medicine should be viewed as separate, with its own challenges and difficulties.

Risk and adverse events in critical care retrieval

Critical care transfers are not without risk and are usually expensive and logistically challenging. (10) When deciding to transfer a critical care patient between facilities, the risks and benefits of the move should be taken into account. Transportation of critically ill patients

should not be seen as the benign and passive movement of patients. The risk to these patients is real and systems should be in place to ensure patient safety. On the other hand, when done safely and efficiently, there are real benefits to patient movement.

A study done by Kahn and colleagues in the USA, found that patients may benefit from transfers. They retrospectively reviewed 180 976 cases of patients in 1170 non-federal hospitals. They found that 83 050 patients (46%) were mechanically ventilated with low tidal volumes. They used published risk estimates to estimate that 4720 (95% range, 2522–6744) lives could have been saved if those patients were transferred to hospitals that treat critically ill patients more often. They also found that transfer times were relatively modest. (14)

Although critical care transportation and retrieval occur on a regular basis, adverse events are common. The stress of transportation, the change in temperature, the noise, the movement, all have the potential to cause the physiological deterioration of patients. Extensive data have been published on the rates of adverse events during the inter-facility transportation of the critically ill, both within different settings and with different types of transportation teams.

A study by Jia and colleagues, published in 2016, found an overall adverse-event rate of 79.8% of the 352 inter-facility transfers (IFT) included in their study. They conducted a prospective multicentre observational study of 34 critical care units in China. The authors further broke down the adverse events into categories according to the cause of the event. They found 7.9% (35 IFTs) were equipment- or staff-related. Patient-related adverse events were 79.4% (349 IFTs), vital-sign-related adverse events were 57.1% (252 IFTs), and blood-gas-related were 46.9% (207 IFTs). Worryingly the incident of critical adverse events was 33.1% (146 IFTs). (15)

A study from the UK, done by Alabdali and colleagues in 2017, found an overall adverse-event rate of 13.7%. They conducted a retrospective cohort study on patients transferred to a tertiary medical facility by paramedics. They found that the most common types of adverse events were hypotension and desaturations. Their study included 227 participants and they were compared with in-hospital patients. They found a higher incidence of adverse events in medical patients than in cardiac patients (adjusted OR: 0.117, 95% CI: 0.02–0.52 and adjusted $p<0.01$). The in-hospital mortality rates were 30.4% and a 30-day survival rate of 68.1%. (16)

A recent study in 2016, from Brazil, conducted by Adversos and colleagues, showed similar results. Brazil has a similarly funded healthcare system to South Africa and should reflect similar outcomes. They performed a prospective review of 102 inter-facility transfers from a public critical care unit. The most common adverse event was a change in blood pressure, both increased and decreased, of 20%. Additional adverse events found were agitation, bradycardia, and desaturation in both a nurse- and physician-lead transportation teams. They found no statistical correlation between adverse events and transportation time. (17)

Another Brazilian study prospectively reviewed 293 transfers of critically ill patients. They found an overall adverse event rate of 29% (86 IFTs). Adverse events were classified according to the World Health Organisation definition. The authors also found that 44.1% (38 IFTs) were related to physiological alterations, 23.5% (20 IFTs) due to equipment failure, 19.7% due to team failure, and 12.7% (11 IFTs) due to delays. (18)

Another study done by Kue and colleagues, published in 2011, involved a retrospective review of 3383 patients transported to an academic quaternary-care hospital in the USA. It found an overall adverse event rate of 1.7% (59 IFTs). The most common adverse events were related to blood pressure and hypoxia (both 25 of 59 IFTs). However, they did find two more serious adverse events, on accidental extubation and an in-transport death. Interventions needed to correct adverse events were increasing oxygenation and administration of vasopressors. They concluded that the adverse event rate was relatively low for transported patients; however, they did not have a control group and did not report on the acuity of the patients. (19)

More recently, a study published in 2013, conducted by James and colleagues, found a much higher rate of adverse events than Kue's study. They did a prospective review of patients transported out of a French academic hospital. Of the 262 ventilated transportations observed, 45.8% (120 IFTs) were associated with an adverse event. Some of the common risk factors associated with higher rates of adverse events were positive end-expiratory pressure >6 cmH2O, sedation before transport, and fluid loading for intrahospital transports. Of all the adverse events, 16.8% (44 IFTs) were considered serious with the potential to cause an increase in the mortality and morbidity of patients. (20)

In a South African study conducted in 2001, a one-year prospective audit found that 82% of critical care paediatric transfers were done by pre-hospital providers and 76% of all transfers were done by road. (21) The researchers also found a high frequency of technical and clinical adverse events, of 36% and 27% respectively. Critical adverse events were found in

9% of paediatric transfers. These high numbers of transfers performed by pre-hospital providers and the frequency of adverse events are the starting point of this study, which looks to improve our understanding of the education obtained by ECPs.

Rates of adverse events differ among healthcare systems. There is heterogeneity in studies as they reported adverse events depending on how they define an adverse event. Some studies have a relatively low threshold for an adverse event, while others have a higher threshold. However, the studies discussed above show that adverse events during transportation are prevalent. This is observed even in established healthcare systems. It is important for the healthcare community to view critical care transportation and retrieval as an integral part of the continuum of care.

Internationally, societies and organisations have brought out guidelines for the transportation of critically ill patients. Examples of these are the Association of Anaesthetists of Great Britain and Ireland, Centres for Disease Control and Prevention, Washington State Department of Health, the Intensive Care Society, and the Academy of Medicine of Malaysia, to name but a few. However, guidelines for South Africa are lacking and, to date, no regulations or guidelines have been published or endorsed by the Health Professions Council of South Africa (HPCSA).

Critical care retrieval education & training, locally and internationally

Education in South Africa is governed nationally by three departments; the Department of Higher Education and Training (DHET), the Department of Basic Education, and provincial government departments. (22) The DHET oversees several institutions, like further education and training colleges, higher education institutions, and adult basic education and training centres.

Higher education institutions operate autonomously and report directly to their councils, instead of the government. The South African Qualification Authority (SAQA) administers the National Qualification Framework (NQF) system, which sets the level of various qualifications offered by institutions. (23) Health education is regulated by the HPCSA and the Council of Higher Education. The HPCSA registers students to practice after completion of their courses. Historically, not all emergency care training programmes were offered by higher education institutions. Colleges and smaller training institutions offered some courses, described below, and were regulated directly by the HPCSA. (24)

Emergency medical care training and education has developed in recent decades. Before 1980, no professional qualification or board existed for emergency care providers. In the mid-1980s, standardised short courses were introduced. Versions of these standardised short courses are still being taught today, although they are being phased out by new legislation. (25) Scopes of practice for these short courses are limited and primarily focus on technician-style training, seen in Anglo-American EMS systems, as opposed to clinical-style training, see in Franco-German EMS systems. Technician-style training focuses on clinical decision making through algorithms and rapid treating of identifiable disorders using decision-making tools and pneumonics. Clinical-style training focuses on clinical reasoning and produces reflective practitioners. (26)

Towards the late 1980s, the first three-year National Diploma in Ambulance and Emergency Technology was introduced to bring a professional qualification to the field of emergency medical care. In 2003, universities started offering Bachelor of Technology degrees in Emergency Medical Care, which involved completing a two-year post-graduation part-time programme. (3) This further increased the knowledge of pre-hospital providers to treat and transport patients with several types of life-threatening emergencies. Today four-year bachelor's degree programmes are offered by universities across South Africa. (25)

Although a bachelor's degree in Emergency Medical Care has been offered by universities for some time now, each university has a different approach to reaching the core standards stipulated by the South African Qualifications Authority. It is suspected that the variation may be particularly apparent in critical care modules, as there is little consensus on what should be included in this module.

The HPCSA has mandated that critical care transportation falls within the scope of practice for all emergency care practitioners (ECPs). However, the HPCSA has not given any clarity about the knowledge required by ECPs to perform critical care retrievals. For this reason, the universities offering BEMC have little guidance on what to include in their curricula and how to approach modules. This could lead to differences in content being taught by the universities. It is important to have a minimum standard for graduating practitioners to promote patient safety.

According to recently released clinical practice guidelines and scopes of practices published by the HPCSA, all pre-hospital providers are allowed to perform inter-facility transfers in relation to their relevant scope of practice. (27) In practice, this means that critical care transportation is performed by providers on the two registers: the Ambulance Emergency

Technician (ANT) registers (Critical Care Assistant and the National Diploma in Emergency Medical Care) and the ECP register.

In South Africa, inter-facility transport of critical care patients is at times done by specialised mobile intensive-care units. These units are usually staffed by ECPs but at times by providers on the ANT register. (28) The units are deployed with specialised equipment, like ventilators and infusion pumps to cater for critical care patients' needs. In a reflection of the wider healthcare system, critical care transportation differs between the private and public sectors, in staffing, availability, equipment, and types of patients transported.

In higher-income countries, critical care transportation is often done by pre-hospital providers with additional qualifications in critical care. In the USA, critical care transportation is performed by critical care paramedics, who are certified flight paramedics or critical care paramedics, although this varies from state to state. (12) Paramedics are often assisted by nurses, physicians, or respiratory therapists according to patients' needs, a practice not often done in South Africa due to resource limitations. Some European countries employ a physician model for critical care transportation. (29)

Standard setting in education

In recent years, standard setting has become an important part of higher education. Setting standards is particularly important in medical education because, after graduation, medical students go on to work in the clinical field with real consequences for patient care. Measuring competencies has become vitally important to medical educators, as the field focuses on producing graduates with the knowledge and skill to practice safely. (3)

The concept of standard setting immerged in the 1980s with a focus of the US government on improving the schooling system. From the implementation of standards in the schooling system, standards have become regular practice. However, common standards are in the education system, there has been little consensus on what actually constitutes a standard. The definition of standards becomes even more blurred when referring to "academic standards". This is because many activities within the academic context are based on implicit tacit practices, that are difficult to measure and evaluate. (30)

For this reason, academic standards remain largely misunderstood, especially by people working outside of the academic context. Employers' often view of standards can differ from those of academic at universities. (31) In its core, an academic standard is an abstract,

multi-dimensional concept, which can be interpreted in different ways by different stakeholders. (32) The determination of what is a “good” standard depends largely on the context of the standard and who is judging the standard. (33)

Academic standards are generally viewed in two ways. One way is as a general set of principles or practices, which can require qualitative interpretation. The second way is as an explicit set of thresholds. The thresholds are normally described as expectation or normative standards. This view of standards is normally interpreted both qualitatively and quantitatively usually using a variety of performance indicators. (34)

Many institutions around the world use a combination of principles and thresholds in order to benchmark within their institution and with other institutions. South African higher education institutions generally have adopted many traits from the Anglophone system, which largely adopts explicit thresholds as their standard-setting method. This was derived from a time when the King set the standard for the educational system, referred to as the “King’s Standard”. However, institutions have the autonomy to decide how and even if they are going to benchmark with other institutions and within themselves. (35)

Historically, standards across institutions are normally judged by someone. Unfortunately, the reliability, integrity, and ultimately the quality of those standards are based on the person’s ability and expertise in the field. However, today, measurable standards and thresholds have been written into many institutions’ policies. An accepted definition of standards within higher education was made by Sadler in 1987 as “a definite level of excellence or attainment or the recognised measure of what is adequate for some purpose, established by authority, custom or consensus”. (36)

This definition shows that there has to be some kind of consensus in producing and following standards. Among institutions and within institutions, a standard of excellence needs to be decided on. And that standard needs to be agreed upon. A standard without agreement is simply one person’s mark or one department’s methods of gauging excellence or competency. However, the process of reaching a consensus can be difficult. The process needs to involve the relevant stakeholders and must be agreed upon by these stakeholders.

The difficulty we currently face in the field of critical care transportation and retrieval is that little consensus has been reached. Institutions training ECPs and the industry have not produced on a standard for which knowledge they feel is needed for safe patient care.

Role of curricula in standard setting

The term *curriculum* has been defined in many ways throughout the history of education. There are two general ways of defining a curriculum. A simple way of looking at it is that a curriculum is all the knowledge and skills learnt during the studying period of a student.(37) This way of defining a curriculum is to view it as everything the student gains from studying. Although useful, this simple definition curriculum seems to leave out some details. The curriculum has been further defined into eight type or aspects.(38) These include the recommended, written, supported, tested, learned, hidden, and excluded curricula. Each of these describes a different interaction the student has with the learning material.

The recommended curriculum refers to the content and skills taught that experts in the field feel should be included. Discipline-based professions have experts in those specific fields which usually set standards for what should be taught to students. (38) These standards are then followed by teachers within the field. For example, Kendall and Marzano's comprehensive report Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education is an example compilation of these standards. (39) Their report sets the standards which American school students should obtain throughout their schooling.

The written curriculum is all the documentation related to the activity's students will be participating in during their study period. It includes documents from regulatory authorities, from the university, to the department, and relates specifically to what will be taught and how it will be taught. (38) Aspects of the written curriculum are usually published to inform both students and the public on the content taught during courses. An example of a document in the written curriculum on the BEMC programme is the qualification register of the programme published by SAQA. (40) This document gives a brief description of the rationale for the qualification, the learning assumed to be in place before the qualification, the qualification rules, the outcomes of the courses, and how it is comparable to other international qualifications in the same field.

The supported curriculum is the part of the curriculum that is informed by endorsed literature. The supporting literature can come from multiple sources, usually from textbooks, software, published journal articles, or multimedia courses. (38) In medical fields, evidence-based medicine is widely practised. The focus on evidence has filtered through to academic programmes where educators use published literature to inform students. An example of this would be literature published on the popular database PubMed©.

The tested curriculum is the part of the curriculum focused on the assessment of the students. The assessments can be developed by the institution, like a class test, or can be developed by a regulator or external authority, like a standardised test. (38) In the field of emergency care, there is no competency test for critical care for ECPs in South Africa, outside of the assessments in undergraduate qualifications.

The taught curriculum is the content delivered to the student by the lecturer. The delivery of the content is usually done through lectures, online tutorials, or multimedia platforms, like forums and online classrooms. (38) However, there can be large variations in the nature of what is actually taught to what is prescribed to be taught. This has been demonstrated by Gehrke and colleagues. In their search for what a curriculum is, they found that what was taught can vary between institutions. (41)

The learned curriculum is arguably the most important aspect of the curriculum and relates to what knowledge and skills students acquire during their studies.(38) Student can learn hard skills like how to insert an intravenous cannula or can learn soft skills like how to search the internet for relevant information in the field. The learned curriculum forms the basis of competence. In medicine, the learned curriculum allows the students to have the baseline knowledge and skills to practise safely on patients. In some fields, like in critical care retrievals, there can be some debate on what the learned curriculum should include.

The last two aspects of the curriculum are more abstract and cannot be found anywhere but are equally important. The *hidden curriculum* is a term coined by Jackson in the late 1960s and refers to the unintended aspects of the curriculum. (42) Specifically, it refers to the aspects of the curriculum learned from the institutional culture or the climate of the educational system. Examples include time allocated to certain skills taught as opposed to others, the allocation of space, and the disciplinary policies of the institution.

In emergency care, an example could be that the time spent learning endotracheal intubations is relatively high in the curriculum, which could make the students believe that endotracheal intubation is an important skill. However, the time spent learning about oral rehydration theory may be short, leading the students to believe that oral rehydration is not important. It may not be the intention of the lecturer to convey this message to students. The lecturer may believe that oral rehydration is more important and should be practised more regularly than endotracheal intubation.

The final aspect of the curriculum is the excluded curriculum. It is everything that is intentionally or unintentionally left out by the lecturer. (43) The excluded curriculum can have profound consequences on how the student views the subject. (38) An example from human sciences in South Africa is due to the fact that there was little written history from before colonisation; there is relatively little known. For this reason, aspects of the history may be excluded from the curriculum. This can warp students' view of South African history.

These aspects or types of curricula give rise to the components of curricula that can be compared in comparison to other curricula of the same nature. These components are:

1. Aims, goals and exit-level learning outcomes
2. Core curriculum and content
3. Delivery of the module (teaching and learning strategies)
4. Clinical exposure and experiential learning
5. Evaluation

strategies

These components of curricula are used as the basis of comparison for the current study as they can be extracted from the curricula documentation.

Comparing curricula

Since the institution of formalised curricula, educators have been comparing them. Curricula are compared across educational systems and within educational systems. Due to the complex nature of what constitutes a curriculum, studies comparing curricula usually only compare one element of a curriculum at a time. Below is a breakdown of how curricula are compared according to their elements.

Curricula have been compared using several methods. This is done within and between educational systems. Some studies use document reviews and descriptively compare different aspect of curricula. An example of this is from Oyewo, who compared curriculum development between South Africa and Nigeria. (44) Some studies survey students experiences, like Chen and colleagues, who assessed stress levels in students through a questionnaire. (45) Other studies are interventional in nature and compare results of students after using an experimental educational technique. This was done by Ghasemzadeh and colleagues who compared teacher-based and student-based teaching methods. (46)

The current study uses document and content analysis to compare curricula, which is a technique used in other studies. A study using a similar technique was conducted by Marcolini and colleagues, comparing the present state of neuro-intensivist training in the US with other critical care programmes in the same setting. The authors gathered information on the prerequisites for admission to multiple subspecialty programmes, programme requirements, composition and leadership of faculties, core critical care competencies, intervention competencies, pre-course knowledge base, and completion and certification criteria. (47) The authors found similarities between the programmes.

Aim of the literature review

The aim of this literature review is to systemically gather, appraise, and record the latest research on curricula within the fields of emergency medical care, critical care transportation and retrieval, and aeromedical care, in order to support the current study. This is to provide a background for the study and to highlight the knowledge gaps in this field. The purpose of the literature review is to establish a base on which to perform the current study.

Literature search strategy, including inclusion and exclusion criteria

A literature review was done in a structured way as to comprehensively collect and appraise the available knowledge related to the topic. Literature from different sources, including the MEDLINE literature database, was searched for published articles in peer-reviewed journals using Medical Subject Heading (MeSH) terms, Google Scholar. Grey literature web searches for information not in published articles was then conducted.

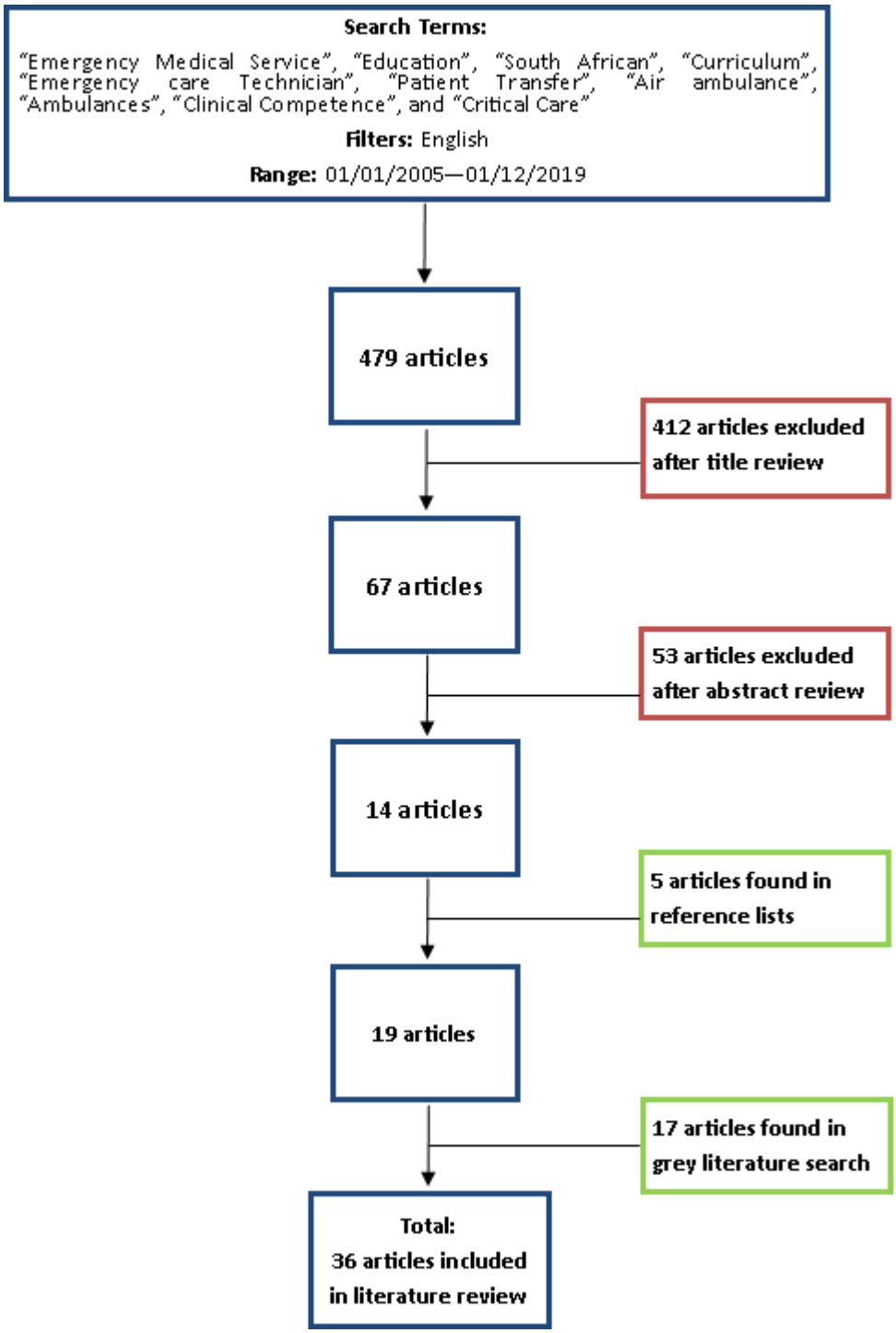
Due to the ever-changing and updating of curricula, only articles from the 1st of January 2005 to the 1st of December 2019 were included in the search. Only English articles were included in the search, as a translation of foreign-language research would be impractical. After reviewing abstracts and titles, articles were excluded if their objectives compared educational techniques rather than curricula content. The searches were performed on the 10th of December 2019.

The MeSH terms used to search for literature were “Emergency Medical Service”, “Education”, “South African”, “Curriculum”, “Emergency Care Technician”, “Patient Transfer”, “Air Ambulance”, “Ambulances”, “Clinical Competence”, and “Critical Care”. Using various combinations of the MeSH terms in multiple searches, 479 articles were found on MEDLINE®. All articles titles were reviewed. Of those, 67 were deemed relevant to the study on their title alone. After abstract review, 53 were excluded due to insufficient relevance to

our article, leaving 14 articles. The reference lists of the included articles were reviewed and an additional five articles were found.

The results of the literature search are summarised in *Figure 1*. A number of themes were extracted from the literature. These include pre-hospital curricula, aeromedical curricula, paediatric curricula in pre-hospital programmes, and competency in pre-hospital training. A list of the literature can be found in *Table 1* and *Table 2* of Appendix 1.

Figure 1: Consort diagram of the literature search:



Pre-hospital curricula

The aim of this literature review is to find and appraise the literature on pre-hospital curricula content. With this aim in mind, a study was found conducted by Sjölin and colleagues in Sweden reviewed a pre-hospital curricula. (48) Sweden requires ambulances to be staffed by at least one registered nurse. There are no standardised curricula and content for ambulance programmes in Sweden. The aim of their study was to describe the educational content of specialist pre-hospital nursing programmes related to professional practice.

The authors gathered curricular documents from open-access university sites. They used a method described by Hsieh and Shannon, a descriptive qualitative research design with summative content. Summative content analysis is the process of identifying and quantifying keyworks in a text in order to understand their use in a particular context. (49) The keywords are then interpreted into categories and sub-categories. Lastly, keywords are analysed to describe their distribution across the text.

Documents were collected from 12 universities, with one university being excluded due to its curriculum not being available online. The number of courses the universities offered varied between 3 and 6, making a total of 49 course curricula analysed. References were extracted from the documents, with a total of 567 references from all the documents. The analysis resulted in the identification of 3 main categories with 16 sub-categories. The three main categories were medical knowledge (referenced n=298 times), nursing knowledge (n=123), and contextual knowledge (n=146).

The sub-categories of medical knowledge were medical science (n=113), clinical judgement (n=57), medical care and treatment (n=50), medical technology (n=33), pharmacology (n= 29), and hygiene (n=16). The sub-categories of nursing knowledge were nursing practice (n=44), knowledge transfer (n=29), ethical views (n=26), and patient relationship (n=24). The sub-categories of contextual knowledge were contextual skills (n=34), employment impact (n=29), policy documents (n=27), management (n=24), major accidents (n=24), and inter-profession (n=8).

The medical knowledge category was mainly dominated by medical science, which largely focused on anatomy, physiology, symptoms, and pathophysiology related to the conditions most commonly seen in pre-hospital medicine. Clinical judgement was the next largest subcategory, focused on clinical decision-making, assessment, and diagnosis, which was related to clinical treatment. Part of the curricula clinical treatment specifically focused on

pharmacology: pharmacodynamics, kinetics, effects, and side effects. The smallest sub-category was hygiene principles.

Contextual knowledge relates specifically to the students' practice in emergency medical services (EMS). The subcategories focus on specific challenges in the EMS, like the operation of pre-hospital equipment, safety on scene, policy and administration of the EMS, and the management of major incidents. Essentially this knowledge equips students to operate within an EMS system.

The nursing knowledge category of the curricula mostly focused on the practices of nursing in specific situations and had the fewest keywords in the curricula. The curricula taught nursing interventions, and physical and psychological care for a variety of nursing-specific situations. Some of those situations were the transfer of patients, some ethical issues around nursing, the patient relationship, and how to interact with other professions.

The authors note that the frequency of a keyword appearing in the curricula documents cannot be associated with the time spent on each concept within the keyword. However, they conclude that the distribution of keywords across the course content could possibly reflect the emphasis placed on the category with which it is associated. The authors note that a large proportion of the curricula focused on nursing knowledge, something that has been noted to be lacking in other pre-hospital curricula. (50)

The main limitation of this study is its comparison of only one element of a curriculum, the written or planned curriculum, and does not compare the hidden curriculum. For a more comprehensive comparison of curricula, the study would have to compare the content being taught and discussed in class. The type of data analysis in the study was appropriate for the stated aim. Another strength of this study is that it sampled almost all the universities (11 or 12), which limits sampling bias.

The authors have also noted, with interest, that the largest proportion of the curricula is focused on medical knowledge. They presume that this is because most courses were designed by professional outside pre-hospital training, like anaesthetic and intensive-care nurses, which made them focus more on what they knew. They note that this focus on medical knowledge comes at the expense of more complex decision-making aspects of pre-hospital care, like clinical judgement and decision making. They further noted that nursing knowledge was focused on the least, which is counter intuitive because the courses are run by nurses.

This study sheds light on the content being taught in curricula for pre-hospital medicine. The results can be interpreted to show the differences between the Swedish and South African pre-hospital contexts. In Sweden, there is no national standard for pre-hospital curricula, as there is in South Africa, as set out by the HPCSA.

HPCSA has not produced national standards for critical care and retrieval medicine operations. This means that services individually decide how they will transfer critical care patients. This can resultin services choosing different equipment and clinical structures for the mobile intensive care units. This lack of standards can be seen in the teaching of undergraduates. All the outcomes for degree programmes in emergency care are stipulated by the HPCSA. It is unclear how the universities teach those outcomes and what emphasis they put on the subject matter related to critical care.

An example of a study from the South African context is from Cohen and Wallis. They aimed to see if the emergency medicine curricula, taught for the registrar programme, was appropriate for the patient population that were seen in emergency centres. (51) Although not specifically in the pre-hospital setting, parallels between emergency medicine and pre-hospital medicine can be drawn, as it is likely they that they see similar cases.

The authors performed retrospective cross-sectional audits of patients presenting to three secondary level emergency centres in the greater Cape Town area. Information regarding the type of clinical presentations, investigations done, and procedures performed were recorded and analysed using basic descriptive statistics.

The sites see around 118 000 patients combined annually. Cases were included if the patient presented in the study period and were excluded if there were incomplete records of the patient, or they absconded without being seen. Clinical presentation was assigned according to a combination of the triager's and doctor's notes. The patient could be assigned multiple clinical presentations, due to them having numerous diagnoses and past medical histories.

A total of 697 patients were initially included in the study. Of those, 83 (11.9%) were excluded due to the folder not being found and 44 (6.3%) absconded before being seen. The authors were able to identify 1283 clinical presentations. The 12 most common clinical presentations included blunt injury (5.9%), abdominal pain (4.9%), shortness of breath (3.7%), lower respiratory tract infection (3.7%), soft tissue injury (3.4%), laceration (3.0%),

chest pain (2.9%), TB (2.7%), gastroenteritis (2.7%), fever (2.7%), diarrhoea (2.7%), and cough (2.7%).

A total of 47 cases' clinical presentation was not included in the emergency medicine curriculum. There were a few rare clinical presentations that were only seen once or twice. The authors suggest that the emergency medicine curriculum should focus on the five most common clinical presentations: trauma, the respiratory, abdominal system and cardiovascular systems, and infectious diseases. However, due to the limited numbers of patients reviewed and the sites used in the study, it is likely that the results show a trend and further studies will need to done to make recommendations for curriculum design.

A total of 115 procedures were performed to treat the clinical presentations. The 12 most common procedures performed were suturing (30.4%), plaster of Paris (15.7%), lumbar puncture (12.2%), joint reduction (6.1%), incision and drainage (5.2%), procedural sedation (5.2%), foreign body removal (2.6%), pleural tap (2.6%), cardioversion (1.7%), thrombolysis (1.7%), rapid sequence intubation (1.7%), and nasal packing (1.7%). The authors suggest that, due to the high numbers of patients requiring suturing, emergency medicine curricula should have extensive training in this procedure. They also noted that regional anaesthetics were performed on 1.7% of the patients and this could be a valuable skill for emergency medicine specialists, as low staff numbers can lead to a lack of patient observations.

A total of 730 investigations were performed on the patients. The most common procedures performed were chest x-ray (20.4%), creatinine, urea, and electrolytes (17.5%), full blood count (15.9%), ECG (9.2%), x-ray (9%), and urine pregnancy test (4.9%).

The study had a number of limitations. The study sites were secondary-level hospitals, meaning that severely injured and ill patients may have by-passed the sites on their way to tertiary-level facilities. On the other hand, minor injuries and illnesses may have been treated at primary-level facilities, which would not provide a clear picture of the patient population treated. The data collection relied on the accuracy of the patient records, which were missing in 19% of the sample. This may have skewed the results.

At the time of this study, the emergency medicine curriculum was based on international curricula and was not evidence-based. International curricula are not always the best fit for South African programmes, as the burden of disease and patient populations could be significantly different. Although this study was from the field of emergency medicine and not

pre-hospital care, it does give insights into the patient population being attended to in some emergency centres, which could be used to guide curricula.

A study conducted by Wang and colleagues with the aim of developing a curriculum and key competencies for health emergency response offices (HEROs) in China. (52) The HERO programme was established after the Severe Acute Respiratory Syndrome (SARS) outbreak and continues to operate in all provinces with the aim of preparing for the next emergency response. From its inception, the HERO staff was trained using training activities with no formal curriculum. This created the need for the development of a formal curriculum.

They used a multitude of sources of information to develop the curriculum. They initially set out to collect data on which of the HERO's staff could be assessed. This included data from three sources. The first was international health regulations on how to respond to emergencies. The second was from related Chinese law and regulations. The third was from Chinese publications and guidelines relating to emergency care.

After the collection of data from the various sources, the authors conducted face-to-face interviews with 11 key informants, which included informants from the government's health emergency services, military, academia, and staff of the existing HERO's programme. Their final source of data was from a self-administered questionnaire of 115 HERO staff members across China, who attended a workshop in Beijing. The last step in the development of the curriculum was that the competencies were reviewed by a technical advisory panel consisting of eight experts in the field.

The results showed 11 keys areas of focus in the curriculum and were ranked according to their need and applicability in the curriculum. The respondents felt that on-site organisation during response, preparedness, and process to alert the community were the three most needed elements of the curriculum, with a relative need of 92%, 91%, and 87% respectively. The other elements with a medium need in the curriculum were surveillance, resource management and stockpiling, risk assessment and management, human resources, and response, with needs of between 80% and 84%. The lowest needs were from the evaluation of response, risk communication, and laboratory capacity, with needs of 72%, 71%, and 57% respectively.

The results from the interviews show that there is a need for the curriculum to move away from didactic teaching methods to more active methods of teaching. The results also show

an interesting educational shift away from traditional teaching styles and methods to a more student-centred approach, involved greater engagement with students during active learning sessions.

The methodology the authors of this study used was appropriate to obtain the outcomes they were looking for. The authors did use multiple sources of information in order to produce the curriculum. This can reduce bias by increasing the number of people with inputs into the curriculum. The development process additionally allowed the authors to interact with different sectors influencing the curriculum.

South Africa has a relatively different approach to pre-hospital medicine than does China. South Africa is moving towards a Franco-German model for emergency medical services, which involves higher-qualified practitioners bringing medical expertise and equipment to the patient. (26) This is in contrast to the Anglo-American model, which involves technicians transporting patients to facilities without fewer medical interventions. The results of this study can demonstrate this difference when compared to emergency care programmes in South Africa.

This study examines a pre-hospital curriculum from a different setting. It shows the developments of a curriculum specifically designed for the preparation of China for emergency responses and the development of a curriculum highlights the need to move away from traditional teaching methods to methods that involve active engagement with students.

Another study that shows the need for the movement away from traditional teaching styles was done by Bradley and colleagues. In high-income countries with ageing populations, the transporting of patients between facilities is common. (53) The authors designed a curriculum focused on patient safety and the transition of care for third-year medical students on the Integrated Internal Medicine-Geriatrics Clerkship programme. (54)

Their study involved the design of a module to increase student's knowledge and confidence in patient safety and transition of care. The study involved pre-module and post-module assessments, and a questionnaire on their confidence in the content of the module. A total of 252 students (91% of the total students participating in the module) participated in the pre-assessment and 265 students (96%) participated in the post-assessment. Analysis of the results found that students were more confident after the module, with 36% reporting they agree or strongly agree that they are confident to transport patients, as opposed to 23%

before the module. They also found that students performed better in the post-assessment as the students were more likely to identify risks in transportation (97% vs. 93%), better knowledge of the most common source of adverse events post-discharge (86% vs. 62%), knew more about ways to reduce readmissions (99% vs. 93%), were more likely to identify patients with low health literacy (28% vs. 14%), and had better knowledge of ways to assess patient's health literacy (14% vs. 2%).

This study shows the modular curricula can increase students' knowledge and confidence related to specific clinical areas like patient safety and transition of care. It also shows a method of constructing a module that does not solely rely on didactic teaching. Their module involved focused and relevant didactic sessions, a visit to a patient the student treated post-discharge, and a reflecting and debriefing session. The structure of their module shows a method of teaching students that involved a greater engagement with them and contextualising their knowledge clinically.

A curriculum comprises many aspects and, within the content, many themes and topics can be taught. A study done by McCallum and colleagues looked at one topic taught in pre-hospital curricula, the use of ultrasound. (55) The authors conducted a systematic review, with searches on MEDLINE, Embase, CINAHL, and the Cochrane Centre Register of Controlled Trials.

Through their searches, they found 12 studies involving 187 paramedics. They found that the majority of pre-hospital ultrasound curricula focused on assessment with sonography for trauma (FAST), which is used to screen patients' cavities for blood or fluid. The length of courses varies considerably, from a few hours on a single day to multiple sessions over two months. However, most courses are completed in a day. The reviewed articles had a range of sensitivities (61.3% to 100%) and specificities (96.3% to 100%). All of the studies concluded that the sensitivity and specificity of pre-hospital providers performing ultrasounds were adequate.

Half the studies described the use of ultrasound to detect pneumothoraxes. This usually formed a smaller part of the curriculum, in one case only 10 mins of the curriculum, with pre-hospital providers able to achieve 82% sensitivity and 94% specificity. Although there is literature describing the use of ultrasound in differentiating shock states, only two curricula include the detection of cardiac standstill. Only one curriculum incorporated fracture detection. Some of the studies incorporated an online component to replace or supplement didactic sessions.

The results of this systematic review show that pre-hospital providers can be taught how to use ultrasound which could change the patients' course of treatment with the results obtained. The authors mentioned that the didactic component of ultrasound curricula should be supplemented by pre-reading, should focus on ultrasound theory, how to acquire images, and detecting of false positives and negatives.

There are a number of limitations to this study. There is a wide variety of scopes of practice of pre-hospital providers, making it difficult to make broad conclusions for all scopes of the present curricula. Some specialised pre-hospital providers may have received training in ultrasound that is not included in the study. Although the authors conducted an extensive literature search, only a small number of studies could be found on the topic, which limits the power of the study to draw broad conclusions for all pre-hospital providers. Further research in the area will have to be conducted to conclusively conclude that ultrasound should be included in pre-hospital providers' curricula.

Even with the limitations of the study and the relative paucity of literature on the topic, this systematic review shows that ultrasound can be incorporated into pre-hospital curricula. In South Africa, ultrasound has been added to the ANT and ECP scopes of practice by the HPCSA. (25) This will mean that training institutions will need to start incorporating ultrasound into their curricula.

As the role of pre-hospital providers evolves and adapts to the needs of healthcare systems, so should the curricula designed to train prospective providers. However, these roles are adapting to include primary healthcare, prevention medicine, and even social care. A study published by Mulholland and colleagues looks at the adapting roles of pre-hospital providers, by doing a systematic literature review on inter-professional pre-hospital training specifically for rural services. (56)

Their literature review involved searching literature from MEDLINE, Scopus, CINAHL and the University of Tasmania's electronic library, using various search terms. A total of 24 articles were found in the initial search on the topic. From the articles they found, three themes emerged: inter-professional education (IPE; six articles), multidisciplinary teamwork (nine articles), and inter-professional learning (nine articles). A further eight articles were found of IPE from the reference lists of the articles already included. Articles were found for various setting, including high-income and low-income countries, and were from 1997 to 2012.

Some of the earlier literature found on IPE focused on ‘high end’ skills, like disaster management, that hospital staff could learn from pre-hospital training. A study conducted in South Africa found that hospital staff could benefit from trench rescue training (57) This was corroborated by articles from the US describing the benefit of courses focused on terrorism, hazardous materials, the military and disaster response. The authors go on to list a few more examples of IPE making a positive contribution in professionals from different fields working together and learning from each other, which shows that there is a history of professionals from different fields working together for the patient’s benefit. For the South African context, when developing critical care modules for pre-hospital providers, other professions should be consulted and provide inputs to produce more rounded students.

The second theme that came through in the study was multidisciplinary teamwork, which they define as healthcare professionals collaborating without performing the same tasks. One of the more common ways multidisciplinary teams work, described in the literature, is one professional working in an environment for which they were not trained. An example of this would be a nurse working on an ambulance. Another way professions can collaborate is during patient treatment. In the pre-hospital environment, this could involve paramedics contacting hospital staff before transportation. This could also include the collaboration with other services like police and fire departments.

The last theme described by this literature review is inter-professional learning, which involves the process of learning between professional fields. An example of this from the reviewed literature was in Australia, where pre-hospital providers are taught a primary healthcare curriculum for rural operations. A conclusion of that research was an expanded scope of practice to cater for the needs of rural populations. (58)

Another study in the review, set in the UK, (59) aimed to see if a training programme for pre-hospital students in a general-practitioner’s ward would produce autonomous, patient-centred practitioners and fostered inter-professional learning. They found that the placements of pre-hospital students had the impact they aimed for. Subsequently, they were better able to treat patients in primary healthcare at a community level.

Conclusions from the research in this review shows that healthcare systems work better when professionals from different fields work together. Some of the limitations of the review are that had a relatively focused search criteria, specifically looking at IPL and rural medicine. More literature on the topic could potentially have been found with broader search criteria. The review did not look at ‘grey literature’ which could have revealed information on

the topic. This study shows the ever-evolving role of pre-hospital providers and shows that they can at times be involved in clinical situations for which they may not have been trained. Furthermore, this study provides some support for the value of inter-professional education in bolstering learning during critical care retrieval training.

In Canada, the EMS is overseen by emergency physicians. However, before an article published by MacDonald and colleagues in 2009, there was no set framework for the curriculum for EMS training as a sub-speciality for emergency physicians. (60) Some EMS training occurred during residence programmes; however, this was not formalised. The authors aimed to gather the existing EMS elements in existing residency programmes and create a curricular framework that could be used to generate a sub-speciality. This lack of set frameworks for EMS training in Canada has been seen in other healthcare education systems. There is a general lack of standard reporting in EMS training and therefore it is not possible to ground subsequent reviews.

The authors found that there were 13 core topics covered in all the EMS residency programmes. The core topics consist of the following: EMS system design, EMS personnel/scope of practice, EMS equipment, communications/dispatch, receiving facilities, medical oversight, patient care, air ambulance operations, mass gathering and disaster medicine, medical/legal considerations, community involvement, education, and research. Some of the programmes had a compulsory one-month EMS rotation, which included a combination of didactic sessions and clinical work-integrated learning.

The authors followed a Delphi process to determine which elements should be included in the framework. Their framework set out the knowledge and skills required for six programmes: undergraduate medical students, community physician, College of Family Physicians of Canada emergency medicine residency, EM residency programmes, sub-residency programmes, and fellowship programmes. Furthermore, they made objectives for each programme, with all objectives forming part of fellowship programmes and the least objects being taught to medical students.

Main objectives were sub-divided into specific elements. The main objectives included the history of the EMS, EMS system design, EMS personnel, EMS equipment, communications, receiving facilities, medical control, patient care, air medical, legal considerations, mass gathering and major incidents, community involvement, education, administrative aspects EMS, research, and experiential activities.

The study provides insight into a method to produce and a structure for a curricular framework in pre-hospital care. This framework can be used in other emergency care educational systems as a guide to the content that should be taught to emergency care providers. It should be noted that although this was the only framework found in peer reviewed literature, Canada's and South Africa's pre-hospital training programmes are not closely aligned academically. There are countries, such as the UK and Ireland, which are more closely aligned to South Africa. Unfortunately, no frameworks from these countries could be found in peer-reviewed literature.

After the search of peer-reviewed published literature was completed, a search for unpublished or grey literature was conducted. The search revealed a number of courses and programmes that are designed for critical care transportation and retrieval medicine. The courses that were found range from master's programmes to short continuous medical education training. These programmes are described below.

An example of a master's is from the University of Stavanger in Norway. (61) Its institution runs a 120-credit Master's in pre-hospital critical care designed for professionals with a bachelor's degree in healthcare with a minimum of two years' experience in pre-hospital medicine. The degree consists of eight modules (90 credits) and a thesis (30 credits). All modules are compulsory and there are no elective modules.

Although this degree incorporates elements of critical care, it mostly focuses on pre-hospital care. The modules focusing on pre-hospital medicine include communication and decision-making in pre-hospital emergency medical, major incidents: medical management and preparedness, pre-hospital emergency medical care and transport medicine. Two modules loosely relate to pre-hospital medicine with point-of-care technology and patient safety. Two modules focus on the scientific method and the philosophy of science and healthcare ethics. The only module specifically focused on critical care is traumatology in pre-hospital critical care.

This degree is a good example of a post-graduate qualification specifically for pre-hospital and critical care medicine. It mostly focuses on pre-hospital medicine rather than critical care, with only 30 credits focused on transportation medicine and critical care. Norway's training for pre-hospital providers has evolved from a system similar to the US, with EMT, to longer courses of two to four years. This master's degree provides a pathway for pre-hospital providers to further their studies after graduating.

The University of Plymouth and the University of Warwick have similar programmes. Their institution offers a Master's of science in pre-hospital critical care and retrieval and transfer, with options to exit the qualification at post-graduate certificate (PGC) and diploma levels. (62) The key feature of this qualification is its specific focus on transfer and retrieval medicine.

In order to obtain a Master's-level qualification, students need to complete modules adding up to 180 credits, with 60 credits of dissertation. Modules are completed in sequence with exit points for PGC (exit at 60 credits) and diploma (exit at 120 credits) students in the module sequence. The PGC modules include a module on applying evidence to practice, and two critical care management modules. Diploma modules include advanced clinical reasoning, transport and retrieval medicine of critical care patients, and research project design. The only master's module is the dissertation.

The United Kingdom has a similar system of qualifications to South Africa, with paramedics, emergency-care technicians, and emergency-care assistants, although technician qualifications are being phased out. The master's programmes offer a route for paramedics to further their studies in a non-formalised sub-speciality of transfer and retrieval medicine. This is the only qualification at a master's level that focuses specifically on transfer and retrieval medicine.

Four post-graduate certifications were found during the internet search, from the USA, Australia, and the UK. The Critical Care Paramedic – Certification (CCP-C) is an exam which can be completed by a wide variety of pre-hospital, military, and hospital staff with differing qualifications to demonstrate their knowledge in critical care transportation. (63) The course work is taught by various service providers and the exam is administered by the International Board of Specialty Certification.

The certification has five key topics that are examined. These include transport and safety; airway, anaesthesia, and analgesics; medical; trauma and burn patient; and special populations. Within special populations, the certification covers obstetric patients, neonatal patients, paediatric patients, bariatric patients, and geriatric patients. The certification is designed for pre-hospital providers working in or seeking employment in a critical care transportation service. The certification was designed to supplement knowledge already gained on other American Heart Association courses like ACLS and PALS.

The second post-qualification curriculum was designed in the state of Wisconsin in conjunction with the University of Wisconsin Hospital and Clinics. Following the curriculum allows institutions to offer a certification for pre-hospital providers to become a critical care transport paramedic. The course is run over 96 hours. Like the CCP-C, the course is designed to follow on the back of the American Heart Association course.

The curriculum mostly focuses on critical care. The curriculum has 16 core areas of teaching. The first three relate to critical care transportation systems and ethics. Two relate to diagnostic and clinical procedures in the ICU. There are a pharmacology topic and seven system topics. Some of the other areas covered in the curriculum are trauma, infectious disease, obstetric emergencies, and neonatal patients.

These two certifications are examples of additional formalised training available to pre-hospital providers in the field of critical care transportation and retrieval medicine. The outcomes curricula of the certifications focus predominantly on critical care. It is presumed that this is because those outcomes were probably not taught during undergraduate training.

The third and fourth were from the Glasgow Caledonian University in the UK and Central Queensland University (CQU) in Australia. The qualifications are done over a year fulltime or two years part time. Both are designed to allow pre-hospital providers additional knowledge and skills to transfer critically ill patients between facilities. (64) The qualifications are modularised. Their contents include background physiology, decision making, aeromedical and retrieval medicine, and patient safety. Only the CQU qualification has a research component.

The search also revealed three continuous medical education programmes taught in South Africa. The University of the Witwatersrand offers the Aviation Healthcare Provider Course, specifically focused on aeromedical transfers. (65) The course content includes the following outcomes: safety considerations, patient assessment and packaging, the physiology of transport in the air medical environment, assessment and care of patients with a wide range of diseases and traumatic injuries. The course is completed in a day and allows doctors, pre-hospital providers, and nurses to learn or refresh their knowledge of aeromedical transfers.

The University of Cape Town offers a five-day course in Aeromedical Evacuation and Transport. (66) The course is taught to medical officers, advanced pre-hospital providers (ECPs or ANTs), and nurses. The content of the course includes an introduction to aeromedical services, physiology of flight, practical considerations in commonly transfer

(examples are pregnancy, neonates, congenital heart disease, airway management), and crew resource management principles.

This is similar to courses run by CCAT Aeromedical Training in the UK. Courses are run from three to five days, all focused on aeromedical transportation and critical care. The courses range from basic introductory courses to advanced courses with in-depth critical care knowledge. The courses build on each other. Topics include all aspects of aeromedical transportation. Similar courses are run by the Royal Flying Doctor Service, North Wales Critical Care and Trauma Network, and Critical Care Network in North West London. (67–69)

Emergency Care Education offers a course in critical care transport aviation. The course can be done modularly on a part-time basis or a fulltime basis over five days. The course aims to teach students to be a competent part of an aeromedical transportation team in a pre-hospital and critical care environment. The course's outcomes come out of the Critical Care Transport textbook and meet the objectives of the Certified Flight Paramedic exam, a certification similar to the critical care paramedic. A breakdown of the topics includes flight physiology, lab analysis, hemodynamic monitoring, and specialised devices such as the intra-aortic balloon pump, airway management, trauma, and pharmacology, which are covered in the context of critical care.

Aeromedical curricula

Inter-facility transfers occur via a variety of modes of transportation, both road and aeromedical transportation form integral components of many healthcare systems. Having a clear picture of curricula taught in the field of aeromedicine helps understand the field of transport medicine as a whole. Mastenbrook and colleagues looked at whether there was a standardised curriculum for aeromedical transportation among residence programmes in the United States (US). (70). They performed a cross-sectional survey of residence programmes to see their involvement in aeromedical transportation. They sampled all 160 residency programmes in the US and 106 participated. Of those, 69 (65%) offer an aeromedical component to their programmes. The type of experience gained in the component varied from observational roles to full flight-physician roles. Only 25 (36%) of the programmes offer a formal aeromedical curriculum.

Of the programmes that incorporated a formal aeromedical component into their programmes, the researchers were able to summarise them into ten broad categories. These included aeromedical protocols and procedures, the pathophysiology of air-related emergencies, EMS aeromedical operational systems, safety aspects of aeromedical

operations, administrative and legal duties of aeromedical practitioners, aircraft and equipment orientation, medical direction, research, and financing of aeromedical operations. In their summarising of the categories, they found that no programme incorporated all the board categories in its curriculum.

There are a number of limitations to a study like this, the most primary being that an evaluation of knowledge and the students' perceived confidence in forming a skill, does not necessarily translate into clinical competence. The study also had a low response rate, with only 66% of the residency programmes responding to the request to participate. It also only received 15 of the 25 written curricula of the programmes with formalised curricula in aeromedical transportation. It only evaluated the written curricula; there could be training within the aeromedical field that residents obtained without it being in the residency programme.

This study shows that the field of patient transportation requires standardisation. Even in high-income countries with advanced infrastructure and operational systems, no standard aeromedical curriculum has been established among resident programmes. This study shows the need for benchmarking and standardisation in the field of transportation medicine.

Another study from the US, reviewing the effectiveness of an aeromedical curriculum, was done by Robinson and colleagues. Their study aimed to review the usefulness of an elective aeromedical module for first- and second-year medical students. (71) The module consisted of 18 hours of fly-along time, two hours of lectures, two case reviews, a written syllabus consisting of articles and position papers, and a written assignment.

They had a similar methodology to Mastenbrook and colleagues, with a pre- and post-assessment (20 items) and an evaluation questionnaire. The study had a sample of 12 students. Again, they found similar results, with a mean increase in test scores post-elective (M 18.67%, SD 1.61), as opposed to the pre-elective results (M 13.83, SD 2.17). They additionally found that students were satisfied (56%) or very satisfied (44%) with the elective. It was the authors' belief that increased satisfaction with the elective would increase knowledge retention.

The study was limited in the following ways. It had a small sample size of only 12, which decreased the power of the study. It was in a single institution and on a single course. The elective was voluntary, so there was a high chance that the elective aligned with the students' interests, which led to a self-selection bias leading to higher satisfaction scores. It

is also likely that the students experienced differences in clinical hour and clinical exposure due to the unpredictable nature of aeromedical transportation, which could have impacted their satisfaction scores. Even with these limitations, this study shows that aeromedical modules can be effective and can align with student interests.

Different healthcare systems have different aeromedical systems. In the UK, pre-hospital medicine is a speciality of emergency medicine and anaesthesia. A study by McQueen and Wyse, aimed at evaluating the experiences of emergency medicine trainees during a year's work-integrated learning programme within a regional air ambulance service. (72) The authors developed an aeromedical curriculum, which was based on the Inter-Collegiate Board for Training in Pre-Hospital Emergency Medicine requirements (IBTPHEM).

The curriculum involved placing a single emergency medicine trainee on a clinical rotation on an aeromedical service. The aeromedical service's clinical database was used to keep track of the trainee's clinical activities. The clinical databases were supplemented by extensive logbooks and clinical notes from trainees that were monitored by clinical supervisors to ensure that the objectives of the programme were being met.

The trainee completed 153 hours of clinical exposure during the year programme. Other activities on the programmes included 44 days of additional activity involving regional study days, professional development days, and study leave. The trainees were involved in 385 aeromedical activations, resulting in 256 scene attendances. Traffic collisions accounted for almost half (48%) of all the callouts. Other major reasons for callouts were industrial accidents and chest pain (10% each).

The trainee performed 45 pre-hospital anaesthetic procedures. The trainees also performed a variety of clinical procedures, including intravenous access, pelvic binding application, vacuum mattress application, thoracostomy, rapid sequence intubation, procedural sedation, intubation without induction, intra-osseous insertion, traction splint application, fracture management, surgical airway, and thoracotomy in descending order of frequency performed.

The clinical experience of the trainee could be summarised into five key areas: clinical activities, supervision, workload and clinical experience, educational and clinical governance activity, IBTPHEM assessments and curriculum. With regard to the clinical activities, the trainee had considerable training in pre-hospital medicine before entering the programme, both on-ground operations and they had completed a diploma in emergency medicine. The trainee felt that the transition to aeromedical clinical operations was easy. This may not be

true for other participants of the programme. The trainee felt the programme was highly reliant on experienced clinical supervisors.

The trainee felt that there should a phased approach to supervision of clinical activities. This should be divided into a period when the student simply observes clinical activities, then co-manages patients with supervisors, and finally when the trainee works independently. Clinical supervision depends on the availability of the clinical supervisor and was limited to when the clinical supervisor was on shift. The trainee felt that this should be addressed in future programmes

The trainee experienced 2.5 activations and 1.6 call outs per clinical shift. Around 40% of call-outs resulted in the transportation of a patient. A large majority of patients (over 70%) were taken to major trauma centres. The trainee felt there was an adequate number of an anaesthetic procedure performed during the programme. Supplementary clinical procedures were performed in a skill laboratory, if the trainee did not acquire them in the clinical hours in the programme.

During the programme, the trainee was released from clinical duties to participate in professional development programmes and courses. These focused-on trauma management, neonatal transfers, major incident management, and pre-hospital anaesthetics. Some of these courses supplemented the training on the clinical programme, which were not formally taught. The trainee engaged with clinical governance structures of the service, attending over 70% of mortality and morbidity meetings. Evidence of the engagement with clinical governance structures was recorded in a portfolio the trainee submitted.

The trainee completed assessments produced by the IBTPHEM. Where the trainee did not have enough clinical exposure to complete assessments, simulations were used to supplement the IBTPHEM requirements. An example of this is obstetric emergencies which are rare in aeromedical clinical activities. The authors recommend additional training in this for future programmes.

The authors concluded that the programme they ran addressed the IBTPHEM requirements and could be used in the future. This study has a few limitations. The study involved only a single participant making broad inferences about the field impossible. The trainee had prior pre-hospital and emergency medicine experience, possibly influencing the results. There was no control group in the study.

The study demonstrates a structure for clinical training in aeromedical operations. The curriculum can be implemented in other settings, specifically in services in South Africa. The training programme involves a good mix of clinical time and uses other resources and programmes to supplement it where it is lacking. This modality for training could be used in the South African context. There is no current post-qualification aeromedical training programme available in South Africa. A challenge for a programme like this in South Africa would be the lack of aeromedical services and appropriately qualified clinicians with experience, which could lead to difficulty in finding clinical mentors for students.

Paediatric curricula in pre-hospital programmes

Critical retrieval teams transport different types of patients, from neonates to geriatrics. Generally, older populations have higher incidences of diseases; however, at times younger patients require transportation between facilities. These transfers can be a daunting task for critical care transport teams, with the added pressure of unfamiliarity with paediatrics and the unique challenges they pose. A study conducted by Miller and colleagues tried to address this in the aeromedical field and paediatric field. (73) Their study involved the generating and testing of continuous medical education (CME) module on paediatric respiratory distress. The authors designed a CME activity consisting of a workshop and an on-the-job experiential learning component, with paired and group discussions, and a didactic session. During the didactic session, five learning domains were taught, comprising recognition of abnormal vital signs; recognition and treatment of children with stridor; wheezing due to asthma; wheezing due to bronchiolitis, and respiratory failure. Pathophysiology, signs and symptoms and treatment were discussed for each domain.

A total of 62 learners attended the workshop. The workshop increased post-assessment scores by 12% (95% confidence interval, 9.4-14.8; $p<0.001$). Qualification and year of experience had no statistical significance on the increase in test scores. Experienced participants (more than one year's paediatric experience) scored higher in the pre-test. The authors concluded that the workshop increased short-term knowledge of participants. They also found that their method of assessment of the impact of CMEs was reliable and could be used in further research.

The limitations of this study included their lack of a control group which did not attend the workshop, which makes it difficult to draw conclusions about other pre-hospital and aeromedical training. Due to the lack of experience of some of the participants, it is highly likely that any intervention would increase their short-term knowledge. It was unclear if this would translate into long-term knowledge and competence. Due to the voluntary nature of

the workshop, there is a potential selection bias for participants that were interested in the topic of the workshop and therefore more likely to acquire more knowledge from the workshop. This study demonstrates the need for continuous training post-qualification.

Paediatric transportation is a highly specialised field of medicine, often involving the intersection between transport medicine, critical care, and paediatric medicine. Another study, conducted by Gee and colleagues, focused on a pilot curriculum taught to paediatric transportation teams. In the US, paediatric transports are often done by specialised transport teams with medical control from a physician. Usually training for these fellows was done on-the-job without a formalised curriculum. The authors developed a training programme and taught it to emergency medicine and critical care fellows.

The pilot curriculum involved an interdisciplinary approach, high-fidelity simulation, and feedback on performance by peers. It was conducted by faculty attending physicians and experienced transport clinicians. It was based on the principals of the Accreditation Council for Graduate Medical Education, which stipulated that the milestones of patient care, medical knowledge, professionalism, interpersonal communication skills, practice-based learning, and systems-based practice should be included in fellowship training.

The pilot curriculum structure consisted of an introduction by the medical control physician (facilitator), with a discussion of the common barriers to telephonic communication and a role-play scenario of a hospital referral. Then some of the participants took part in a high-fidelity case scenario involving a deteriorating patient that necessitated the transporting team to consult with the facilitator. A debriefing session was held after the simulation when all the participants were invited to comment. The debriefing session centred around key discussion topics including two-way communication, creating of shared understanding between communicating parties, use of a standardised handover, and the development of a relationship between the transporting teams and hospital staff.

Twenty-six participants were enrolled in the pilot curriculum and study, divided into 11 fellows and 15 transport team clinicians. Participants completed a questionnaire which asked them to rate how realistic the scenario was, the importance of the content of the curriculum, and the possible impact on future teamwork. All but one fellow completed the questionnaire. On the whole, participants felt the curriculum increased their communication skills by strongly agreeing (4.5 out of 5 on a Likert scale). They strongly agreed (5 out of 5) that the training was realistic and important.

The study had a small sample size, which limited its power. The participants were not involved in pre- and post-curriculum assessments, making it difficult to quantify the impact on the curriculum. It also had no control group to test the efficiency of the curriculum. The curriculum did, however, shed light on what and how transportation curricula were being taught. The use of high-fidelity simulation has, at very least, had a positive impact on students' perception of the content they are being taught. The pilot curriculum also focused heavily on communication skills and the inter-professional communication between transporting and hospital staff.

Competence in pre-hospital training

All curricula are designed with the goal of producing competent graduates who have the skills and ability to perform in the environment in which they were educated. The concept of competence is central to curricula design but there has been considerable debate on what competence is and how to assess it. This is what Clement and Mackenzie tried to address in their paper focused on competence in pre-hospital care based in the United Kingdom in 2005. (74)

Their paper is written as a position paper that reviewed the current literature at the time. The authors began by defining competence as an ability to operate to an adequate, safe standard. They go on to elaborate on this concept, that it involves the fusion of knowledge, understanding, and skills. They draw a distinction between academic knowledge and competence, a concept that may be unpopular in medical fields.

They then described competence-based curricula and frameworks. They define competence frameworks as a range of work activities needed and the setting of outcomes in order to deliver service. They then described competency themes they felt should be incorporated into intensive-care medicine, including resuscitation and stabilisation, clinical assessment, investigation, data interpretation and diagnosis, organ system support, monitoring and clinical measurement, equipment safety, specific patient populations, pre- and post-intensive care, end-of-life care, professionalism, and scientific principles knowledge. These themes can be used as a guideline for all healthcare educators who teach intensive care as part of their curricula.

The authors' framework for competence involves an interplay between the scope of practice, curriculum content, and competencies. Scope of practice is divided into themes, which include the roles and general functions, and units, which include the actions and activities which will be performed during clinical work. Curriculum content is divided into four concepts:

elements (basics), performance criteria (standards and objectives), resources (teaching material), and links (defined syllabus items and learning outcomes). Lastly, they define competence as a combination of hard skills and soft skills. The hard skills involve cognitive, medical, basic science, and clinical knowledge, as well as the technical and clinical skills to perform in the given environment. Soft skills relate to behaviour and combine attitudes and emotions. After the curriculum has been taught, the students' performance must be assessed. This can be through a variety of methods.

This paper illustrates that competence is not solely connected to knowledge and sets out a framework to instruct critical care curricula. This paper is relevant to this literature review as it describes a curriculum not only as a way to impart knowledge but also as a tool to assess the competence of a student. It also describes topics and themes that can be contained in a critical care curriculum.

There are two broad types of evaluation in healthcare education, traditional evaluation and competency-based evaluation. Traditional evaluation is usually time-based and involves each student demonstrating competency according to a group standard and within a fixed time period. Many institutions around the world use traditional evaluation to assess their students. In contrast, competency-based evaluations are individual and are not fixed to a predefined time period. There are many advantages to competency-based evaluation, although it is usually logistically challenging and more difficult to administer. (75)

Gruppen and colleagues have identified four challenges to the implementation of competency-case evaluation: identifying the health needs of the community, defining competencies, developing self-regulated and flexible learning options, and assessing learners for competence. (76) Although these challenges can be daunting for institutions, once overcame, competency-based evaluation can produce more motivated and focused students. Additionally, it allows educators to individualise assessments, giving them more power of when and how students' progress through programmes. Competency-based education has become more popular in medical education and there is some consensus between experts that it will be the dominant method of teaching in the future.

As competency-based education becomes more popular in medical education, it is likely to form part of critical care transportation and retrieval courses. Competency-based education view students as impressionable to outside influences that create learning outcomes regardless of innate capabilities or processes. This could affect the structure of these courses and allow students more control over their studies as students that were not

traditionally allowed access into certain programmes, may be in the future. As the lines between different medical fields are constantly being blurred and traditional roles for practitioners are evolving, it is likely that different types of practitioners will be involved in critical care in the future.

Identification of gaps or needs for further research

Curriculum development is one of the steps in improving student's clinical performance, with the hope of increasing patient safety. Internationally, critical care transfers are regulated heavily, and curricula outcomes are prescribed in detail. (77) Locally, universities use their own discretion to decide which elements of the course outcomes are focused on in the critical care module. Before this study, there was no literature on which elements have been focused on by critical care module coordinators as well as no comparisons of emergency care programmes among South African universities.

Summary and interpretation

The aim of this literature review was to gather and appraise the literature describing the curricula of pre-hospital programmes. A total of 14 articles were found on the topic and 21 sources were found describing the outcomes of critical care pre-hospital curricula. All, except one, were set in healthcare systems other than South Africa. The articles were divided into four main topics, namely, pre-hospital curricula, aeromedical curricula, paediatric pre-hospital curricula, and competency in pre-hospital training.

It can be seen from this literature review that there has been no published work specifically describing pre-hospital curricula in the South African setting. Moreover, no literature could be found comparing emergency medical care curricula. This paucity of knowledge in the field justifies the current study, which sets out to compare critical care transportation and retrieval curricula taught in pre-hospital degree programmes in South Africa.

Standard setting in medical education is an important step in producing consistency in the clinical treatment of patients. In South Africa, the HPCSA has mandated critical care retrieval and transportation to be performed by ECPs. ECPs are trained at universities and it is unclear how the universities approach their critical care modules. Answering this question would provide the field with a clear path to producing a standard.

There are many ways to compare curricula, from document reviews to content analyses, to interviews and questionnaires. All methods compare a single aspect of a curriculum. The

method chosen in this study will be qualitative content analysis in order to compare the written curriculum. Although this method does not compare many aspects of the curriculum, which will have to be compared in other studies, it does show what outcomes the universities consider are important to critical care transportation.

In conclusion, there is a lack of studies comparing curricula in critical care retrieval curricula in South Africa, as well as many curricula taught around the world specifically focusing on critical care transportation. This lack of consistency can be addressed in the study.

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Appendix 1: Results of Literature Search

Table 1: Search results from peer-review sources

YEAR AUTHOR REFERENCE & TITLE	SAMPLE SIZE/ SETTING	STUDY DESIGN/ METHODOLOGY	PRIMARY OUTCOME	LIMITATIONS AND CONFOUNDERS
2018; SW Gee, PL Holt, MJ. Stoner; Safe interfacility transport of pediatric patients: medical control training, an interdisciplinary approach Ref - (78)	10 fellows and 15 transportation team clinicians	Pilot curriculum with a questionnaire on the quality of the curriculum	The participants strongly agreed that the pilot curriculum had a positive impact on their communication skills, and felt that the curriculum was realistic and important.	Limited number of participants. Lack of control group. Lack of assessment before and after curriculum.
2016; JO Miller, S Thammasitboon, DC. Hsu, MI. Shah, CG. Minard, JM. Graf; Continuing medical education for air medical providers Ref -(73)	Sixty-two learners attended the workshop. Fifty-nine learners completed both pre-curricular and post-curricular testing.	CME workshop with assessment of knowledge related to paediatric respiratory conditions during aeromedical transportation.	Statistical increase in test scores of 12.1%.	Selection bias due to voluntary nature of intervention. Experience of participants could affect post-assessment results.

2015; SM Bradley, D Chang, R Fallar R Karani; A patient safety and transitions of care curriculum for third-year medical students Ref -(54)	3rd-year medical students at an urban medical school enrolled from 2012 to 2014. 292 students pre-assessment and 265 students post-assessment.	Interventional module with pre- and post-assessment for knowledge and a questionnaire to assess confidence.	Students were more confident after the module and had greater knowledge of patient safety and transition of care.	The study did not test the student's competence but rather their knowledge. Clinically competence
2015; J Mastenbrook, P Savino, P Mazurek, J Eichel, W Selde, G Ekblad; Air Medical curricula in emergency medicine residencies: a national survey Ref -(70)	106 residency programmes across the US.	Survey of residency programmes related to aeromedical components of their programmes.	There was no standard aeromedical curriculum taught in residency programmes. Ten board categories were identified in the programmes which had a formal aeromedical component.	Low response rate of only 66% with only 15 of the 25 curricula obtained. Residency programmes were contacted directly, there may be aeromedical training that occur outside of the written and planned curriculum.
2015, J McCallum, E Vu, D Sweet, HD. Kanji; Assessment of paramedic ultrasound curricula: a systematic review Ref -(55)	Twelve studies with 187 paramedics were included	Systematic review with electronic searches of MEDLINE, Embase, CINAHL, and the Cochrane Center Register of Controlled Trials following Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.	Paramedic ultrasound curricula in FAST and pleural ultrasound is feasible and time effective with successful application	Varying scope of practice making it difficult to make broad conclusions on all pre-hospital providers. Incorporation of ultrasound into other pre-hospital curricula that wasn't examined in the review. Small number of studies focused on the topic.
2014; Y Wang, Xiangrui L, Yuan Y, Patel MS; A multi-method approach	Document review from multiple sources, 11 keys informants from the	Multi-method review. Data collected from various sources	The development of a HERO curriculum	N/A

to curriculum development for in-service training in China's newly established Health Emergency Response Offices Ref - (60)	government's health emergency services, military, academia, and staff of the Health Emergency Response offices (HERO's) programme, 115 self-administered questionnaires.	including, document review with interviews on proposed competencies for HERO's programme, self-administer questionnaire of a workshop conducted for HERO staff.		
2014; P Mulholland, T Barnett, J Spencer; Inter-professional learning and rural paramedic care Ref - (56)	36 articles were included in the review relating to the topic	Systemic review of literature searching databases including MEDLINE, SCOPUS, CINAHL and the University of Tasmania electronic library	Three major themes were identified in the literature, namely, inter-professional education (IPE), multidisciplinary teamwork, and Inter-professional learning.	Limited search technique to obtain literature. Did not include all research types in search.
2014; H Sjölin, V Lindström, H Hult, C Ringsted, Lisa Kurland; What an ambulance nurse needs to know: A content analysis of curricula in the specialist nursing programme in prehospital emergency care Ref - (48)	12 universities offer pre-hospital registered nurse curricula were included, with 1 being excluded. A total of 49 courses were examined.	The result shows that the course content can be described as medical, nursing and contextual knowledge with a certain imbalance with largest focus on medical knowledge, with 16 sub-categories within the three main categories.	Clarifies how the content in the education for ambulance nurses in Sweden looked with a discussion on the content distribution.	The distribution of keywords and theme in curricula cannot be related to the time spent on the topics.

2013; C McQueen, M Wyse; The delivery of the new prehospital emergency medicine curriculum: reflections on a pilot programme in the UK Ref - (72)	1 trainee of a 12 month aeromedical clinical learning programme.	Evaluation of a the training programme against requirements of the IBTPHEM.	The programme compared favourably to the IBTPHEM requirement and the curriculum can be sued for future programmes.	Small sample size of only 1.. The trainee had prior pre-hospital and emergency medicine experience possibly skewing the results. There was no control group in the study.
2010; KJ Robinson, L Bolton, K Burns; Air medical transport curriculum provides education for medical students Ref - (71)	12 1st and 2nd year medical students undertaking air medical transport elective	Survey using a questionnaire with knowledge and satisfactory questions related to the elective	Significant improvement of the test scores and overall the students were satisfied with the elective.	Study was from on institution, had a small sample size, and was of a voluntary programme. Inconsistence student experience due to the nature of aeromedical operations.
2010; KL Cohen, LA Wallis; Is the current South African emergency medicine curriculum fit for purpose? An emergency medicine practice analysis Ref - (51)	Three secondary-level hospitals in the greater Cape Town area.	Collection of patient care records focusing on clinical presentation, procedures performed, and investigations, with a comparison to the emergency medicine curriculum.	A total of 1283 clinical presentations were recorded with 47 not included in the emergency medicine curriculum. 115 procedures were performed and with 730 investigated.	Study sites were not ideal to get a clear picture of the patient population. Incomplete patient records during data collection.
2009; RD MacDonald, J Ip, K Wanger, A Rothney, K McLelland, AH	EMS curricula from Canadian EM and EMS training programs and a sample of U.S. curricula	Collection of EMS components of residency programmes, development of an EMS	The development of a curricular framework for physicians in Canada	Some of the authors of the paper and the experts consulted were programme directors of the programmes sampled which

Travers, et al; The development of a national emergency medical services Curriculum framework for physicians in Canada Ref - (60)		curricular framework using a Delphi study design.		could lead to reporting bias.
2005; R Clements, R Mackenzie; Competence in pre-hospital care: evolving concepts Ref - (74)	N/A	Position paper	Description of competency and setting out of a framework of assessing competency.	Lack of scientific method and systematic review of literature. Relatively old.

Table 2: Search results from grey literature

INSTITUTION, & REFERENCE	NAME OF COURSE	ADMISSION CRITERIA / PREREQUISITE / TARGET AUDIENCE	LENGTH OF COURSE	LEVEL OF QUALIFICATION	LEARNING OUTCOMES OF COURSE
Norwegian Air Ambulance and the University of Stavanger Ref - (61)	Master in Pre-Hospital Critical Care	Bachelor's Degree in healthcare. All applicants must document a minimum of 2 years of relevant experience in pre-hospital emergency care	Part-time study with an estimated duration of 4 years. Full-time 2 years	Masters 120 credits	• Communication and Decision-making in • Pre Hospital Emergency Medical C. • Scientific Methods • Pre Hospital Emergency Medical Care and Transport Medicine • Philosophy of Science and Healthcare Ethics • Traumatology in Pre Hospital • Point of Care Technology • Patient Safety • Major Incidents: Medical Management and Preparedness • Master Thesis
University of Plymouth Ref -(62)	Certificate, Diploma and Masters in Pre Hospital Critical Care / Retrieval and Transfer	University's entry requirements for study at postgraduate level. A practicing healthcare professional.	Full-time 1 year, part-time 3 years	Postgraduate certificate: 60 credits Postgraduate Diploma: 120 credits Masters: 180 credits	• Applying Evidence in Practice • Critical Care Management - Airway, Breathing and Circulation • Critical Care Management - Neurological, Environmental and Special Patient Groups • Pre-hospital Critical Care Passport Competencies 1 • Advanced Clinical Reasoning for the Critical

					Care Patient • Retrieval and Transfer of a Critical Care Patient within Special Situations • Project Design for Research • Pre-hospital Critical Care Passport Competencies 2 • Research Dissertation (60 credits)

International Board of Specialty Certification
 	
Ref -(63)
	Certified Critical Care Paramedic (CCP-C)	Any licensed or certified paramedic functioning in a specialty and or critical care clinical practice arena	Examination	Post-graduate certificate	• Transport and Safety
					• Airway, Anaesthesia, and Analgesics
					• Medical
					  ○ General Medical
					  ○ Cardiac Patients
					  ○ Neurologic Patients
					  ○ Respiratory Patients
					  ○ Toxic Exposure and Environmental Patient
					• Trauma/Burn Patient
					• Special Populations
					  ○ Neonatal Patients
					  ○ Paediatric Patient
					  ○ Bariatric Patient
					• Geriatric Patient

Wisconsin Department of Health Services Division of Public Health Emergency Medical Services Section -	Critical Care Transport Paramedic Course	• Be at least 21 years old • Possess a high school diploma or its equivalent • A healthcare provider level	The course takes place over 96 hours	Post-EMT Paramedic qualification.	• Basic and advanced airway management • Pulmonology and ventilator management • Cardiovascular A and P with advanced therapies (IABP/VAD) • Hemodynamic monitoring • Critical care pharmacology • Neurologic emergencies and monitoring techniques

University of Wisconsin Hospital and Clinics Ref -(79)		CPR program • EMT-Paramedic license or certification with a three years' experience • ACLS • PALS			• Advanced trauma assessment • Radiology (x-ray and CT) • Lab interpretation • Infectious disease and sepsis management • Multi-organ dysfunction • Paediatric and neonatal transport considerations • Air medical operations, flight physiology and safety
University of Warwick Ref -(80)	Advanced Clinical Practice (Critical Care)	Doctors, nurses and paramedics caring for critically ill patients	Full-time 1 year, part-time 3 years	Postgraduate certificate: 60 credits Postgraduate Diploma: 120 credits Masters: 180 credits	Modules • Advanced Emergency Practice • Special Incident Management • Essentials of Clinical Education • Introduction to Leadership and Management in Healthcare Contexts • Community-Based Care • Work-based Learning
Glasgow Caledonian University Ref -(81)	Principles of Critical Care	Paramedic registered with the Health Professions Council	1 year full-time	Post-graduate qualification	• Demonstrate an in depth knowledge of human anatomy, physiology and pathophysiology across all age ranges in relation to critical care and high dependency patients. • Examine the decision making processes in critical care management and the impact of interventions upon these during out of hospital environments. • Demonstrate effective care through recognition and application of appropriate pharmacological interventions.

					• Demonstrate an understanding of microbiology, biochemistry and radiology in relation to the critically unwell patient. • Demonstrate an understanding and knowledge of primary and secondary retrieval of a critically ill patient and triage principles to be applied. • Develop a professional approach to the application of patient safety and risk management protocols.
Central Queensland University Ref -(64)	Graduate Diploma of Paramedic Science (Critical Care)	• Diploma of Paramedic Science with a minimum of 3 years' experience • Advanced Diploma Intensive Care Paramedic or equivalent in advanced practice with a minimum of 2 years' experience • Bachelor of Paramedic Science or equivalent	1 years full-time, 2 years part-time	Post-graduate qualification	• Advanced Clinical Assessment and Decision Making • Pharmacological Application in the Critical Care Setting • Medical Science Research Project 1 • Aeromedical, Retrieval and Tactical Medicine • Students must complete the following compulsory units: • Advanced Critical Skills Application • Advanced Assessment, Diagnostic Interpretation and Management • Medical Science Research Project 2 • Advanced Clinical Care of Trauma and Environmental Emergencies

		with a minimum of 2 years experience			
Royal Flying Doctor Service Ref -(67)	Specialised Training in Aeromedical Retrieval	Doctors, nurses, and paramedics	2 days	Continuous medical education	• Introduction to Aeromedical Retrieval Medicine • Transport Modality Choices • Introduction to Aviation Physiology • Aviation Physiology - Real World Cases • Human Factors in Aeromedical Retrieval • Principles of Interfacility Transportation • Paediatric Retrieval • The Bariatric Patient • The Disturbed Patient • Preparing the Critically Ill for Transport • Drugs and Equipment in the Aeromedical Environment
North Wales Critical Care & Trauma Network Ref -(68)	All Wales Critical Care (& Trauma) Networks Regional Transfer Course		3 days	Continuous medical education	• Communication • Resuscitation and Primary Survey • Packaging Patients for Transfer • Minimal monitoring; equipment dos & don'ts • Inter and intra-hospital transfers; bariatric, L0 & L1 patients • Transfer personnel, training, quality assurance, documentation & audit • Specialist Transfers; neuro & spinal patients • Ambulance orientation • Legal & Ethical issues in transferring critically ill patients

					• Transfers by helicopter • Part B Skills
Critical Care Network in North West London Ref -(69)(69)	Transfer course	Doctors, nurses, paramedics and other healthcare professionals	1 day	Continuous medical education	• Transfer governance • Pre-transfer stabilisation • Specific transfer physiology • Specific management of aortic and neurosurgical emergencies • Trouble shooting equipment problems • Transfer process management
CCAT Aeromedical Training Ref - (82)	Basic				
	Clinical Considerations in Aeromedical Transport Foundation Level (CCAT FL) Course	All courses are for doctors, nurses, paramedics and other healthcare professionals who are working in or wish to work in aeromedical transportation.	5 days	Continuous medical education	• The first part of the course is devoted to the principles of aviation and environmental physiology that form a basis for the remainder of the course. The second part of the course lasts four days, and covers clinical aspects of transport medicine with special relevance to fixed wing and rotary wing flight.
	Helicopter Medical Flight Crew (HMFC) course		3 days		• Aviation awareness • Crew Resource Management (Human Factors) • Radio communications • Navigation • Helicopter emergencies • Safety in and around helicopters • Ground handling • - Site selection
	Advanced				
	CCAT	CCAT FL course	3 days	Continuous medical	• Next step course for graduates of the CCAT

	Intermediate Level (CCAT IL) Course			education	FL course. It covers more complex cases in aeromedical retrieval and transport, and emphasises real case discussions and scenario teaching.
	CCAT Advanced Level (CCAT AL) Course	Previous CCAT courses	3 days		• Graduates of previous CCAT courses and others with appropriate experience in aeromedical retrieval and transport.
	HEMS Advanced Course	Previous HMFC course	5 days		• Graduates of previous HMFC course and others with appropriate experience in aeromedical retrieval and transport. The course covers: • Pre-hospital emergency care • Advanced human factors • Disaster medicine.
University Hospitals Bristol Ref - (83)	Transport of the Critically Ill Course	Emergency physicians, anaesthetists, intensivists, nurses, ODPs and paramedics.	2 days	Continuous medical education	• Assessing a critically ill patient prior to transfer • Stabilising a patient prior to transfer • What equipment to take and how to use that equipment • Transferring a patient within a hospital, for example, to radiology and theatres • Preparing to and transferring a patient in a helicopter and ambulance • Transporting variety of patients from children to adults with conditions, for example, head injury and road traffic accidents.

North West London
 	
Ref - (69)
	Critical Care Transfer Course	Multi-disciplinary (not specifically stipulated but it is assumed pre-hospital, nursing, and intensive care doctors could attend)	1 day workshop	Continuous medical education	• Introduction
					• Background – national picture
					• Background – local picture
					• Why worry about transfers?
					• Physiological effects of transfer
					  • Dynamic Hazards
					  • Static Hazards
					• Legal, insurance and safety considerations
					• Preparation and stabilisation
					  • Transfer checklist
					  • Patient
					  • Staff
					  • Equipment
					  • Organisation
					  • Departure
					• Subspecialty transfers:
					  • Neurosurgical transfers:
					• Preparation
					• The transfer
					  • Vascular Emergencies
					• Modes of Transfer:
					  • Road Ambulance:
					  • Helicopter & Fixed-Wing Transfer
					• Transfer Documentation
					• Top Tips

Various institutions: University of the Witwatersrand, S.A Red Cross Air Mercy	Aviation Healthcare Provider Course	Paramedics, nursing sisters and doctors who transport patients in the air. Participants are	1 day course	Continuous medical education	• Safety considerations. • Patient assessment and packaging. • The physiology of transport in the air medical environment. • Assessment and care of patients with a wide

Services Ref - (65,84)		required to pass an aviation medical examination as a pre-requisite for entry			range of diseases and traumatic injuries
University of Cape Town Ref - (66)	Aeromedical Evacuation and Transport	Medical officers (working in emergency centres); paramedics (BTech or ALS); nursing sisters (working in emergency centres)	5 day course	Continuous medical education	• Introduction to Aeromedical Services • Physiology of flight • Practical considerations in commonly transfer (pregnancy, neonates, congenital heart disease, airway management) • Crew Resource Management Principles
Emergency Care Education Ref - (85)	Critical Care Transport Aviation course	Paramedics, nurses, physicians, and specialty crew	5 day course	Continuous medical education	• Pre-hospital critical care transport: o Flight physiology o Lab analysis o Hemodynamic monitoring o Specialized devices such as the intra-aortic balloon pump. • Standard topics : o Airway management o Trauma o Pharmacology are covered in the context of critical care

PART B: MANUSCRIPT IN ARTICLE FORMAT

A comparison of critical care transportation modules taught in bachelor's degrees in emergency medical care in South Africa

by

Mr Nathan John Conradie, Dr Willem Stassen, and Prof Craig Lambert

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Abstract

Background

Critical care retrieval (CCR) involves the movement of critically ill patients between healthcare facilities. CCR forms an important part of the continuum of care South Africa, like other low- to middle-income countries, has a relative shortage of ICU beds with the potential need for transportation of patients between facilities. CCR is mostly done in South Africa by emergency care practitioners; however, it is unclear how universities offering Bachelors in Emergency Medical Care (BEMC) approach their teaching in critical care. Additionally, it is unclear if the critical care modules taught of EMC programmes adequately prepare graduates for CCR.

Method

The study used various methods to describe and compare the curricula of critical care modules offered on BEMC programmes. Curricula were assigned into components and sub-components according to accepted definitions of curricula. The components included aims, goals, composition and objectives of the course, content or teaching material, modes of transaction between teachers and students, and evaluation. Components of curricula were compared using qualitative content analysis and descriptive analysis.

Data were generated from qualitative content analysis were represented on tables which have been used to illustrate the similarities and differences of the modules. Results from the cluster analysis were generated; however, small sample size did not allow for significance testing.

Results

Four universities offer BEMC programmes and all four were approved to participate in the study. Final approval to participate was obtained by three of them. University names were kept anonymous. University A and C had a similar structure to their programmes and had the same learning outcomes. Content analysis found these universities to be 100% similar. University B was significantly different and its programme had a different structure and content, sharing only 58% similarly with others.

The results of the descriptive analysis show four of the five components were similar, with the only the module structure differing significantly. This shows an overall similarity in the modules.

Discussion

Although the modules are relatively similar, it is surmised by the authors that the modules are unlikely to prepare graduates for the clinical complexity and logistical challenges of critical care transportation and logistical difficulties of moving critically ill patients.

Conclusion

The universities offering critical care modules on BEMC programmes should academically benchmark with each other in order to standardise the content taught to students. It is the recommendation of the authors that further training in critical or post-graduate certification be required by regulators in order to fully prepare ECPs for critical care transportation and retrieval.

Background

Critical care transfers are not without risk and are usually expensive and logistically challenging. (1) When deciding to transfer a critical care patient between facilities, the risks and benefits of the move should be considered. Although critical care transportation and retrieval occur on a regular basis, adverse events are common. (2) The stress of transportation has the potential to cause the physiological deterioration of patients. It is important for anyone performing critical care transportation and retrievals to be prepared for the complex nature of these cases. (3)

There are little data on the rates of critical care retrievals in South Africa. However, South Africa, like other low- to middle-income countries, has a relative shortage of ICU beds. This is seen most prominently in peri-urban and rural areas. (4,5) This shortage could lead to the need for patients to be moved between facilities. From data on neonates, there are a significant number of neonates being transported in the rural health district. (6) The number of referrals can far outweigh hospitals' ability to accommodate patients. (7)

In recent years, standard-setting has become an important part of higher education. Setting standards is particularly important in medical education because after graduation medical students go on to work in the clinical field with real consequences for patient care. Measuring competence has become vital to medical educators as the field focuses on producing graduates with the knowledge and skill to practice safely. (8)

Since the institution of formalised curricula, educators have been comparing them. Curricula are compared across educational systems and within educational systems. Due to the complex nature of what constitutes a curriculum, studies comparing curricula usually only compare one element of a curriculum. Comparing curricula is the initial step in benchmarking of curricula and eventually standardisation of curricula outcomes and competencies. (9)

To perform a safe critical care transfer, a practitioner needs to rely on a comprehensive knowledge of many aspects of patient care, including pathology, pharmacology, interpretation of diagnostics results, and equipment operations. The Health Professions Council of South Africa (HPCSA) has mandated that critical care transportation falls within the scope of practice of emergency care practitioners (ECPs) who have obtained a Bachelor of Emergency Medical Care (BEMC). However, the HPCSA has given little clarity on the knowledge required by ECPs to perform critical care retrievals and transportation. For this reason, the universities offering BEMC have little guidance on what to include in their

curricula and how to approach this module. (10) The aim of this study is to compare the critical care modules and to assess if these modules adequately prepare students for the rigors of critical care transportation and retrieval.

Methodology

This lack of published data on what universities deem important to include and focus on in their critical care modules is the basis for the current study, which aims to compare the critical care modules taught on BEMC programmes. The comparison was conducted using document analysis. Qualitative (content analysis) and quantitative methods (descriptive analysis) were used to describe differences depending on the nature of the component being compared.

Ethics approval was obtained from the Human Research Ethics Committee of the University of Cape Town (reference number 640/2018). After institutional approval from each of the relevant universities, the respective Heads of Department (HODs) of Emergency Medical Care were contacted for final approval and to refer the research team to the relevant year coordinators.

Data analysis

Designated year coordinators provided, via email, electronic versions of the study guides for the critical care modules. First, modules were divided into categories according to well-established aspects of a curriculum, namely: (11)

- Component 1 – Aims, goals, composition and objectives of the course
- Component 2 – Content or teaching material
- Component 3 – Modes of transaction between teachers and students
    - Sub-component 3.1 – Staff
    - Sub-component 3.2 – Student-teacher interaction
    - Sub-component 3.3 – Information technology
    - Sub-component 3.4 – Work integrated learning
- Component 4 – Evaluation
    - Sub-component 4.1 – Practical
    - Sub-component 4.2 – Theory

Each aspect of the curriculum was analysed differently depending on the component the data was from.

Descriptive analysis

For components 1, 3, and 4 descriptive analysis was used to compare components. With this technique, the results of the analysis were described without statistical analysis being

performed. Information was extracted directly from curricula documents and arranged in tables and themes.

Content analysis

Component 2 was compared using qualitative inductive content analysis. Content analysis is a method used to draw objective inferences from material from differing sources.(12) The coding process generates binary outcomes; either the outcome forms part of the content taught or it does not.

Results

In South Africa, four universities have accreditation by the HPCSA to offer the BEMC programmes. All four were approached to participate in the research; however, only three gave approval. The names of the universities have been anonymised in order to protect their institutional integrity.

Component 1 –Aims, goals, composition and objectives of the course

Module structure				
University	**Course length**	**SAQA Credits**	**NQF level**	**Module composition**
A	Semester	12	8	Standalone module
B	Year	15	8	Incorporated
C	Year	12	8	Standalone module
Module composition				
University	**Intensive care**	**Thrombolytics**	**Aeromedical transportation**	**Dive emergencies**
A	✓	✓	✓	✓
B	✓	✓		✓
C	✓	✓	✓	✓

Table 2. Breakdown of structure and composition of modules

Table 1 shows the structure and composition of the modules and represents the differing approaches of the universities. No university is like the others, with some using year module and semester modules either incorporated into other modules or standalone. University B is the only university not to include aeromedical transportation in its critical care teaching.

Component 2 – Content and teaching material

Table 2 below shows the domains generated from the coding process and shows the domains covered by each module. A total of 83 domains were generated from the coding process.

Domains	University		
	A	B	C
General			
Need for ICU	✓		✓
Function of ICU units	✓		✓
Pressure ulcers treatment	✓		✓
Maintaining neutral thermal environment	✓		✓
Care of intercostal drains and wound dressing	✓		✓
Ventilation			
Indications for ventilation	✓		✓
Differentiate between vol, pressure time cycled	✓	✓	✓
Explain and compare the following vent modes:	✓	✓	✓
IMV	✓	✓	✓
CMV	✓	✓	✓
SIMV	✓	✓	✓
BiPAP / BIPAP	✓	✓	✓
APRV	✓		✓
Manipulation	✓	✓	✓
Set up and monitoring:	✓	✓	✓
Ventilation rate	✓	✓	✓
Tidal volume	✓	✓	✓
Minute volume	✓	✓	✓
Flow	✓		✓
PEEP	✓	✓	✓
I:E ratio	✓	✓	✓
Trigger	✓	✓	✓

Pressure support	✓	✓	✓
Peak airway pressure	✓	✓	✓
Plateau pressure	✓		✓
Slope	✓		✓
FiO2	✓	✓	✓
Integrated modes and ventilation settings	✓	✓	✓
Ventilator graphs	✓		✓
Ventilation alarms	✓	✓	✓
Patient monitoring			
Pulse oximetry	✓		✓
Capnography	✓		✓
Troubleshooting with patient-ventilator problems	✓	✓	✓
Risk factors of VALI	✓		✓
Weaning of patients from ventilator	✓		✓
NIV - indication, contra-indications, modes	✓	✓	✓
Set up of NIV	✓	✓	✓
Arterial blood gas			
Role and interpretation of ABG	✓	✓	✓
Obtaining an arterial sample	✓	✓	✓
Monitoring			
ECG	✓		✓
Arterial oxygen saturations	✓		✓
End-tidal CO2	✓		✓
Non-invasive blood pressure	✓		✓
Temperature	✓		✓
Haemodynamic monitoring	✓		✓
Role and management of central vascular access	✓		✓
Infusions			
Flow rates and drug dosage calculations	✓	✓	✓
Use and troubleshooting of an infusion devices	✓	✓	✓
Role and management of nasogastric feeds	✓	✓	✓
Role and management of TPN	✓	✓	✓

Fluid balance			
Fluid requirement of critically ill patient in various disorder (post-surgery, trauma, burns, metabolic disorders, and sepsis)	✓	✓	✓
Appropriate choice of fluids for patients above	✓	✓	✓
Fluid balance monitoring	✓	✓	✓
Intra-aortic balloon pump			
Indication, functioning, monitoring and troubleshooting	✓	✓	✓
Imaging			
Chest X-ray	✓		✓
Preparation for transfer, transfer, handover			
Patient assessment	✓		✓
Accumulation of data and history taking	✓		✓
Patient packaging	✓		✓
Decision-making in prep for ICU transfer	✓		✓
Haemodynamic changes in transfer	✓		✓
Stressors of transport	✓		✓
Patient handover	✓		✓
Special populations			
Geriatrics		✓	
Obese and malnourished		✓	
Abused and neglected		✓	
Psychiatric emergencies		✓	
Combative, violent patient		✓	
Diving emergencies		✓	
DIC		✓	
Obstetrics and gynaecology emergencies			
Conception to birth		✓	
Ectopic pregnancy		✓	
Abortion		✓	
Abruption placentae		✓	
Placenta previa		✓	

Pre-eclampsia and eclampsia		✓	
Cardiac arrest in pregnancy		✓	
Management of premature labour		✓	
Pre-hospital tocolysis		✓	
Labour and delivery		✓	
Post-partum haemorrhage		✓	

Table 2. Breakdown of outcomes taught on modules

The results of the content analysis show that University A and University C have the same outcomes in the critical care module. This represents a 100% similarity (83 of 83 domains). This is in contrast to University B, which only shares 58% of the outcomes of the other two universities (48 of 83 domains).

Component 3

Sub-component 3.1- Staff

Staff compliment			
University	**Number of staff**	**Employment type**	**Qualifications of staff**
A	Four	One permanent and three part-time	Two PhD in the field of Emergency Medical Care, One BEMC, and one Professional Nurse
B	One	One permanent	PhD in the field of Emergency Medical Care
C	One	One permanent	BEMC

Table 3. Staff complement of modules

Table 3 shows the staff composition and qualification teaching on the critical care modules.

Sub-component 3.2- Student and teacher interaction

All universities use lectures as their main teaching platform with supplementary information given online. This took the form of pre-reading in the case of University A, tutorials and videos for University B, and pre-reading and videos for University C. All the universities use an online platform to distribute module information and course content.

Sub-component 3.3 – Information technology

All the universities use an online platform for distributing module information and course content. All use well-established online learning platforms, either Blackboard (used by University A) or Moodle (used by universities B and C).

Sub-component 3.4 – Work-integrated learning

Structure of WIL			
University	**Module of WIL**	**Module coordinator**	**Assessment**
A	Clinical practice	Year coordinator	Case study, oral presentation, and reflective journal
B	Clinical practice	Year coordinator	Completion of patient report forms
C	Clinical practice	Year coordinator	Case study, oral presentation, and reflective journal

WIL clinical learning sites								
University	**Pre-hospital**	**EC**	**ICU**	**CCU**	**Theatre**	**NICU**	**Obstetric unit**	**HEMS**
A	✓	✓	✓		✓	✓		✓
B	✓	✓	✓	✓	✓	✓	✓	
C	✓	✓	✓			✓		

Table 4. Structure of work-integrated learning and clinical learning sites

Table 4 shows the breakdown of WIL in the modules. All the universities integrate WIL into the clinical practice module, which is supervised by the year coordinator. University A and C have the same assessment for clinical practice with a case study, oral presentation, and a

reflective journal. University B only assesses students on the completion of patient report forms.

Component 4 - Evaluation

Sub-component 4.1 – Practical evaluation

Practical assessment - Overview		
University	**Simulation**	**Objective structured clinical examination (OSCE)**
A	Two components – clinical component and post-simulation viva	Not included in the module
B	Two components – clinical component and post-simulation interview	Included – does not carry a mark
C	Three assessments – simulation x3	Included – does not carry a mark

Practical assessment - OSCE						
University	**Adult medical cardiac arrest**	**Adult traumatic cardiac arrest**	**Mechanical ventilation**	**Infusion device operations**	**Delivered of mal presentation**	**Chest x-ray interpretation**
A						
B	✓	✓	✓	✓	✓	
C			✓	✓		✓

Table 5. Breakdown of practical assessment of modules

Table 5 shows the composition of the practical assessments of the module. All universities use a simulation for assessment. Only University A does not incorporate OSCEs into the practical assessment, with universities B and C incorporating them.

Sub-component 4.2 – Theory evaluation

Weightings of assessments – University A				
ICU		**Thrombolytics**	**Aeromedical**	**Dive Emer.**
Written assessment	Simulation and viva	Written assessment	Written assessment	Written assessment
25%	25%	30%	10%	10%
100%				

Weightings of assessments – University B					
Theory			**Practical**		
Test 1	Test 2	Test 3	OSCEs	Patient simulation	Post simulation interview
20%	20%	60%	✓	70%	30%
60%			**40%**		

Weightings of assessments – University C							
Year work							**Final Exam**
Written assessments			Practical assessments				Written assessment
Assign.	Test 1	Test 2	Sim.1	Sim.2	Sim.3	OSCEs	
5%	20%	25%	10%	10%	30%	✓	
50%							**50%**

Table 6. Breakdown and weighting of practical assessments of the modules

Table 6 represents the marks and weighting of the theoretical component of the assessments of the module. All the universities use cumulative assessment to generate a final mark for the module.

Discussion

The aim of the study was to compare the critical care modules taught in degree emergency care programmes in South Africa. In four of the five components compared, the universities were more similar than they were different. The study found that the universities are complying with the regulations as stipulated by SAQA and that the curricula can be broadly compared using the method in the study.

In South Africa, emergency medical care is a developing field which has undergone significant changes in recent years. Is it clear from HPCSA policy and guidelines that critical care retrieval and transportation is to be performed by ECPs, when available? This moves the roles of ECPs into an area of medicine, i.e. critical care, that the qualification largely does not focus on. Around 465 of the 480 credits focus on pre-hospital and emergency care. As the roles of the ECP adapt and change, it is important for the field to constantly re-evaluate these roles and training.

A bachelor's degree in emergency medical care has been offered by universities since the early 2000s; however, each university has a different approach to reaching the core standards stipulated by the South African Qualifications Authority. This variation in training has the potential to cause disparities in the clinical treatment of patients and by extension the potential to cause differing patient outcomes.

There are a few inconsequential differences to the module. However, the main difference is seen in the staff conducting the modules. Universities B and C have staff from the field of emergency care, while University A has staff from the field of critical care, with the use of a professional nurse. This difference could be attributed to the way the universities see the content as outside of the field of emergency care or it could be the availability of staff and partnerships between institutions. However, uses inter-professional collaboration between fields has been shown to be beneficial and can be adopted by universities in this field. (13)

The universities have many similarities. They have a similar teaching style, with the use of didactic sessions augmented by an online platform. The use of information technology during teaching and learning has been shown to increase student engagement and student performance (14), with students being more digitally active than they have ever been before. (15)

Studies from high-income countries show the use of online platforms improves student performance. As demonstrated by González and colleagues, who found a 0.48 point increase in student scores (95% CI: 0.10-0.86) on a ten-point scale of students who had access to an online platform. (16) These results are corroborated by a meta-analysis done by the US Department of Education, which looked at studies from 1996 to 2008 and found that, on average, students did better in online learning conditions that with face-to-face instructions. (17)

This is encouraging within the African context, where access to technology is not readily available to everyone. (18) The use of ICT provides educators with the ability to address serious environmental and structural challenges faced by students. Some of these challenges include the lack of preparedness and general competency with technology, multilingual needs in English medium settings, large class sizes, and inadequate curriculum design. (19) With this in mind, it is encouraging to see the universities in this study using ICT to the extent that they are.

It is noteworthy that the departments at the universities in the study have not moved away from classroom-based lectures, as some institutions have. In a study conducted on 211 university student in the UK, Mann and Robinson found that 59% reported being bored during lectures half the time, while 30% found most or all of their lectures boring. The boredom is associated with diminished academic achievement and satisfaction, which lead to increased truancy (20) These results demonstrate that the traditional classroom lectures may not be the most effective way of imparting knowledge to students. It is advisable for universities to find alternative methods of teaching in order to simulate student engagement and encourage learning.

The universities had similar approaches to work-integrated learning. Critical care transportation takes place within a variety of clinical environments. The universities address this by placing their students in different clinical environments within the structure they have chosen for the module. The universities split the time students spend during work-integrated learning among multiple clinical environments. This means relatively little time is spent in critical care units as opposed to units dedicated to emergency medicine or pre-hospital care.

Measuring the competence of graduates and estimating the clinical time required to achieve competency can be difficult. Research into competency at pre-hospital providers usually measures competency with a single clinical skill or procedure. Deakin and colleagues found that students performed 25 intubations before graduating but required up to 200 to be able to practice unsupervised. (21) However, their study did not relate the frequency of the skills performed with the clinical hours required to obtain the skills. It is estimated that this would be substantial and far beyond the clinical exposure in critical care modules.

In the related field of nursing, it can take up to ten years of experience for nurses' competency to plateau. (22) This, coupled with the risk of exposing patients to an inexperienced practitioner, has made many fields in medicine require graduates to go through a period of supervised practice before practising independently. This is not the case

in South Africa and ECPs have no supervised practice when working clinically in both the pre-hospital and critical care settings. It is recommended to the universities that additional time be allocated to critical care in work-integrated learning to fully prepare graduates for the complexities of critical care patients.

Each university has its own approach to practical assessments. Their simulations differ slightly in structure. It is assumed that, if the universities use simulation in their evaluations, they also use it as part of their teaching and learning. This is in line with the literature, which shows simulation to be a positive training tool for pre-hospital providers. (23) Abelsson and colleagues conducted a meta-analysis on the use of simulation in pre-hospital training and found it to be beneficial. They further concluded that simulation provided a means to assess the student's treatment, physical assessment, and procedures in a realistic environment.

Two of the universities use OSCEs as part of their module. OSCEs have been shown to be an effective method of assessment in the medical field in general and more specifically in critical care training. (24,25) OSCEs are used to assess baseline clinical competency without the clinical reasoning required by simulation assessments. It is unclear from the documents reviewed why University A does not use them in their critical care module. Although none of the universities uses OSCE assessments to contribute to the mark and are there only to allow students entrance into final examination. This is in line with the NQF level of the module, as OSCEs assessments are generally considered lower on Bloom's taxonomy and could not form a large proportion of a module at an NQF level of eight.

The content and outcomes taught in the modules were similar. University A and C have the same outcome; University B shares almost 60% of the outcomes. Considering the structures are so different, with University B combining the critical care component into the emergency medical care module, there is similarity in the content taught. There is no literature available describing the type of patients seen by transportation teams in the South African EMS system, so it is difficult to draw conclusions on the appropriateness of the outcomes in relation to the patient population.

The critical care modules form only a relatively small fraction of the entire BEMC programme. The module is between 12 to 15 SAQA credits and the entire programme is 480 credits. This shows that, on the whole, the BEMC programme focuses on emergency medical care and rescue rather than critical care retrieval and transportation. This may leave graduates exposed when required to transport clinically complex and logistically difficult

critical care patients. In order to address this, it is recommended that the weighting of the module be reconsidered by both the universities and regulators.

After a comparison such as this, several questions arise. Is the content taught on the module fit for purpose? Is the content in line with the roles and responsibilities of ECPs? Within the context of the current regulatory framework and patient population, do the modules adequately prepare graduates for, arguably, the most clinically complex patients seen by pre-hospital providers? It is the opinion of the authors that the answer to these questions is no. The modules do not adequately prepare students.

By the standards of the regulators, a newly qualified graduate could be called to transport a critical care patient on their first call after registration. Critical care patients usually have multiple comorbidities and have complex clinical presentations. It is suspected by the authors of this study that many graduates would be inadequately equipped to treat these patients safely and with a minimal chance of adverse events only with the critical care modules in their undergraduate studies.

The results of this analysis show the need for standard settings in the field of critical care transportation and retrieval. This will require collaboration between stakeholders and role players. Collaboration will be crucial to producing attainable, valid, and reliable standards, through a process of academic benchmarking between universities and clinically in the form of an examination or certification. Standards in critical care transportation are used within other healthcare systems, like the Critical Care Paramedic – Certification, (26) or post-graduate training from a diploma to masters (27,28) and have been implemented to protect patients and practitioners alike.

Although this study focused only on one module and did not focus on student preparedness for clinical practice, it may be the case that the programme as a whole does not prepare students for clinical practice. There is evidence, from expert consensus, that students leaving BEMC programmes may not be adequately prepared the complex environment of critical care transportation and retrieval. (29) This has the potential to cause harm to patients during clinical practice and especially during these extremely risky transportation and retrieval procedures.

Conclusion

In South Africa, as in the rest of Africa, there is a two-fold problem with critical care services. First, the lack of critical care units within healthcare systems, and secondly, the large distances between critical care units. This leads to the potential that many patients will require transportation between facilities or the retrieval of patients from facilities that do not have the resources to treat them. Practitioners performing these risky transfers need appropriate training in order to safely perform them.

The analysis shows many keys similarities between the critical care modules taught at South African universities, which is in line with the regulator's requirements. However, the current programmes may not adequately prepare graduates for the critical care transportation environment. Further research in the field will need to be conduct with a focus on competency-based standards and student preparedness for the clinical environment. The field should take steps to reduce risk to patients through a process of benchmarking with service and healthcare systems locally and internationally.

Limitations

One of the universities offering the programme declined to participate in the study. This limited the sample size and eliminated the possibility of extensive statistical analysis, namely, cluster analysis. Additionally, the study only analysed one type of curriculum, the written curriculum. In order to truly benchmark between universities, other types of curricula need to be analysed.

There is a potential that certain content related to critical care could have been taught in other modules or form part of informal training within work-integrated learning. This study did not include this in the data analysis and further studies are required to assess the true difference in the content taught on the BEMC programmes.

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Competing interests

The authors are employed at one of the universities in the study, CL is a permanent employee, while WS and NJC are part-time employees.

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PART C: ADDENDA

Relevant journal Instructions to Authors

General article format/layout

Submitted manuscripts that are not in the correct format specified in these guidelines will be returned to the author(s) for correction prior to being sent for review, which will delay publication.

General:

Manuscripts must be written in UK English (this includes spelling).

The manuscript must be in Microsoft Word or RTF document format. Text must be 1.5 line spaced, in 12-point Times New Roman font, and contain no unnecessary formatting (such as text in boxes). Pages and lines should be numbered consecutively.

Please make your article concise, even if it is below the word limit.

Qualifications, full affiliation (department, school/faculty, institution, city, country) and contact details of ALL authors must be provided in the manuscript and in the online submission process.

Include sections on Acknowledgements, Conflict of Interest, Author Contributions and Funding sources. If none is applicable, please state ‘none’.

Abbreviations should be spelt out when first used and thereafter used consistently, e.g. 'intravenous (IV)' or 'Department of Health (DoH)'.

Numbers should be written as grouped per thousand-units, i.e. 4 000, 22 160.

Quotes should be placed in single quotation marks: i.e. The respondent stated: '...'

Round brackets (parentheses) should be used, as opposed to square brackets, which are reserved for denoting concentrations or insertions in direct quotes.

If you wish material to be in a box, simply indicate this in the text. You may use the table format –this is the only exception. Please DO NOT use fill, format lines and so on.

Research

Guideline word limit: 3 000 words (excluding abstract and bibliography)

Research articles describe the background, methods, results and conclusions of an original research study. The article should contain the following sections: introduction, methods, results, discussion and conclusion, and should include a structured abstract (see below). The introduction should be concise – no more than three paragraphs – on the background to the research question, and must include references to other relevant published studies that clearly lay out the rationale for conducting the study. Some common reasons for conducting a study are: to fill a gap in the literature, a logical extension of previous work, or to answer an important question. If other papers related to the same study have been published previously, please make sure to refer to them specifically. Describe the study methods in as much detail as possible so that others would be able to replicate the study should they need to. Where appropriate, sample size calculations should be included to demonstrate that the study is not underpowered. Results should describe the study sample as well as the findings from the study itself, but all interpretation of findings must be kept in the discussion section. The conclusion should briefly summarise the main message of the paper and provide recommendations for further study.

May include up to 6 illustrations or tables.

A max of 20 - 25 references

Structured abstract

This should be no more than 250 words, with the following recommended headings:

Background: why the study is being done and how it relates to other published work.

Objectives: what the study intends to find out

Methods: must include study design, number of participants, description of the research tools/instruments, any specific analyses that were done on the data.

Results: first sentence must be brief population and sample description; outline the results according to the methods described. Primary outcomes must be described first, even if they are not the most significant findings of the study.

Conclusion: must be supported by the data, include recommendations for further study/actions.

Please ensure that the structured abstract is complete, accurate and clear and has been approved by all authors. It should be able to be intelligible to the reader without referral to the main body of the article.

Do not include any references in the abstracts.

Acknowledgements

Research Protocol

Emergency Medicine Divisions' Research Committee: PROPOSAL CHECK-LIST

Use this check list to structure your proposal. There are a few hints and tips at the end of this list although many more are available on the various postgraduate and HREC websites of UCT and SUN

☒ ***Title***

☒ ***Version tracking (indicated by date, version and author name in page footer)***

☒ ***Purpose of the study/ summary/ abstract***

☒ ***Background/ literature review***

☒ Research question/ aim

☒ Objectives

Methodology (for larger studies with several parts, e.g. PhD, describe methods for each part separately using the headings below)

☒ Study design

☒ Characteristics of the study population

☒ Recruitment and enrolment

☒ Research procedures and data collection methods

☒ Data safety and monitoring

☒ Data analysis

Ethical considerations (for larger studies with several parts, describe for each part separately)

☒ Description of risks and benefits

☒ Informed consent process

☒ Privacy and confidentiality

☐ Reimbursement for participation

☐ Emergency care and insurance for research-related injuries

☒ ***Dissemination of findings plan (for larger studies with several parts, describe as one section)***

☒ ***Project timeline (for larger studies with several parts, describe as one timeline)***

☒ ***Resources utilisation (for larger studies with several parts, describe as one section)***

☒ ***Budget (for larger studies with several parts, describe as one overall budget)***

☒ ***References***

Appendices

☐ Proposed data capture form

☐ Consent and patient information (see templates for both on respective HREC's websites)

☐ Questionnaires

Title

A comparison of the critical care transportation modules on Bachelor's degrees in Emergency Medical Care programmes taught at South African universities

Research questions

How do critical care modules compare on Bachelor of Emergency Medical Care (BEMC) programmes offered by South African universities?

Purpose of the study

Critical care transfer is a developing field, with high acuity patients frequently being transferred between facilities. To perform a safe critical care transfer a practitioner needs to rely on a comprehensive knowledge of many aspects of patient care, including pathologies, pharmacology, interpretation of diagnostics results, and equipment operations. Some of this knowledge and these procedures are taught in the critical care module of the Bachelor of Emergency Medical Care programme and some are expected to be learnt during clinical experience.

The Health Professions Council of South Africa (HPCSA) has not yet published guidelines on what are the core competencies of emergency care practitioners regarding critical care transportation. The HPCSA has published Clinical Practice Guidelines (CPGs) and Scopes of Practices for emergency care providers towards the end of 2016. The CPG are currently in the final implementation stage.

The purpose of this study is to compare the content and delivery of critical care modules on BEMC programmes offered by South African universities. This will inform the educational departments and facilities of the universities by offering insights into how institutions approach the critical care transportation module. This could lead to eventual standardisation of the field of critical care transportation through the developments of a post-graduate qualification and the development of an industry assessment. In addition to providing insights into how educational departments view the critical care module, the study will be the first to perform benchmarking on any modules on the BEMC programmes. These results will benefit the profession as the process of standardisation improves quality and will improve patient care.

Summary

The proposed study is a document analysis and comparison of the critical care modules of the Bachelors of Emergency Medical Care (BEMC) programmes offered by South African universities. The Council of High Education and the Health Professions Council of South Africa provide the universities with outcomes which the BEMC programmes need to incorporate into their curriculum. However, it is unclear which outcomes the universities consider should be part of the critical care module. The study will set out to analyse the modules according to the established elements of curricula. Each element of curricula will be analysed, using descriptive analysis, content analysis, and cluster analysis. The results will be written up and will be provided to the universities involved before being submitted for publication in a peer-reviewed journal.

Background and literature review

Critical care retrieval in South Africa

The Health Professions Council of South Africa (HPCSA) has mandated that critical care transportations falls within the scope of practice for all emergency care practitioners (ECPs). However, the HPCSA has not given any clarity about the knowledge required by ECPs to perform critical care transportation. For this reason, the universities offering BEMC have little guidance on what to include in their curricula and how to approach modules. This could lead to differences in content being taught by the universities and, by extension, different competencies to safely transport critical care patients. It is important to have a minimum standard for graduating practitioners to promote patient safety.

Critical care transportation is undertaken often within the South African healthcare system. Currently, only 23% of state health care facilities have intensive care units or high care units. This is in contrast to 84% of private facilities having access to these units. (1) This, along with a shortage of medical specialists, means patients are often transferred for further management.

In South Africa, critical care transportation is mostly done by pre-hospital providers. In 2001, a one-year prospective audit found that 82% of critical care paediatric transfers were done by pre-hospital providers and 76% of all transfers were done by road. (2) The researchers also found a high frequency of technical and clinical adverse events, of 36% and 27% respectively. Critical adverse events were found in 9% of paediatric transfers. These high numbers of transfers performed by pre-

hospital providers and the frequency of adverse events is the starting point of this study, which looks to improve our understanding of the education obtained by ECPs.

Education in South Africa

Education in South Africa is governed nationally by two departments, including the Department of Higher Education and Training (DHET), the Department of Basic education, and provincial government departments. The DHET oversees several types of institutions, namely further education and training colleges, higher education institutions, and adult basic education and training centres.

Higher education institutions operate autonomously and report directly to their councils, instead of the government. The South African Qualification Authority (SAQA) administers the National Qualification Framework (NQF) system, which sets the level of various qualification offered by institutions.

History of emergency care training in South Africa

Emergency medical care training and education has developed in the recent decades. Before 1980, no professional qualification or board existed for emergency care providers. In the mid-1980s, standardised short courses were introduced. Versions of these standardised short courses are still being taught today, although they are being phased out by new legislation. Scopes of practice for these short courses are limited and primarily focus on technician-style training. (3)

Towards the late 1980s, the first three-year National Diploma in Ambulance and Emergency Technology was introduced to bring a clinician-style approach to emergency medical care. In 2003, universities started offering Bachelor of Technology Degrees in Emergency Medical Care, which involved completing a two-year part-time programme.(3) This further increased the knowledge of pre-hospital providers to treat and transport several types of life-threatening emergencies and to perform critical care transportation. Today four-year Bachelor's degree programmes are offered by four universities across South Africa. These included the University of Johannesburg, Cape Peninsula University of Technology, Durban University of Technology, and Nelson Mandela Metropolitan University.

Although a Bachelor's degree in Emergency Medical Care has been offered by universities for some time now, each university has a different approach to reaching the core standards stipulated by the Professional Board of Emergency Care. It is suspected that the variation may be particularly apparent in critical care modules as there is little consensus on what should be included in this module.

Critical care transfers in South Africa

According to recently released clinical practice guidelines and scopes of practices published by the HPCSA, all pre-hospital providers are allowed to perform inter-facility transfers in relation to their relevant scope of practice.(4) In practice, this means that critical care transportation is performed by providers on the two registers: the Ambulance Emergency Technician (ANT) registers (including Critical care Assistant and National Diploma in Emergency Medical Care) and the ECP register. Of the graduates performing these transfers, only ECPs have undertaken a formal module dedicated to critical care.

In South Africa, inter-facility transport of critical care patients is at times done by specialised mobile intensive care units. These units are usually staffed by ECPs or providers on the ANT register. The units are deployed with specialised equipment, like ventilators and infusion pumps to cater for critical care patients' requirements. In a reflection of the wider healthcare system, critical care transportation differs between the private and public, in staffing, availability, equipment, and types of patients transported, to name a few.

In developed countries, critical care transportation is often done by pre-hospital providers with additional qualifications in critical care. In the USA, critical care transportation is performed by critical care paramedics, who are certified flight Paramedics or Critical care Paramedics, although this varies from state to state. Paramedics are often assisted by nurses, physicians, or respiratory therapists according to patients' needs, a practice not often done in South Africa due to resource limitations. The UK has a similar system to the US with Paramedics. Some European countries employ a physician model for critical care transportation. We are currently unsure of the preparation ECPs obtain for critical care transportation. It is for this reason, a comprehensive comparison is necessary in order to standardise the curricula.

Curriculum development

Curriculum design is an important part of developing a learner into a clinician who possesses clinical competence and procedural excellence but also produces practitioners who are self-directed and engage in reflective practice. Kern and colleagues have defined a curriculum as 'a planned learning experience'. (5) The curriculum is a guide for the teaching and learning process in which the learner is facilitated, stimulated, and progressively guided through acquiring the knowledge to perform in the real-world environment of clinical medicine. (6)

There are several well-established principles of teaching and learning. Some of the described teaching and learning principles include the following: learning is a cognitive brain activity which is most effective during self-study. Learning is reliant on prior knowledge and it is essential to a base level of knowledge. Students will be encouraged to learn more if the learning material is closely aligned with their interests and is relevant to their role as practitioners. Practice is an important part of a student's ability to master a subject. Favourable learning conditions encourage student's learning. Material presented in a logical order makes it easier for students to learn. (7)

These principles should guide the construction of the curriculum. A curriculum has five components namely:
The framework within which the coordinator makes assumptions about the students, such as capacity, social norms, ability and other factors outside of direct contact time with students
The aims, goals, and objectives of the curriculum
Subject-matter, which is the content taught to the students during the time the student is engaging with the curriculum

The teaching process, including all teacher-student interactions, both directly (e.g. during class time) and indirectly (e.g. through a student portal or during self-study)

The method of evaluating students and the programme

Each of these components works together to bring a student from being a novice of the subject to a graduate professional. A medical curriculum provides the students with the theoretical knowledge to perform as a professional as well as skills to treat patients in a clinical environment. Chambers and colleagues suggests that a curriculum is a complex interplay between its components and it should be designed to make a graduate competent and capable. Chambers says that a curriculum is

dynamic and should change according to the student's needs and our evolving understanding of medicine. (7)

Summary

Curriculum development is the first step in improving student's clinical performance and increasing patient safety once they have graduated. Internationally, critical care transfers are regulated heavily and curricula outcomes are prescribed in detail. Locally, universities use their own discretion to decide which elements of the course outcomes are focused on in the critical care module. As of now, we do not know which outcomes the universities focus on in the critical care module. For this reason, it is important to compare them for the purpose of standardisation and curriculum benchmarking.

Aim

The aim of this study is to compare the critical-care transportation modules of four universities offering a BEMC degree in South Africa.

Objectives

The objective of this study are to compare the critical care module of BEMC programmes in South Africa, according to the following components of curricula:

Aims, goals and exit-level learning outcomes

Core curriculum and content

Delivery of the module (teaching and learning strategies)

Clinical exposure and experiential learning

Evaluation strategies

Methodology

The study will use various methods to describe the similarities and differences between the content of critical care modules offered by South African universities. Content analysis is a method used to draw objective inferences from material of differing sources. (8) The content analysis for this study will be done in two parts. Firstly, documents will be collected from the university related to critical care modules and inductive content analysis will be done. Secondly, course coordinators will be

contacted after the content analysis to check if domains are covered in other modules on the BEMC programme. Each of these parts will be described below.

Content analysis is a method growing in popularity, especially in health science research. (9) Content analysis describes a group of analytical approaches which vary depending on the aims and objectives of the study. All methods use the same basic structure: content, be it video, text, or audio, is coded according to a set of criteria and then interpretations are derived from the data collected from the coding process. Coding involves organising content in a way that allows for identifiable, indexing, and retrieval of content related to the research question.

The method of content analysis that will be used for this research is conventional content analysis, a qualitative approach. In this method, researchers do not use predetermined categories or domains when coding data but rather let the domains flow from the data as the analysis is taking place.

Inductive dominant content analysis is used when a subject has a general lack of knowledge or previous research in an area of interest. It involves the researcher having little or no preconceived theories on what she or he will find. (10) . Content will be categories into domains using a inductive approach.

The principal researcher will first seek ethical and methodological approval from the Emergency Medicine Divisional Research Committee. After that the proposal, will go for ethical approval through the ethics committee.

Upon attaining the required approvals, the principal researcher will approach the all universities Head of Departments (HODs) of Emergency Medical Care to get clearance to perform the research. Appendix A contains a copy of the letter that will be sent to the HODs.

After approval from the HODs, all the documents will be collected and data analysis through the proposed methodology will commence. After the results have been completed and the final report handed in and marked, the universities will have access to the report.

For this research, the first part will include conventional content analysis, which is generally used when a researcher wishes to describe a phenomenon, in this case the similarities of the approaches used by the universities offering BEMC to the critical care module. This approach is generally used

when there is limited research and there are no existing theories of the phenomenon. (4) In this case, the principal researcher could not find any literature describing the approaches of universities to the critical care module.

The study will look at all the documentation used by the universities in the critical care modules. This will include syllabi, logbooks, and assessment forms. Domains will be created from documents and will not be predetermined. Each domain for each university will be assigned a binary value, with one or zero. After the coding process, statistical analysis will be done on the results to determine the similarity of the modules.

It is acknowledged by the researcher that the universities may categorise their course content differently, meaning that some of the content covered by one university in the critical care module may be covered on another module. This involves the second part of the data collection. At this stage, domains will be decided on and the course coordinator will simply say if the content is covered in other modules. This will be done through email correspondence, where the coordinator will be asked to provide evidence of the domains being in other modules. A similar approach of data extraction and analysis will be followed. The domains filled out in this way will be identified in the final statistically analysis. This will give the researcher an idea of what the universities consider to be part of critical care training.

The study will start with the principal investigator approaching the relevant Departments of Emergency Medical Care (EMC) for approval to use their learner guides as the comparison material. See Appendix A for the letter that will be given to the HOD of EMC. The comparison will be done through content analysis.

The universities which will be approached to be involved in the study include:

- University of Johannesburg
- Cape Town University of Technology
- Durban University of Technology
- Nelson Mandela Metropolitan University

Data safety and monitoring

The data will be secured on a password protected file on the principal researcher's computer. Only he and the supervisors will have access to the data. The data will be backed up on a password

protected Microsoft OneDrive account. Documents collected in the research procedure will be deleted after submission of the final report. Data used for statistical purposes will be deleted five year after the publication of an article in a peer-reviewed journal.

Data analysis

The analysis of the curricula will come in two forms. Firstly, the module documents will be collected and analysed in different components, described below. In these components the analysis will focus on the specific outcome that will be specific to the domain. Secondly, all the documents will be compared to each other for similarities. This process is described below.

Domain specific analysis

Data will be analysed in the following way:
After obtaining all the relevant documentation for the Module Coordinator, the principal researcher will assign content to specific domains. These domains will be as follows:
Domain 1 –Aims, goals, and objectives of the course
Domain 2 – Content or teaching material
Domain 3 – Modes of transaction between teachers and students
Subdomain 3.1 – Staff
Subdomain 3.2 – Student and teacher interaction including theory and practice
Subdomain 3.3 – Information technology
Subdomain 3.4 – Work integrated learning
Domain 4 – Evaluation
Subdomain 4.1 – Practical
Subdomain 4.2 – Theory
Each domain has a different outcome that will be collected; some will produce categorical data, some will have binary outcomes, while some will produce a qualitative outcome. Methods for analysing data that will be used are described below.

Descriptive analysis

Domains 1, 3, and 4 will be analysed using descriptive analysis. In this technique, the results of the analysis will be described without statistical analysis being performed. The description will link categories in the areas of the domains.

Content analysis

Domain 2 will be compared using qualitative content analysis. Data from the content analysis will then be represented on a matrix which will be used to illustrate the similarities and differences of the module with binary and continuous outcomes.

The coding process will generate two types of data. The first is binary, an example of this will be for domains in course material section. Either the content is covered in the course or it is not. For this type of data, totals will be added up of the different areas and similarities of the modules will be compared with each other. The second type will be continuous; this will be domains that can have multiple options, like in number of clinical hours in the course. Statistically analysis will be done on the results.

Cluster analysis

The cluster analysis will be done on all the documents using software from NVivo. The software will represent its results in the form of cluster maps where the closer the sections are the more similar they are. Like content analysis, the software codes the content into nodes and produces a graphical representation of how much the content from different sources has in common. This will produce a similarity index which will show how much the modules have in common. In this case this will be done through a process of word similarities, where the programme matches similar words and phrases together in different texts to produce a similarity index. The purpose for making these two distinct types of analysis is to obtain different types of results. On one hand, the research project would like to assess differences that are more tangible and can be used by interested academics to specifically match their modules to other modules around the country. On the other hand, the project looks to see overall similarities to assess consistency across universities.

Ethical considerations

As the study does not deal with personal information or patient records, ethics approval waiver will be sought by the Ethics Committee at UCT before starting the study. Approval will need to be obtained by the relevant universities that offer the BEMC program. Each university will consider the risk to their institution and will make a decision on their participation in the study. There will be no penalty to the universities for not participating in the study. The HPCSA has not given any directive on what constitutes a critical care transportation of a patient. For this reason, the universities participating in the study cannot be held liable for not complying to the regulation as there is none.

Universities participating in the study will not be named in the final write up and cannot be identified should the study be published.

Project timeline

2018	APR	MAY	JUN	JUL	AUG	SEPT	OCT	Nov	Dec	Jan	Feb
EM-DRC					X						
Ethics						X					
Data Analysis						X	X	X			
Compilation of final report								X	X	X	
Submission											X

Resource utilisation

The study is funded by the principal investigator and no external funding was obtained. Resources listed in the budget will be managed by the principal investigator.

Budget

Budget				
April – October 2018				
Item	**Description**	**Unit cost**	**No. of units**	**Total cost**
Computer	For research and write-up	1	R13 000	R13 000
Research travel	To supervisors	5	R200	R1 000
Telephonic communication	To get permission from institution and data	1	R500	R500
Total				R14 500

The research project is self-funded by the researcher. No external sources of fund were sort by the researcher.

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Appendices A

University of Cape Town

Rondebosch

Cape Town

7700

(DATE)

Mr Nathan Conradie

349 Kikuyu, Waterfall

Johannesburg

2195

RESEARCH PERMISSION LETTER

Dear (Head of Department of Emergency Medical Care)

My name is Nathan Conradie and I am an Emergency Care Practitioner based in Johannesburg. I am currently registered in the Master of Philosophy in Emergency Medicine programme at the University of Cape Town. As part of the completion of my Master's, I am required to do a research project.

The topic of my research project is: A comparison of the critical care transportation modules on Bachelor's degrees in Emergency Medical Care programmes taught at South African universities. The purpose of this study is compare the different critical care modules between the universities offering Bachelor of Emergency Medical Care (BEMC) programmes.

Please see the proposal for the study attached to this email. The proposal has been approved by the University of Cape Town's Emergency Medicine Divisions' Research Sub-Committee and obtained ethical clearance from the facilities ethics committee.

The study will hopefully shed some light on how the different universities view the module. Currently there are no standards of the Health Professions Council of South Africa on what should be included in the critical care module.

It is requested that the documents that you will be required to send to the principal researcher, should you decided to participate in the study, will include the learner guide, syllabi, logbooks, and assessment forms for the course. All documents will be kept securely and under password protection. The intellectual property in the supplied documents will not be used for anything other than the study. Your institution will only be mention in the final write up to identify the participating universities. It will not be published should the report be submitted to a journal for publication. This will protect your institution from potential liability. You will be sent the final study report after marking.

Should you have any further questions or concerns, please do not hesitate to send them either to myself, or one of my research supervisors. Details are below.

Thank you for accepting the letter and I hope to hear from you soon.

Kind regards,

Nathan Conradie (Principal investigator)

UCT MPhil student

Email: NathanConradie@yahoo.com

Cell: +27 83 288 2739

Willem Stassen (Supervisor)

Programme Coordinator: PhD Emergency Medicine

Division of Emergency Medicine

Department of Surgery

University of Cape Town

Tel +27 76 502 2187

Professor Craig Lambert (Co-supervisor)

Tel +27 82 653 2125

HREC approval letter

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: sumayah.ariefdien@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

22 October 2018

HREC REF: 640/2018

Dr W Stassen
Division of Emergency Medicine
F51-62 OMB

Dear Dr Stassen

PROJECT TITLE: A COMPARISON OF THE CRITICAL CARE TRANSPORTATION MODULES ON BACHELOR'S DEGREES IN EMEREGENCY MEDICAL CARE PROGRAMMES TAUGHT AT SOUTH AFRICAN UNIVERSITIES (Masters Candidate - Mr N Conradie)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee (HREC) for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 October 2019.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student: Mr Nathan Conradie will also be involved in this study.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

Signature Removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938