A comparison of the content taught in critical care transportation modules across South African bachelor's degrees in emergency medical care

N J Conradie,[1] MPhil; **C Vincent-Lambert,**[2] PhD; **W Stassen,**[1] PhD;

[1] *Division of Emergency Medicine, University of Cape Town, South Africa*
[2] *Department of Emergency Medical Care, University of Johannesburg, South Africa*

Corresponding author: *N J Conradie (nathanconradie@yahoo.com)*

Background and objective. Critical care transport (CCT) involves the movement of critically ill patients between healthcare facilities. South Africa (SA), like other low- to middle-income countries, has a relative shortage of ICU beds, making CCT an inevitability. In SA, CCTs are mostly done by emergency care practitioners; however, it is unclear how universities offering Bachelor in Emergency Medical Care (BEMC) courses approach their teaching in critical care and whether the content taught is consistent between institutions. In our study we formally evaluate and compare the intensive and critical care transport modules offered at SA universities in their BEMC programmes.

Methods. The electronic version of curricula of the critical care transport modules from higher education institutes in SA offering the BEMC were subjected to document analysis. Qualitative (inductive content analysis) and quantitative (descriptive analysis) methods were used to describe and compare the different components of the curriculum. 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 and work-integrated learning.

Results. The four universities that offer BEMC programmes were invited to participate, and three (75%) consented and provided data. The duration of the modules ranged from 6 to 12 months, corresponding with notional hours of 120 - 150. A total of 83 learning domains were generated from the coding process. These domains included content on mechanical ventilation, patient monitoring, arterial blood gases, infusions and fluid balance, and patient preparation and transfer. Two universities had identical structures and learning outcomes, while one had a different structure and outcomes; it corresponded with a 58% similarity. Clinical placements were in critical and emergency care units, operating theatres and prehospital clinical services.

Conclusion. In all components compared, the universities offering BEMC were more similar than they were different. It is unclear whether the components taught are relevant to the SA patient population and healthcare system context, or whether students are adequately prepared for clinical practice. Postgraduate educational programmes might need to be developed to equip emergency care practitioners to function in this environment safely.

Keywords. emergency medicine; medical education; critical care transport.

South Afr J Crit Care 2022:38(1):20-25. https://doi.org/10.7196/SAJCC.2022.v38i1.498

Contributions of the study

Owing to the limited availability of ICU beds in South Africa, optimising and standardising critical care transport is an important consideration. This study identifies important elements for improving emergency medical care training in South Africa, as well as areas needing further research.

Critical care transfers (CCTs) are considered to be of high risk for crew and patient, expensive and logistically challenging.[1] Clinicians making decisions around the interfacility transfer of a critically ill or injured patient need to carefully consider the potential benefits of relocating the patient against the risk of adverse events associated with the transfer. Authors differ on the definition of exactly what constitutes an 'adverse' event, with rates ranging from 1.7% to 79.8% being reported. Much of the literature in this regard is from international studies; however, a 2003 South African (SA) study reported technical and clinical adverse event rates associated with CCTs of 36% and 27%, respectively.[2]

There are few data on the exact number of CCTs conducted in SA. However, SA, like other low- to middle-income countries, has a relative shortage of ICU beds, more especially in rural areas.[3,4] This shortage necessitates the need for critical care patients to be transferred to and between facilities. In many instances the number of referrals can far outweigh the receiving facilities' ability to accommodate patients.[5] In the local context, ambulance crews often spend lengthy periods of time with critical patients during CCTs. From a patient safety perspective, it becomes important to ensure that those pre-hospital emergency care providers facilitating the CCT are highly qualified and competent in CCT. Studies have shown that the use of specialist retrieval teams is associated with a significant reduction in mortality and physiological deterioration of patients being transferred.[6] Specialist teams receive additional training and have in-depth knowledge of the transportation environments, allowing them to perform CCTs more safely than novice teams.

Locally, the Health Professions Council of South Africa (HPCSA) has mandated that CCT falls within the scope of practice of emergency care practitioners (ECPs) who have obtained a Bachelor of Emergency Medical Care (BEMC) degree and paramedics who have obtained national diplomas, diplomas in emergency medical care, or short-course critical care assistant qualifications.

In recent years, standard-setting relating to professional qualifications has become an important part of higher education. Setting standards is particularly important in medical education because after graduation, students go on to work in the clinical field, with real consequences for patient care. Measuring competence has become essential to medical educators as the field focuses on producing graduates with the knowledge and skill to practise safely.[7] In the case of regulated professions such as medicine, nursing and emergency care, one would expect a form of standardisation to occur with regard to the curriculum and the associated assessment criteria. The curriculum in turn becomes driven and informed by the needs of the profession and patients. And, in this instance, the expected scope of practice and capabilities of emergency care graduates to perform CCTs.

What makes the current local context and situation challenging is that the profession does not have a common definition about exactly what constitutes a CCT or the minimum expected qualifications and skill sets of those who are to conduct CCTs. Simply put, there are currently few or no recognised minimum practice standards in place to guide the safe transfer of critically ill patients to and between facilities.[8] This problem is compounded by the fact that the HPCSA has given little clarity on the extent and nature of knowledge required by ECPs to perform CCTs. For this reason, SA universities offering BEMC have made use of their own discretion and institutional autonomy to decide what to offer in their curricula and how to approach the delivery of their intensive and critical care offerings.[9] However, given that their graduates would all enjoy the same registered scope of practice, clinical competencies and related skill sets, one would expect to see a great deal of similarity in the critical care modules offered at local universities. The aim of this study was to evaluate and compare the intensive and critical care transport modules offered at SA universities in their BEMC programmes.

Methods

This study was conducted by subjecting the electronic version of curricula of the critical care transport modules from higher education institutes (HEIs) in SA offering the BEMC to document analysis. Qualitative (content analysis) and quantitative methods (descriptive analysis) were used to compare the different components of the curriculum.

Procedure

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 co-ordinators. Designated year co-ordinators provided, via email, electronic versions of the curricula documents including study guides, work-integrated learning (WIL) timetables, and documents relating to assessment for the critical care modules.

First, curriculum documents were designated into categories according to well-established [10] components of a curriculum, namely:

- 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

The division of the curriculum into these components[10] provided a framework through which to approach the different curricula and provide for comparison across institutions. This paper only focuses on components related to student learning, as these components relate directly to the clinical aspects of what is taught rather than the educational component. These components are 1, 2 and 3.4.

Data analysis

Each aspect of the curriculum was analysed differently depending on the component the data was from, and the type of data being compared. Numerical data extracts for components 1 and 3.4 were subjected to descriptive analysis.

Component 2 was compared using inductive qualitative content analysis, as described by Erlingsson and Brysiewicz[11] and Elo and Kyngäs.[12] Course content was coded by first condensing meaning units in the curriculum documents, and then categorised (into domains) to provide an overview of the content covered.

Coding was conducted by the first author (NC) and was refined through frequent debriefing sessions between the authors. Where data were missing from the coding process, the authors went back to the participating universities and asked for additional curriculum documents to review. All participating universities provided additional documentation which was subsequently analysed. An example of this was the shift rosters, which described where the students were rostered for WIL, which was not in the original documents that were sent.

Following content analysis, the content of each curriculum was compared between universities to determine similarities. The greatest number of curriculum items represented 100% and any number less was expressed as a proportion of the whole.

Ethics approval was obtained from the Human Research Ethics Committee of the University of Cape Town (ref. no. 640/2018). Further institutional approval was provided by each of the participating HEIs, in accordance with their specific requirements. The names of the universities have been anonymised in order to protect their institutional integrity. As there is a relatively low number of institutions offering the programme (four), all institutions were approached to participate in the study.

Results

Approval to participate in the study was obtained from only three of the four universities (75% response rate).

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

All the universities had a different approach to their critical care teaching. Two universities, A and C, have stand-alone modules for critical care transportation, while university B incorporates it into another module. This leads to a fundamentally different structure to the fourth year of their BEMC programmes.

The duration of the modules ranged from 6 months (University A) to 1 year (Universities B and C). Notional hours were 120 for Universities A and C and 150 for University B (integrated module).

Table 1. Breakdown of domains taught in modules

Domains	University A	University B	University C
General			
Need for ICU	✓		✓
Function of ICU units	✓		✓
Pressure ulcers treatment	✓		✓
Maintaining neutral thermal environment	✓		✓
Care of intercostal drains and wound dressing	✓		✓
Mechanical ventilation			
Indications for ventilation	✓		✓
Differentiate between cycling modes	✓	✓	✓
Explain and compare the following vent modes:	✓	✓	✓
◦ IMV	✓	✓	✓
◦ CMV	✓	✓	✓
◦ SIMV	✓	✓	✓
◦ BiPAP/BIPAP	✓	✓	✓
◦ APRV	✓		✓
Ventilator adjustments	✓	✓	✓
Set up and monitoring	✓	✓	✓
Ventilation rate	✓	✓	✓
◦ Tidal volume	✓	✓	✓
◦ Minute volume	✓	✓	✓
◦ Flow	✓		✓
◦ PEEP	✓	✓	✓
◦ I:E ratio	✓	✓	✓
◦ Trigger	✓	✓	✓
◦ Pressure support	✓	✓	✓
◦ Peak airway pressure	✓	✓	✓
◦ Plateau pressure	✓		✓
◦ Slope	✓		✓
◦ FiO_2	✓	✓	✓
Integrated modes and ventilation settings	✓	✓	✓
Ventilator graphics	✓		✓
Ventilation alarms	✓	✓	✓
Monitoring of mechanical ventilation			
Pulse oximetry	✓		✓
Capnography	✓		✓
Troubleshooting with patient-ventilator problems	✓	✓	✓
Complications of mechanical ventilation	✓		✓
Weaning of patients from ventilator	✓		✓
NIV – indication, contraindications, modes	✓	✓	✓
Set-up of NIV	✓	✓	✓
ABG			
Role and interpretation of ABG	✓	✓	✓
Obtaining an arterial sample	✓	✓	✓
Patient monitoring			
Electrocardiography	✓		✓
Arterial oxygen saturations	✓		✓
End-tidal CO_2	✓		✓
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 infusion devices	✓	✓	✓
Role and management of nasogastric feeds	✓	✓	✓
Role and management of TPN	✓	✓	✓

continued

Table 1. (continued) Breakdown of domains taught in modules

Domains	University A	University B	University C
Fluid balance			
Fluid requirement of critically ill patient in various disorders (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		✓	
Abruptio placentae		✓	
Placenta praevia		✓	
Pre-eclampsia and eclampsia		✓	
Cardiac arrest in pregnancy		✓	
Management of premature labour		✓	
Pre-hospital tocolysis		✓	
Labour and delivery		✓	
Postpartum haemorrhage		✓	

ICU = intensive care unit; IMV = intermittent mandatory ventilation; CMV = continuous mandatory ventilation; SIMV = synchronised intermittent mandatory ventilation; BIPAP = biphasic positive airway pressure; APRV = airway pressure release ventilation; PEEP = positive end-expiratory pressure; FiO_2 = fractional inhaled oxygen; NIV = non-invasive ventilation; ABG = arterial blood gas; CO_2 = carbon dioxide; TPN = total parenteral nutrition; DIC = disseminated intravascular coagulation.

Table 2. Structure of work-integrated learning and clinical learning sites

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

EC = emergency centre; ICU = intensive care unit; CCU = critical care unit; NICU = neonatal intensive care unit; HEMS = helicopter emergency medical services.

Universities A and C have structured their modules into the same outcomes, combining intensive care, thrombolytics, aeromedical transportation, and dive emergencies into one module. University B has similar outcomes but does not include aeromedical transportation in their module.

Component 2 – Content and teaching material

Table 1 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.

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).

Sub-component 3.4 – Work-integrated learning

Table 2 shows the breakdown of WIL sites in the modules. All the universities integrate WIL into the clinical practice module, which is supervised by the year co-ordinator.

Discussion

The aim of the study was to compare the critical care transport modules taught in emergency care degree programmes in SA. In all three components compared, the universities were more similar than they were different. This shows a similarity between modules with an agreement across domains of between 58% and 100% (average of 86%). This is in line with the regulations stipulated by the South African Qualifications Authority (SAQA) and the HPCSA. The universities taught similar content despite using differing module structures. The duration of the modules ranged from one to two semesters. Clinical placements were in critical and emergency care units, operating theatres and prehospital clinical services.

Content and WIL outcomes should ideally be reflective of the healthcare system, context and burden of disease and injury of the setting within which the healthcare providers will be functioning.[13-15] While limited literature has been found on the patient population requiring CCT, these have mostly focused on logistic elements,[4] reported limited clinical data,[16] or only described a paediatric subpopulation.[2,17] This makes it difficult to draw any meaningful conclusions as to whether the content described is, in fact, sensitive to the context and patient population. This should be explored in future studies and should also link to ECP scope of practice.

As per the clinical practice guidelines and related scopes of practice released by the HPCSA in 2018,[18] it can be surmised that CCT is to be performed by ECPs, when available, and that they would be the primary cadre of EMS providers performing these transfers. This moves the roles of ECPs, and by necessity other prehospital providers, into an area of medicine, i.e. critical care, that their qualification largely does not focus on. For example, around 465 of the 480 credits for the BEMC degree focus on prehospital and emergency care. This is also reflected in the WIL plans, as institutions split the clinical learning time of students among multiple clinical environments. This means relatively little time is spent in critical care units, as opposed to units dedicated to emergency medicine or prehospital care. Importantly, as the roles of the ECPs adapt and change to fulfil the needs of the healthcare system, so should training, educational standards and scopes of practice. 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 or the establishment of a postgraduate qualification to address the possible shortfall. Considering that ECPs are expected to be clinically excellent in the prehospital management of emergencies, the latter solution is probably more practicable.

This shortfall is likely reflected in the high rates of adverse events described in previous studies investigating the transportation of critically ill or injured patients when performed by practitioners who lack advanced or specialised training.[2,19,20] Importantly, adverse events are often underreported in emergency care and these rates are likely underestimating the true incidence.[21] Our study indicates that there is consistency between the different universities on taught content, and variability between knowledge and skill across the institutions is therefore unlikely to explain such high rates. This therefore brings the appropriateness of the 'standard' into question. By this standard, a newly qualified graduate could be called to transport a complex critical care patient on their first call after registration – a call for which they may be wholly unprepared. Further research is required to establish the views of graduates and their employers regarding their perceived confidence and competence to engage in CCTs after graduation.

Study 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 cluster analysis. This also affected the external validity of the work − results may thus not be applicable to this university. 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 WIL. This study did not include this in the data analysis and further studies are required to match results deductively. The study did not assess student competency or ability to operate within the clinical environment, a function of not only education but a culmination of multiple factors. These elements affect the internal validity of the results presented herein.

Validity was bolstered, however, through: improving qualitative trustworthiness and credibility[22] by adopting well-established, multi-method research designs; frequent debriefing sessions between the authors; engaging with universities to obtain data that were not immediately apparent; and examining results through the context of previous research in the discussion. Bolstering credibility ensures reliability/dependability.[22] Yet, reliability is further ensured through employing overlapping methods and in-depth discussion of the research and analysis processes followed.

Conclusions

In SA, 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 to safely perform them, which necessitates the need for a clear and considered standard.

In all components compared, the universities offering BEMC were more similar than they were different. However, in the context of high adverse event rates, it is likely that these programmes may not adequately prepare graduates for CCT. Additionally, it is unclear whether the components taught are relevant to the SA patient population and healthcare system context. Further research in the field will need to be conducted with a focus on these missing elements of the curriculum, including student preparedness for the clinical environment. Postgraduate educational programmes might need to be developed to equip emergency care practitioners to function in this environment safely.

Declaration. None.
Acknowledgements. The authors would like to acknowledge the participation of the universities involved in this study.
Author contributions. NJC conducted the study and wrote the article; CV-L and WS provided support and oversight of the study.

Funding. The study was self-funded. No financial support was provided to the authors.

Conflicts of interest. 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.

1. Droogh JM, Smit M, Hut J, de Vos R, Ligtenberg JJM, Zijlstra JG. Inter-hospital transport of critically ill patients: Expect surprises. Crit Care 2012;16(1):R26. https://doi.org/10.1186%2Fcc11191
2. Hatherill M, Waggie Z, Reynolds L, Argent A. Transport of critically ill children in a resource-limited setting. Intensive Care Med 2003;29(9):1547-1554. https://doi.org/10.1007/s00134-003-1888-7
3. Naidoo K, Singh J, Lalloo U. Critical analysis of ICU/HC beds in South Africa: 2008-2009. S Afr Med J 2013;103(10):751-753. https://doi.org/10.7196/samj.6415
4. Bhagwanjee S, Scribante J. National audit of critical care resources in South Africa: Unit and bed distribution. S Afr Med J 2007;97(12 Pt 3):1311-1314.
5. Gordon K, Allorto N, Wise R. Analysis of referrals and triage patterns in a South African metropolitan adult intensive care service. S Afr Med J 2015;105(6):491-495. https://doi.org/10.7196%2FSAMJ.9007
6. Bellingan G, Olivier T, Batson S, Webb A. Comparison of a specialist retrieval team with current United Kingdom practice for the transport of critically ill patients. Intensive Care Med 2000;26(6):740-744. https://doi.org/10.1007/s001340051241
7. Mayosi B, Benatar S. Health and health care in South Africa - 20 years after Mandela. N Engl J Med 2014; 371(14):1344-1353. https://doi.org/10.1056/nejmsr1405012
8. Venter M, Stanton D, Conradie N, Jordaan L, Venter C, Stassen W. The need for setting standards in critical care transfers. South Afr J Crit Care 2017;33(1):32. https://doi.org/10.7196/SAJCC.2017.v33i1.319
9. NECET. National Emergency Care Education and Training Policy. 2017:1-16. https://www.medbox.org/document/south-africa-national-emergency-care-education-and-training-policy#GO (accessed 27 February 2022).
10. Kelly AV. Theory and practice. J Pastor Care Couns 2016;30(3):145.
11. Erlingsson C, Brysiewicz P. A hands-on guide to doing content analysis. African J Emerg Med 2017;7(3):93-99. https://doi.org/10.1016/j.afjem.2017.08.001
12. Elo S, Kyngäs H. The qualitative content analysis process. J Adv Nurs 2008;62(1):107-115. https://doi.wiley.com/10.1111/j.1365-2648.2007.04569.x (accessed 13 August 2018).
13. Supe A. Designing a dynamic contextual curriculum. Int J Adv Med Heal Res 2016;3(2):55. https://doi.org/10.4103/2349-4220.195946
14. Pigoga JL, Cunningham C, Kafwamfwa M, et al. Adapting the emergency first aid responder course for Zambia through curriculum mapping and blueprinting. BMJ Open 2017;7:1-7. https://doi.org/10.1136/bmjopen-2017-018389
15. Quintero GA. Medical education and the healthcare system - why does the curriculum need to be reformed? BMC Med 2014;12(1):213. https://doi.org/10.1186/s12916-014-0213-3
16. D'Andrea PA, van Hoving DJ, Wood D, Smith WP. A 5-year analysis of the helicopter air mercy service in Richards Bay, South Africa. S Afr Med J 2013;104(2):124. https://doi.org/10.7196/samj.7310
17. Howard IL, Welzel TB. Current practice of air medical services in inter-facility transfers of paediatric patients in the Western Cape Province, South Africa. S Afr J Child Health 2014;8(4):143.
18. Health Professions Council of South Africa. Clinical Practice Guidelines for Emergency Care Providers. 2018. https://www.hpcsa.co.za/Uploads/EMB/CLINICAL PRACTICE GUIDELINES - PROTOCOLS- JULY 2018.pdf (accessed 20 November 2021).
19. Bambi S, Lucchini A, Innocenti D, Mattiussi E. Complications in critically ill adult patients' transportations reported in the recent literature. Emerg Care J 2015;11(1). http://doi.org/10.4081/ecj.2015.4781
20. Fan E, MacDonald RD, Adhikari NKJ, et al. Outcomes of interfacility critical care adult patient transport: A systematic review. Crit Care 2006;10(1):R6. https://doi.org/10.1186/cc3924
21. Zoghby MG, Hoffman D, Mahomed Z. The reporting of adverse events in Johannesburg Academic Emergency Departments. Afr J Emerg Med 2021;11(1):207-210. https://doi.org/10.1016/j.afjem.2020.10.005
22. Shenton AK. Strategies for ensuring trustworthiness in qualitative research projects. Educ Inf IOS Press 2004;22:63-75.

Accepted 8 November 2021.