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Profile of referrals to an intensive care unit from a regional hospital emergency centre in KwaZulu-Natal

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ABSTRACT

Introduction: The objective was to describe the clinical characteristics, disease profile and outcome of patients referred from a regional hospital Emergency Centre (EC) to the Intensive Care Unit (ICU).
Methods: A retrospective review was performed using data extracted from the Integrated Critical Care Electronic Database (iCED). Data were extracted from the database with respect to patient characteristics, Society of Critical Care Medicine (SCCM) grading, and outcome of the ICU referral. Modified early warning scores (MEWS) were calculated from EC referral data.
Results: There were a total of 2187 referrals. Of these, 56.3% (1231/2187) were male. The mean age of referrals was 36 years. Of the referred patients, 41.5% (907/2187) were initially accepted for admission. A further 378 patients were accepted for admission after a follow up ICU review. Medical conditions accounted for the majority of patient referrals, followed by general surgery and trauma. Most patients initially accepted to ICU were classified as SCCM I and II and had a mean MEWS of 4. Almost half of the patients experienced a delay in admission, most commonly due to a lack of ICU bed availability. ICU mortality was 13.6% for patients admitted from the EC.
Discussion: The EC population referred to the ICU was young with a high burden of medical and trauma conditions. Decisions to accept patients to ICU are limited by available resources, and there was a need to apply ICU triage criteria. Delays in the transfer of ICU patients from the EC increase the workload and contribute to EC crowding.

African relevance

- Emergency centres (ECs) provide an essential role in the continuum of care of critically ill patients.
- There is limited literature profiling admissions from an EC to the intensive care unit in low- to middle-income countries.
- This study describes the clinical characteristics and outcomes of EC patients referred to the intensive care unit.
- Triage criteria need to be applied to ensure appropriate and rational utilization of resources.

Introduction

Critical care medicine plays an increasingly important role in emergency medicine. Emergency centres (ECs) provide an essential role in the continuum of care of critically ill patients from prehospital to the definitive setting of an intensive care unit (ICU) [1]. The challenges of EC care are numerous, including increasing patient numbers, EC crowding and increased length of stay [2,3]. In the United States (US), annual visits of critically ill patients to the EC increased by 79% between 2001 and 2009, and EC length of stay by 32% during the same period [4]. There is limited data quantifying the demand placed on ECs in low-to-middle income countries. Available estimates suggest that it may be greater than resource-rich settings due to a “double burden of disease” in resource-limited settings [5,6]. There is an increase in the prevalence of non-communicable diseases combined with a lack of improvement in the higher burden of communicable diseases [6]. Decisions regarding which patients to admit to ICU are complex because of the escalating

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demand on already strained resources.

Although there are triage scores to support decision-making, there is limited literature on factors that are important to intensivists, and even less research on decision-making processes by referring non-intensivists. Twelve factors that influence referral decisions to ICU from the EC have been identified [7]. There were three overarching themes: patient, clinician and resource factors. Patient factors include age, comorbidities and reversibility of the current clinical condition. Clinician factors include clinician experience and perception of the patient's quality of life. This is influenced by locally accepted standards and perceived consensus about what the EC would do [7]. Resource factors include current bed occupancy status and availability of equipment. Currently, there is a paucity of literature describing these factors in low- to middle-income countries such as South Africa, where the growing burden of critical illness makes ICU triage essential for appropriate resource allocation [8,9].

A number of scoring systems have been developed to identify disease severity and predict patient outcome [10,11]. The majority of these scoring systems have been extensively explored in the ICU setting, and include, the Acute Physiology and Chronic Health Evaluation (APACHE), Simplified Acute Physiology Score (SAPS), Sequential Organ Failure Assessment (SOFA), and Multiple Organ Dysfunction Score (MODS) [10,11]. Several scoring tools have been developed for critically ill patients in the EC setting [12]. These early warning scores (EWS) are based on patient vital signs and observational data [13]. Although not created specifically for the EC, the Modified Early Warning Score (MEWS) is a prospectively validated scoring system which uses physiological data to identify patients at risk of deterioration [14]. The parameters for the calculation of MEWS are routinely captured in the EC, with a higher score used to predict the likelihood of admission to an ICU [13].

The study hospital is one of three public hospitals in the Pietermaritzburg Metropolitan Area in KwaZulu-Natal (KZN). It is a 900-bed regional level hospital and serves a total population of approximately 1.4 million. The EC is staffed by emergency medicine specialists, registrars and medical officers, and is capable of providing advanced respiratory support (invasive and non-invasive ventilation), inotropic support, and invasive blood pressure monitoring.

Patients seen in the EC either present directly (self-referrals or brought by ambulance) or are referred from one of eighteen clinics and community health centres and nine district hospitals within the catchment area. The hospital also serves as a regional referral centre for trauma with 24-h on site access to ICU, operating theatres and surgeons. There are no surgical subspecialities, such as neurosurgery on site, and patients requiring tertiary services are transferred. Both adult and children trauma patients are managed in the EC, while children with medical conditions are seen by paediatrics and referred directly to the paediatric intensive care unit (PICU) if required.

The ICU, run by both intensive care specialists and anaesthetic specialists with an interest in critical care, consists of six ventilated beds and three high-care beds. This supply-demand mismatch makes triage of patients considered for ICU admission, and rationing of available resources, both necessary and challenging [15]. The ICU predominantly admits adults (>12 years old), however, if the PICU is full, then any patient >20 kg weight will be admitted.

The Society of Critical Care Medicine (SCCM) prioritisation model is used to guide triage and rationing decisions [16]. Using this model, patients are prioritised for admission based on the likelihood of benefit from ICU care. Patients are graded from I to IV as follows: priority I: critically ill, needing active physiological support; priority II: not currently critically ill but at risk of becoming so, and requiring intensive monitoring; priority III: critically ill requiring active physiological support but with a guarded prognosis owing to associated illness. Patients in category IV are refused ICU admission on the basis of being “too well” to warrant ICU admission (IVA) or are critically ill with irreversible physiological failure and are “too sick” to benefit from admission to ICU (IVB) [16].

The objectives of this study were to describe the patient characteristics, disease profile and severity of illness of patients referred from a regional hospital EC to the ICU. Additional objectives were to describe the outcome of ICU referrals and the outcome of patients admitted to ICU.

Methods

A retrospective review of all patient referrals to ICU from the EC at the study site between July 2014 (commencement of the patient database) and September 2019 was conducted. Ethics approval for the study was obtained from the University of KwaZulu-Natal Biomedical Research Ethics Committee (Ref. 861/19). The Integrated Critical Care Electronic Database (iCED) served as the data source [17]. The database was developed as a clinically practical and cost-effective solution to data collection in the Pietermaritzburg metropolitan critical care system. It also meets the requirements of a registry, enabling quality improvement, systems planning and research in a developing country [17].

Referral to ICU is by written request made on a standardised form. These referral forms are completed by the relevant speciality and the patient subsequently reviewed by an allocated member of the ICU team, with the final decision made by the ICU consultant on call. The form contains clinical information, as well as administrative data of the referring doctor, location of the patient and time of referral. After review of the patient, the information is captured on the database. Emergency referrals are made by telephone with a form completed afterwards.

All patients referred to the ICU for admission were included in the data analysis. Exclusion criteria included paediatric medical patients and obstetric patients, as both groups present to independent emergency assessment units. The following data were extracted for patients referred from the ED: age, sex, race, referring discipline, comorbidities, diagnosis (non-communicable, infectious and trauma), the reason for referral, outcome of consult (admitted, indeterminate or refused), SCCM grading, reasons for refusal or indeterminate outcome, patients admitted and those not admitted, delay and reasons for the delay of accepted patients transferred from the EC to ICU, ICU length of stay and discharge status (alive or deceased). In addition, physiological variables for calculation of a MEWS score were extracted from the referral data. No patient or clinician identifiers were used.

Data were entered into spreadsheets and transferred to the statistical programme R version 3.6.2 for analysis [18]. Statistical analysis involved descriptive and inferential statistics. For numerical variables, the data were summarised in the form of minimum, maximum, quartiles, mean, deviation and the coefficient of variation. Categorical variables were summarised in the form of counts and percentage frequencies. For the inferential statistics, the mean comparison was made on three groups. Analysis of Variance (ANOVA) was used in the case where the numerical variables were following a normal distribution and Kruskal Wallis, where the distribution was not following the normal distribution. The association between two categorical variables was done using Chi-squared or Fischer's exact test depending on the distribution of the counts within the cross-tabulations. Significance was set at $p < 0.05$.

Results

There were a total of 2187 referrals from the EC to ICU over 63 months. Table 1 describes the patient profile referred to the ICU from the EC.

The primary disease of patients referred to ICU was classified as trauma-related, non-communicable or infectious. Table 2 describes the referrals according to the primary disease classification and the organ or system involved.

Of the patients referred to ICU, 41.5% (907/2187) were initially accepted, 17.9% (392/2187) were refused ICU admission, 0.2% (5/2187) had their referrals withdrawn, and 0.1% (3/2187) died before an

Table 1
Profile of patients referred to ICU.

		Total (n), % of total (2187)	Accepted ($n = 907$) n (%)	Indeterminate ($n = 876$) n (%)	Refused ($n = 392$) n (%)	*p*-Value
Age (years), median (IQR)		36 (26–53)	33 (24–48)	37 (27–54)	43 (28–60)	<0.001
Age groups						
	<20	230 (10.5)				
	21–39	1004 (45.9)				
	40–59	585 (26.7)				
	60–79	331 (15.1)				
	≥80	30 (1.4)				
	Missing	7 (0.3)				
Gender						
	Male	1231 (56.3)	521 (57.4)	495 (56.6)	210 (53.6)	<0.001
	Female	956 (43.7)	386 (42.6)	380 (43.4)	182 (46.4)	
Discipline related referral						
	Medicine	1160 (53)	474 (52.3)	412 (47.0)	264 (67.3)	<0.001
	General surgery	498 (22.8)	155 (17.1)	275 (31.4)	66 (16.8)	
	Trauma	474 (21.7)	249 (27.5)	168 (19.2)	57 (14.5)	
	Burns	17 (0.8)	13 (1.4)	3 (0.3)	1 (0.3)	
	Orthopaedics	20 (0.9)	8 (0.9)	9 (1.0)	3 (0.8)	
	ENT	3 (0.1)	1 (0.1)	2 (0.2)	0 (0)	
	O&G	14 (0.6)	5 (0.6)	7 (0.8)	1 (0.3)	
	Paediatrics	1 (0)	2 (0.2)	0 (0)	0 (0)	
Race						
	Asian	21 (1.0)	8 (0.9)	9 (1.0)	4 (1.0)	<0.001
	Black	2097 (95.9)	867 (95.6)	842 (96.1)	375 (95.7)	
	Mixed-race	21 (1.0)	13 (1.4)	4 (0.5)	4 (1.0)	
	White	20 (0.9)	7 (0.7)	8 (0.9)	5 (1.3)	
	Missing data	29 (1.3)	12 (1.3)	13 (1.5)	4 (1.0)	
Common comorbidities						
	None	1283 (58.9)	512 (49.7)	451 (43.7)	148 (28.5)	<0.001
	HIV	483 (22.1)	169 (16.4)	192 (18.6)	118 (22.7)	
	Hypertension	359 (16.4)	118 (11.5)	153 (14.8)	86 (16.5)	
	DM	354 (16.2)	143 (13.9)	137 (13.3)	73 (14.0)	
	Cardiovascular	81 (3.7)	24 (2.3)	29 (2.8)	28 (5.4)	
	Chronic respiratory	74 (3.4)	21 (2.0)	23 (2.2)	30 (5.8)	
	CKD	64 (2.9)	22 (2.1)	21 (2.0)	20 (3.8)	
	Epilepsy	64 (2.9)	21 (2.0)	25 (2.4)	17 (3.3)	

Note: The total includes all categories, including patients who died, and referrals that were withdrawn. These columns have been omitted from the table.
IQR, interquartile range; ENT, ears nose and throat; O&G, obstetrics and gynaecology; HIV, human immunodeficiency virus; DM, diabetes mellitus; CKD, chronic kidney disease.

Table 2
Referrals according to primary disease and organ/system involved.

			Total (n)%
Primary disease			
Non-communicable			472 (21.6)
Trauma			1088 (49.8)
Infectious			627 (28.7)
Most common organ/system involved			
Neurological			616 (28.2)
Metabolic			578 (26.4)
	Overdose	194	
	DKA	181	
	Other	203	
Sepsis			513 (23.5)
	Respiratory	242	
	Skin and soft tissue	132	
	Intra-abdominal	33	
	Gastrointestinal	29	
	Genitourinary	17	
	Other	60	
Airway			413 (19.9)
Respiratory			383 (17.5)
Cardiovascular			285 (13)
Gastrointestinal			268 (12.3)
Renal			136 (6.2)
Haematological			10 (0.5)
Genitourinary			5 (0.2)

ICU decision was made. There were 876 patients (40.5%) where the decision to accept or refuse admission could not be made after the initial ICU review, these patients were labelled as indeterminate, and a decision was subsequently made after further review (Fig. 1). After a follow-

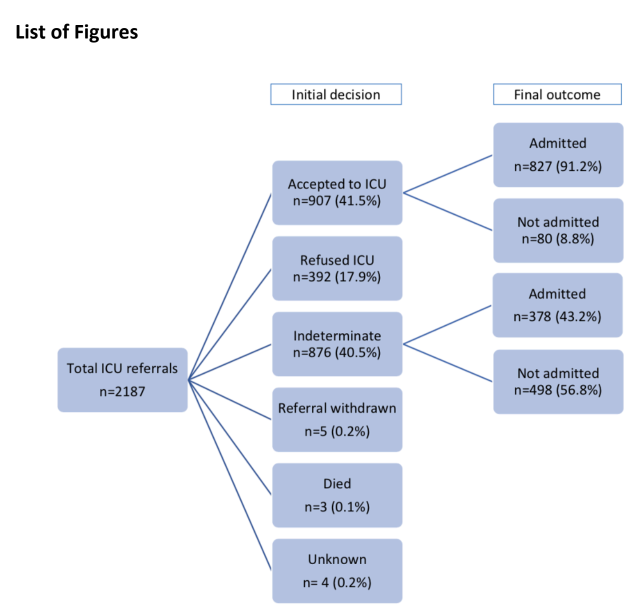

Fig. 1. Summary of ICU decision and outcomes of referrals.

up review, a further 378 patients were accepted for admission; thus 58.8% (1285/2187) were eventually accepted to ICU for admission.

Of the patients accepted by ICU, the majority (60.7%, 550/907) were triaged as SCCM priority 1. Those refused ICU admission were either considered too severely ill (67.6%, 265/392) or too well (31.6%, 124/392) to benefit from ICU care. The reason for refusal was not recorded for the remaining three patients.

Patients initially accepted for ICU admission had a mean age of 36 years and were predominantly male. Of the 907 accepted to ICU, 52.3% were due to medical conditions followed by trauma and surgical conditions (Table 1).

Of the patients from the group initially accepted, 91.2% (827/907) were physically admitted to ICU. Of the 8.8% (80/907) who were accepted but not admitted, most frequent reasons included being transferred to another unit (including a neurosurgical unit) and an improvement in their clinical condition, such that they no longer required ICU care (Fig. 2).

The most common reasons for an indeterminate decision were patients requiring review intra- or post-operatively before a final decision could be made (26.1%, 229/876), unavailability of ICU bed (21.5%, 188/876) and need to reassess the patients' condition after EC interventions (19.2%, 168/876). After review, 43.2% (378/876) were subsequently admitted to ICU. The admitted patients had a mean age of 39 years, and most (58.5%, 221/378) were male. The mean MEWS score in this group was 5.

Of the patients admitted to ICU, 46.1% (555/1205) experienced a delay from the time of decision to their arrival in ICU. The mean time from ICU decision to admission was 6 h and 26 min. The most common reasons for this included a delay in an ICU bed becoming available (36.8%, 204/555), and patient admissions to ICU post-operatively after going to theatre from the EC (26%, 144/555). Other reasons included a delay in transferring patients due to EC staff occupied with emergencies (10%, 58/555), ICU staff too busy to transfer (4.7%, 26/555), issues with equipment and a broken hospital elevator in two cases.

Most patients accepted to ICU were classified as SCCM category I and II (Table 3). Patients in the SCCM category I, III and IVB had a mean MEWS score of 5. Patients in category II and IVA had a mean MEWS score of 4 and 3, respectively.

Of those accepted to ICU, the mean MEWS was 4 (Table 3). The mean MEWS of patients who died before an ICU decision could be made, and those who were refused ICU admission was 7 and 5 respectively.

Of the 1205 patients admitted to ICU, most patients (86.4%, 1041/1205) were discharged from ICU, and 13.6% (164/1205) died in ICU. There was no significant difference in the mortality rate of patients who experienced a delay in transfer to ICU compared to those who did not experience a delay [14.1% (78/555) versus 13.2% (86/650), $p = 0.72$].

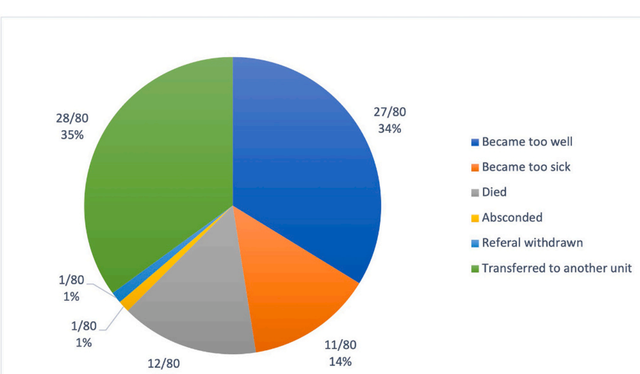

Fig. 2. Reasons for accepted patients not being admitted to ICU.

Table 3
Correlation between MEWS score and SCCM category and ICU decision.

	Total n (%)	Accepted ($n = 907$) n (%)	Indeterminate (n = 876) n (%)	Refused (n = 392) n (%)	p-Value
SCCM					
I	798 (36.7)	550 (60.6)	248 (28.3)	0 (0)	<0.001
II	422 (19.4)	270 (29.8)	152 (17.4)	0 (0)	
III	120 (5.5)	55 (6.1)	62 (7.1)	3 (0.8)	
IVA	377 (17.3)	20 (2.2)	233 (26.6)	124 (31.6)	
IVB	457 (21.0)	11 (1.2)	181 (20.7)	265 (67.6)	
MEWS score					
Mean (SD)	4.29 (2.21)	4.11 (2.13)	4.34 (2.19)	4.60 (2.40)	0.038
Missing data	772 (35.5)	326 (35.9)	277 (31.6)	169 (43.1)	

Discussion

In this study, patients admitted to ICU were younger, and with fewer comorbidities when compared to studies from developed countries which reflect an older patient profile [4,19,20]. The younger patient profile is in keeping with other African data [21]. A large burden of trauma, HIV-related disease and a rise in non-communicable diseases are contributory factors to the difference in patient characteristics and admission profile compared to high-income countries [5,6]. Differences in bed availability may also be associated with variation in the clinical characteristics of patients accepted to ICU [22–24]. International comparisons demonstrate that developed countries with higher bed availability are more likely to admit older and less severely ill patients [22,23].

While medical and surgical conditions accounted for most ICU referrals, trauma-related conditions contributed significantly to admissions with more than half of the referrals being accepted for admission to ICU. An early study from a large tertiary centre in Johannesburg also showed a high ICU admission rate from trauma-related conditions [25]. The high admission rate for medical conditions is in contrast to recently published data from KZN, where patients from internal medicine were twice as likely to be refused in comparison to surgical patients [26]. This may be due to a bias in accepting surgical patients in primarily surgical ICUs compared to the ICU in this study, which caters for a mix of surgical and medical patients. Other possible contributory factors include the perceived poorer outcome of medical patients due to multiple comorbidities, and longer length of ICU stay and bed occupancy for medical conditions.

The heterogeneity of the systems involved is reflective of the common presentations to the EC, which has a varied case mix. Admissions for drug overdose and sepsis are consistent with global trends which show an increase in the rate of admissions [27,28].

Only 41.5% (907/2187) of the patients referred to ICU were initially accepted for admission. In KZN, the ratio of public ICU beds to population is 1:32,000 [29]. This highlights the large demand placed on limited resources and the need for rationing and triage decisions. A lack of available staffed ICU beds is increasingly described in both local and international literature as a reason for delayed ICU transfer, and was the main reason for delay in this study as well [30,31].

In contrast to other published South African data, the refusal rate of 17.9% in this study is low [26]. It is comparable to studies from developed countries which had refusal rates between 17 and 38% [9,20]. Of the patients refused, most (66.3%) were considered "too sick" to benefit from ICU care and 31.4% were considered "too well" for ICU. To optimise resources, the SCCM Task Force recommends that ICU admission decisions should take a combination of factors into consideration including the patient's condition, diagnosis, prognosis, the potential for the patient to benefit from ICU interventions and bed availability [32]. Patients refused admission reflects the triage process, where, in order to utilise available ICU facilities efficiently, only patients who will derive the most benefit from ICU care are admitted. This process excludes patients who can be effectively managed outside the ICU (too well) and patients where ICU admission is deemed inappropriate (too sick). These decisions are generally made by the ICU specialists in consultation with the specialists from the patient's base discipline as part of a multi-team discussion.

A significant proportion of patients had indeterminate decisions on the initial referral with at least 43.2% subsequently accepted for ICU admission. Reasons for these decisions included the need to reassess patients in theatre or after EC interventions to determine if ICU care would still be required, and to await the results of further investigations before a final decision could be made. This reflects the rapidly changing clinical condition of patients in the EC, and the shortage of information at the time patients present to guide decision making in a resource-constrained environment.

In contrast to high-income countries where the EC length of stay was found to be between two to four hours, almost half of the patients in this study experienced a delay to ICU admission of over six hours [33,34]. The responsibility for the ongoing care of these critically ill patients places high demands on EC resources and leads to an increase in workload and EC crowding [31,35,36]. EC associated factors leading to ICU admission delays are also described in studies from developed countries and may be an important factor in resource-limited settings as well [31,36].

Early intensive care admission of critically ill patients is associated with improved clinical outcomes. Studies have demonstrated a higher ICU and in-hospital mortality in patients whose transfer from the EC to ICU was longer than 6 h [37–39]. The hazard ratio of ICU mortality has previously been shown to increase by 1.5% for every 1 h delay in ICU admission [39]. In this study, the mortality rate of patients who experienced a delay to ICU admission was similar to those who did not experience a delay. There are a number of factors which may be contributing to patient outcome in this study including optimal preadmission resuscitation and stabilization, evidence-based risk stratification and collaboration between EC and ICU teams, which allows continued delivery of high-quality critical care until ICU transfer occurs.

In those that had a completed MEWS score, there was good correlation between the MEWS score and the SCCM classification. The MEWS is a simple tool that EC staff could use together with clinical assessment as a predictor of illness severity and to identify patients for referral to ICU.

To date, this is one of few studies profiling admissions to an ICU from an EC in South Africa using a large, high quality database. Despite this, several limitations have been identified. This was a retrospective study which is susceptible to bias. Data on the referral forms were captured by different practitioners in the ICU team and are therefore subject to individual interpretations. However, this is minimised by training all ICU practitioners on completion of the referral forms, and the use of a standardised form. Also, the sample may underestimate the number of patients requiring referral to ICU and the total workload of critical care patients managed in the EC. There may be critically ill patients who either improve or die in the EC before ICU referral, or not discussed with ICU due to a lack of bed availability or perceived futility of ICU admission. Obstetric and paediatric medical patients are seen in their respective departments and did not make up the case mix of patients referred from our EC. The data regarding referrals from other hospitals and clinics was incomplete and thus not included in the analysis to determine if these patients had a different mortality rate.

A heterogeneous population with a high burden of trauma as well as HIV co-infection was seen in the EC. Just over half of all EC referrals to ICU were eventually admitted. The most common reason for declining ICU referrals was due to perceived poor patient outcome when ICU triage criteria were applied. Decisions to accept patients to ICU are limited by available resources and the need to prioritise patients who would derive the most benefit from ICU care. Delays in the transfer of ICU patients from the EC increase the EC workload and contribute to EC crowding.

Further research is required to quantify the demand placed on both EC and critical care resources to ensure appropriate and rational utilisation of these resources. Although studies such as this enable a better understanding of factors affecting ICU referral decisions, further study is required to identify common conditions that lead to ICU admission and refine decision making protocols for these conditions. The development of an ED-based critical care registry may assist in early identification of patients requiring a higher level of care and improve coordination between EC and ICU teams.

Dissemination of results

The results of the study have been shared with relevant departments. The results will be shared with the Division of Emergency Medicine, University of KwaZulu-Natal.

Authors' contribution

Authors contributed as follows to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: MS contributed 50%; RM 25%; RW 15% and NA 10%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of competing interest

The authors declared no conflict of interest.

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