An analysis of referrals to a level 3 intensive care unit in a resource-limited setting in South Africa

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Background. With a shortage of intensive care unit (ICU) beds and rising healthcare costs in resource-limited settings, clinicians need to appropriately triage admissions into ICU to avoid wasteful expenditure and unnecessary bed utilisation.
Objective. To assess the nature, appropriateness and outcome of referrals to a tertiary centre ICU.
Methods. A retrospective review of ICU consults from September 2016 to February 2017 at King Edward VIII Hospital was performed. The study was approved by the University of KwaZulu-Natal Biomedical Research Ethics Committee (BE291/17). Data pertaining to patients' demographics, referring doctor, diagnosis, comorbidities as well as biochemical and haemodynamic parameters were extracted. This information was then cross-referenced to the outcome of the ICU consultation. Data were descriptively analysed.
Results. Five hundred consultations were reviewed over a 6-month period; 52.2% of patients were male and the mean age was 44 years. Junior medical officers referred 164 (32.8%) of the consultations. Although specialist supervision was available in 459 cases, it was only utilised in 339 (73.9%) of these cases. Most referrals were from tertiary (46.8%) or regional (30.4%) hospitals; however, direct referrals from district hospitals and clinics accounted for 20.4% and 1.4% of consultations, respectively. The appropriate referral pathway was not followed in 81 (16.2%) consultations. Forty-five percent of consults were accepted; however, 9.3% of these patients died before arrival in ICU. A total of 151 (30.2%) patients were refused ICU admission, with the majority (57%) of these owing to futility. Patients were unstable at the time of consult in 53.2% of referrals and 34.4% of consults had missing data.
Conclusion. Critically ill patients are often referred by junior doctors without senior consultation, and directly from low-level healthcare facilities. A large proportion of ICU referrals are deemed futile and, of the patients accepted for admission, almost 1 in 10 dies prior to ICU admission. More emphasis needs to be placed on the training of doctors to appropriately triage and manage critically ill patients and ensure appropriate ICU referral and optimising of patient outcomes.

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Contribution of the study
There is a paucity of information related to ICU referrals in South Africa. The nature, appropriateness and outcomes of referrals to a tertiary ICU is discussed in this study.

Patients who are critically ill require urgent care in intensive care units (ICUs) to reduce the risk of mortality. In a resource-limited setting with inadequate ICU beds, trained staff and healthcare resources, appropriate triage and immediate admission is challenging. In South Africa (SA), public healthcare spending is currently approximately 13.8% of total government expenditure but, when adjusted for inflation, allocations and spending on the health budget are expected to decrease in coming years.[1] As healthcare costs rise in a low- middle-income country such as SA, there has been an inclination to cut back on expenditure and redirect resources towards preventive and primary healthcare that has resulted in a lack of human and financial resources in critical care infrastructure.[2,3] The demand for critical care continues to increase owing to factors associated with an ageing population, combined with the high burden of human immunodeficiency virus (HIV) disease and trauma.[4] Unfortunately, the demand for critical care outweighs the available resources. A study by Bhagwanjee and Scribante revealed that in SA only 23% of public hospitals have an ICU, with KwaZulu-Natal (KZN) having approximately 100 or less ICU beds.[5] The availability of ICU beds largely influences admission into ICU as, with a bed shortage, clinicians need to appropriately triage patient admissions into such units to avoid wasteful expenditure and unnecessary bed utilisation.[6]

In SA, there are limited data that evaluate the demand placed on critical care units. In addition, data are scarce regarding the characteristics and adequacy of patient referrals to ICUs.[7,8] Therefore, the objective of the present study was to assess the nature, appropriateness and outcome of referrals to a tertiary centre ICU. It is hoped that these data will highlight possible interventions to improve critical care services in a resource-limited setting.

Methods

The research was carried out at King Edward VIII Hospital (KEH) ICU, a 12-bed multidisciplinary ICU in Durban, KwaZulu-Natal, South Africa. This is a closed, intensivist-led ICU, with a nurse-to-patient ratio of 1:1. The ICU serves as a referral ICU for predominantly the eThekwini region but also for the province of KwaZulu-Natal. All referrals are analysed by the critical care team, with the on-call consultant making the final admission decision. A member of the ICU team usually assesses intrahospital referrals physically. A telephonic consultation is mainly used for referrals from outside the hospital. All patients who are discussed within the ICU have a standardised referral proforma completed by the ICU doctor in the unit at the time of the referral.

This was a retrospective review of 500 referral forms of patients referred to the ICU over a 6-month period from September 2016 to February 2017. No referrals were excluded from this study. Biomedical Research Ethics Committee (BE291/17) approval was obtained from the University of KwaZulu-Natal, KEH and the Health Research Committee of the KwaZulu-Natal Department of Health.

Referral data extracted included: the experience of the referring doctor, discussion of the patient with a specialist or another ICU, the outcome of that discussion, the referring discipline, the level of the referring healthcare facility and the reason for referral of the patient to an ICU. A community service medical officer (CSMO) refers to a doctor who has completed their internship and is serving a one-year placement as a junior medical officer prior to full registration as an independent medical practitioner. A grade 1 medical officer (1MO) has 0 - 5 years' experience post registration, a grade 2 medical officer (2MO) has 6 - 10 years' experience post registration, and a grade 3 medical officer (3MO) has >10 years' experience. The levels of referring healthcare facilities refer to state healthcare facilities, except where listed as 'private'. Private healthcare facilities have variable resources but are generally equivalent to a regional or tertiary hospital in the state sector and would be staffed by specialist medical practitioners.

When evaluating the adequacy of a consult, two key metrics were explored. One was whether the necessary data were available during the consult for the ICU team to make an appropriate decision on ICU admission, and the second was whether the patient would have been stable for transfer to the referral ICU if accepted. The adequacy of the data contained on the consult form was assessed by the principal investigator (UVJ) using a standard format analysing clinical data and special investigations. Clinical data were deemed adequate if the basic history and examination areas on the consult proforma had been completed. Special investigations were noted to have been 'done' if the results of these were included in the dedicated areas on the consult proforma, 'not indicated' if the investigation was not necessary for the specific consultation, and 'missing' if the investigation was indicated but the results were not recorded. Any doubts as to the adequacy of clinical data and appropriateness of investigations were resolved by consensus after discussion with a senior intensivist (KdV). No established criteria exist to determine whether a patient is stable for transfer. Patients were deemed unstable for transfer if the patient had any one of the following: a mean arterial pressure (MAP) <65 mmHg, SpO_2 <90%, or pH <7.0 on arterial blood gas. These criteria were based on clinical criteria proposed by senior intensivists in the study ICU. While individual patients may have been transferred despite values falling outside the range listed above, these were the initial targets recommended by the unit intensivists.

Patient data that were extracted included: age, gender, working diagnoses, comorbidities, physiological parameters, biochemical parameters and results of radiological and other investigations. The sequential organ failure assessment (SOFA), quick sequential organ failure assessment (qSOFA) and acute physiological and chronic health evaluation (APACHE) II scores were calculated from these data. In the event of missing data, the patient was allocated a score of zero for that respective variable. This was done to under-estimate, as opposed to over-estimate, both the severity of the illness and mortality risk. 'Working hours' were defined as Monday to Friday between 08h00 and 15h59. Any time frame that did not fall within this range was deemed to be 'After hours'.

The referral pathway of the health system in South Africa, and hence referrals to KEH ICU, is tiered, whereby lower-tiered centres, e.g. clinics, first refer to their next higher-tier centre, e.g. district hospitals who then refer to regional centres.[9] Healthcare facilities are expected to refer patients to other facilities that are within their referral area. If the referral did not follow this pathway, it was deemed to be inappropriate.

The outcome of the consultation was classified as accepted, refused or withdrawn. Refused patients were subdivided into three categories, no need (those who were deemed not to require ICU management), futile (where ICU care was deemed to be non-beneficial to that patient owing to the severity of their acute or chronic illness), and no beds (a patient who required ICU but was unable to be accepted owing to a bed or staff shortage). A consult was deemed to be withdrawn when the referring doctor withdrew the request for an ICU bed. The reasons for the referring doctor withdrawing a consultation were grouped as the patient improving and not requiring admission into the ICU, the patient dying before a decision regarding ICU admissions was made, or transfer to another ICU.

The data required for this study were obtained from the referral proforma form and extracted directly onto a Microsoft Excel spreadsheet in chronological order. The consultation forms were assigned a unique identification number that corresponded to the patients' data on the spreadsheet. This procedure was done to ensure no duplication of data occurred and protection of the patients' identity. Re-referrals were treated as a new consultation.

The captured data were analysed using IBM SPSS Statistics for Windows Version 27.0. Categorical variables were described as percentages and compared using the chi-square test or Fisher-Freeman-Halton test, where appropriate. Continuous data were described using median and interquartile range (IQR) as the distribution was generally non-Gaussian. These data were compared using the Mann-Whitney U-test.

Results

A total of 500 referrals were studied over a 6-month period. Demographic and clinical data for these referrals are shown in Table 1. The ages of the referred patients ranged from 9 to 91 years. The most common specific primary diagnoses were pneumonia (14.2%), toxin ingestion (7.6%), cardiac failure (4.8%), renal failure (4.8%) and intra-abdominal sepsis (4.6%).

Of the 362 patients referred for ventilatory support, 95.9% were referred for invasive ventilation.

Details of the referral process and pathway are provided in Table 2. The majority of referrals where the appropriate pathway was not followed (*n*=82) were from regional hospitals (*n*=52, 63.4%) and district hospitals (*n*=17, 20.7%) situated outside the referral area of the study hospital. All seven (8.5%) referrals directly from clinics were deemed to be inappropriate. The remainder (*n*=6, 7.3%) were from tertiary and private hospitals. The adequacy and completeness of the data received for each referral is shown in Table 3.

Table 1. Demographic and clinical data

Demographic and clinical data		*n* (%) or median (IQR)
Age		42 (29 - 57)
Sex	Female	234 (47.3%)
	Male	261 (52.7%)
Primary diagnosis	Infective	166 (33.2%)
	Non-communicable	253 (50.6%)
	Trauma	81 (16.2%)
Presence of any comorbidity		317 (63.4%)
Comorbidities	Asthma	20 (4.0%)
	Cardiac failure	16 (3.2%)
	CKD	20 (4.0%)
	COPD	21 (4.2%)
	CVA	17 (3.4%)
	Diabetes mellitus	82 (16.4%)
	Epilepsy	20 (4.0%)
	HIV	120 (24.0%)
	Hypertension	121 (24.2%)
	IHD	10 (2.0%)
	Mental health disorder	10 (2.0%)
	TB (past or current)	57 (11.4%)
Physiological parameters	Systolic blood pressure (mmHg)	113 (100 - 130)
	Diastolic blood pressure (mmHg)	68 (56 - 80)
	Glasgow coma scale	15 (9 - 15)
	Respiratory rate/min	25 (18 - 35)
	Heart rate/min	110 (94 - 127)
	Saturation (%)	96 (91 - 99)
	pH	7.31 (7.19 - 7.42)
	HCO3- (mmol/L)	20.1 (14.9 - 24.4)
	Lactate (mmol/L)	2.7 (1.3 - 6)
Reason for referral	Organ support	411 (82.2%)
	Other	89 (17.8%)
Organ support requested	Inotropic support	161 (32.2%)
	Ventilation	362 (72.4%)
	Dialysis	55 (11.0%)
Other reasons for referral	Advice	21 (23.6%)
	Palliation	4 (4.5%)
	Miscellaneous	64 (71.9%)
Number of organs where support requested	0	89 (17.8%)
	1	259 (51.8%)
	2	137 (27.4%)
	3	15 (3.0%)
Organ dysfunction on consultation	Cardiovascular	169 (33.8%)
	Respiratory	236 (47.2%)
	CNS	132 (26.4%)
	Renal	154 (30.8%)
	Liver/GIT	104 (20.8%)
	Haematological	75 (15.0%)
Number of organ dysfunctions on consultation	0	52 (10.4%)
	1	193 (38.6%)
	2	140 (28.0%)
	3	78 (15.6%)
	>4	37 (7.4%)
Metabolic derangement		187 (37.4%)
SOFA score		4 (3 - 6)
APACHE II score		18 (12 - 24)
qSOFA score	0	82 (16.4%)
	1	237 (47.4%)
	2	149 (29.8%)
	3	32 (6.4%)

CKD = chronic kidney disease; COPD = chronic obstructive pulmonary disease; CVA = cerebral vascular accident; HIV = human immunodeficiency virus; IHD = ischaemic heart disease; TB = tuberculosis; CNS = central nervous system; GIT = gastrointestinal tract; SOFA = sequential organ failure assessment; APACHE II = acute physiological and chronic health evaluation II; qSOFA = quick sequential organ failure assessment.

Stability for transfer and the outcomes of the ICU consultations are shown in Table 4. A total of 19.6% of patients were on inotropes at the time of consult, with 40.8% of these patients still hypotensive at the time of consultation.

Associations between missing consult data and clinical instability are shown in Table 5. An increased risk of instability was noted in those with either past or current tuberculosis (TB) (68.4% v. 51.2%, p=0.014). When treated as a categorical variable, SOFA remained significantly associated with missing data (p=0.018), with no statically significant association with instability (p=0.575).

Fig. 1 illustrates the relationship between SOFA category and missing data and instability. The incidence of missing data tends to decrease with increasing SOFA score, while instability tends to increase with increasing SOFA score. qSOFA was significantly associated with both missing data (p=0.049) and instability (p <0.001). Fig. 2 shows that both missing data and instability tend to increase with increasing qSOFA score.

As noted in Table 5, significantly more unstable patients had an investigation missing. There was a significant association between instability at the time of the consult and an increased risk of missing consult data. Furthermore, there was a significant association (p<0.001) between the number of criteria met for instability and the incidence of missing data, as shown in Fig. 3. Data for patients with three criteria for instability are likely to be unreliable as this only included six patients overall.

While there was no statistically significant association between the day of the week on which the consult occurred and missing data (p=0.553) and instability (p=0.052), there was a tendency to increased clinical instability early in the week (Monday and Tuesday) which decreased to a stable, lower level from Thursday to Sunday. When Monday and Tuesday were combined into a single category and compared with Wednesday to Sunday as a single category, this difference became apparent, with an incidence of instability of 64.3% as opposed to 48.4%, respectively (p=0.001).

Table 2. Administrative data related to consultation

Administrative data related to consultation		*n* (%)
Time of referral	08h00 - 15h59	216 (43.2%)
	16h00 - 23h59	141 (28.2%)
	00h00 - 07h59	111 (22.2%)
Day of referral	Monday	77 (15.4%)
	Tuesday	77 (15.4%)
	Wednesday	65 (13.0%)
	Thursday	61 (12.2%)
	Friday	75 (15.0%)
	Saturday	78 (15.6%)
	Sunday	67 (13.4%)
Referral during working hours v. after hours	Working hours	157 (31.4%)
	After hours	324 (64.8%)
Primary referring discipline	Medical	262 (52.4%)
	Obstetrics & Gynaecology	38 (7.6%)
	Surgical	200 (40.0%)
Level of referral centre	Tertiary	234 (46.8%)
	Internal	209 (41.8%)
	External	25 (5.0%)
	Regional	152 (30.4%)
	District	102 (20.4%)
	Clinic	7 (1.4%)
	Private	5 (1.0%)
Level of referring doctor	Intern	5 (1.1%)
	CSMO	24 (5.5%)
	1 MO	164 (37.4%)
	2 MO	28 (6.4%)
	3 MO	18 (4.1%)
	Registrar	190 (43.4%)
	Specialist	9 (2.1%)
Is there a consultant available at the hospital?	No	30 (6.1%)
	Yes	463 (93.9%)
If consultant available at the hospital, was the patient discussed with the consultant?	No	37 (8.0%)
	Unknown	90 (19.4%)
	Yes	336 (72.6%)
Was the patient discussed with another ICU?	No	275 (66.1%)
	Yes	141 (33.9%)
Site of other ICU	Other hospital	17 (15.7%)
	Referring hospital	91 (84.3%)
Outcome of consult with other ICU	Accepted	1 (0.7%)
	No beds	125 (89.9%)
	Pending review	8 (5.8%)
	Refused admission	5 (3.6%)
Was the appropriate referral pathway followed?	No	82 (16.4%)
	Yes	418 (83.6%)

CSMO = community service medical officer; MO = medical officer.

Discussion

The demographic data for the cohort are noteworthy for its young median age. This is in keeping with data from other ICUs in South Africa and other low-middle-income countries.[2,8,10-14] The spread of primary diagnoses illustrates the triple burden of non-communicable disease, communicable disease and trauma faced by South African ICUs. Although trauma comprised a large proportion of ICU admissions, this is lower than reported in another large South African ICU.[2,10,13] Despite the young median age, the incidence of comorbidities was high at 63.4%. The impact of the HIV epidemic is apparent in this regard, with 24.0% of patients known to be HIV positive, which is in keeping with data from other centres in South Africa.[10,13,14]

When comparing our patient cohort with another ICU in the same province, 36.2% of our patients had a qSOFA score ≥2 v. 60.6% in a study by Khan *et al.*[10] This trend continued when looking at a study done in Botswana, where their mean APACHE II score was 25 v. 18 in our study.[14] However, when comparing the mean APACHE II score in our study group with high-income countries such as Japan and the USA, no difference was seen, with similar mean APACHE II scores of 18 noted across all three studies.[15,16]

Analysis of the referral pattern data highlights a number of areas where intervention may be appropriate to improve critical care utilisation

Table 3. Descriptive data regarding adequacy of the consultation

Descriptive data regarding adequacy of the consultation		*n* (%)
History and examination	Adequate	424 (84.8%)
	Missing data	76 (15.2%)
Relevant laboratory investigations	Done	437 (87.4%)
	Missing	63 (12.6%)
Chest X-ray	Done	307 (61.4%)
	Missing	78 (15.6%)
	Not indicated	115 (23.0%)
ECG	Done	159 (31.8%)
	Missing	38 (7.6%)
	Not indicated	303 (60.6%)
CT brain	Done	35 (7.0%)
	Missing	26 (5.2%)
	Not indicated	439 (87.8%)
Ultrasound or CT abdomen	Done	43 (8.6%)
	Missing	16 (3.2%)
	Not indicated	441 (88.2%)
Number of patients missing at least one investigation	Not missing	343 (68.6%)
	Missing	157 (31.4%)
Total number of missing items in consult	0	328 (65.6%)
	1	84 (16.8%)
	2	65 (13.0%)
	3	13 (2.6%)
	4	4 (0.8%)
	5	6 (1.2%)

ECG = electrocardiogram; CT = computerised tomography.

Table 4. Patient stability and outcome of consultations

Patient stability and outcome of consultations		*n* (%)
Stable for transfer	Yes	234 (46.8%)
	No	266 (53.2%)
Reasons deemed unstable for transfer	Hypotension (MAP <65 mmHg)	82 (16.4%)
	Hypoxia (SpO_2 <90%)	185 (37.0%)
	Severe acidosis (pH <7.0)	65 (13.0%)
ICU decision	Accepted	225 (45.0%)
	Refused	151 (30.2%)
	Withdrawn	124 (24.8%)
Outcome of accepted patients	Admitted	204 (90.7%)
	Died before arrival	21 (9.3%)
Reason for refusal	Futile	85 (56.3%)
	No beds	13 (8.6%)
	No need	53 (35.1%)
Reason for withdrawal of consult	Died	30 (24.2%)
	Improved/No need for ICU	55 (44.4%)
	Transferred to another ICU	21 (16.9%)
	Unstable for transfer	1 (0.8%)
	Unknown	17 (13.7%)

MAP = mean arterial pressure; SpO_2 = oxygen saturation; ICU = intensive care unit.

and outcomes. Referrals to a Level 3 ICU from a clinic should not occur; however, they accounted for 1.4% of ICU referrals in this cohort. Critically ill patients should be triaged to avoid them being managed at, or transported to, clinics that are ill-equipped to deal with such patients. It is also unlikely that patients referred from clinics will have the necessary clinical data and investigations available to make a rational decision on ICU admission, which may likely result in poor utilisation of ICU beds.

The large proportion of referrals from district hospitals (20.4%) is of concern, as these hospitals should be referring patients who are seriously ill or at risk of becoming seriously ill to their regional referral facility prior to the patient requiring ICU. Reasons for this finding may be that patients present late to the district facility when already critically ill, or the medical staff in the district facility do not identify high-risk patients timeously, resulting in up-referrals only once the patient deteriorates and requires critical care.[17] Another reason may be that regional referral facilities, because of their limited resources, have a high threshold for accepting patients from district facilities. Regional facilities appropriately make up the largest proportion of referrals (30.4%). The functioning of ICUs at regional level and the distribution of case severity may be of concern. The Critical Care Society of Southern Africa Guidelines for the Provision of Critical Care Services in South Africa make reference to level 1, 2 and 3 ICUs.[18] Regional hospitals are meant to have level 2 ICUs which should manage critically ill patients requiring support for one or two failing organ systems. The study ICU is a level 3 ICU and should be managing predominantly complex critically ill patients. As 51.8% of patients required only single organ support at referral, it appears that a number of patients who should be managed at lower levels of care are being referred to the level 3 ICU. This may suggest a problem at a regional level where there are too few ICU beds, or that the beds are being used inappropriately. The increased presence of intensivists at regional hospitals may improve the situation.

The high risk of accepted patients from district and regional hospitals dying before arrival in ICU raises concerns about the quality of acute management provided at lower levels of care and the safety of transporting such patients. Increasing critical care education and training for medical, nursing and paramedic staff at these levels may result in better patient outcomes.

The high burden of emergency after-hours consultations has significant implications on staffing and staff wellbeing. While the majority of ICU referrals (56%) are conducted by a senior doctor (MO grade 2 or above), 44% are still conducted by junior doctors. This has potential implications for the quality of the consult and the quality of the resuscitation and transfer of critically ill patients. Even though consultants were available at the hospital in 93.9% of referrals, the consultant's advice was only confirmed to have been sought in 67.2% of the cohort. While this may be due to the advice not being recorded on the consult form, it highlights that consult input is probably not being sought in a large proportion of ICU referrals. This is likely to lead to inappropriate

Table 5. Associations with missing consult data and patient instability

		No data missing Median (IQR) or *n* (%)	Data missing Median (IQR) or *n* (%)	*p*-value	Stable Median (IQR) or *n* (%)	Unstable Median (IQR) or *n* (%)	*p*-value
Time of consult	Working hours	101 (31.9%)	56 (34.1%)	0.612	70 (30.2%)	87 (34.9%)	0.265
Referring discipline	Medical	176 (53.7%)	86 (50.0%)	0.735	108 (46.2%)	154 (57.9%)	0.026
	O&G	24 (7.3%)	14 (8.1%)		22 (9.4%)	16 (6.0%)	
	Surgical	128 (39.0%)	72 (41.9%)		104 (44.4%)	96 (36.1%)	
Level of referral centre	Tertiary	156 (47.6%)	78 (45.3%)	0.001	106 (45.3%)	128 (48.1%)	0.001
	Regional	96 (29.3%)	56 (32.6%)		88 (37.6%)	64 (24.1%)	
	District	74 (22.6%)	28 (16.3%)		39 (16.7%)	63 (23.7%)	
	Clinic	0 (0.0%)	7 (4.1%)		0 (0.0%)	7 (2.6%)	
	Private	2 (0.6%)	3 (1.7%)		1 (0.4%)	4 (1.5%)	
Level of referring doctor	Intern	3 (1.0%)	2 (1.4%)	0.003	5 (2.4%)	0 (0.0%)	0.073
	CSMO	14 (4.8%)	10 (6.8%)		13 (6.1%)	11 (4.9%)	
	1 MO	122 (41.8%)	42 (28.8%)		77 (36.3%)	87 (38.5%)	
	2 MO	19 (6.5%)	9 (6.2%)		17 (8.0%)	11 (4.9%)	
	3 MO	7 (2.4%)	11 (7.5%)		6 (2.8%)	12 (5.3%)	
	Registrar	125 (42.8%)	65 (44.5%)		92 (43.4%)	98 (43.4%)	
	Specialist	2 (0.7%)	7 (4.8%)		2 (0.9%)	7 (3.1%)	
Is a consultant available?	Yes	311 (96.6%)	152 (88.9%)	0.001	220 (94.8%)	243 (93.1%)	0.424
Was the patient discussed with a consultant?	Yes	233 (84.7%)	106 (79.1%)	0.156	170 (84.6%)	169 (81.3%)	0.372
Was the appropriate referral pathway followed?	Yes	285 (86.9%)	133 (77.3%)	0.006	197 (84.2%)	221 (83.1%)	0.739
ICU decision	Accepted	149 (45.4%)	76 (44.2%)	0.469	115 (49.1%)	110 (41.4%)	0.200
	Refused	103 (31.4%)	48 (27.9%)		67 (28.6%)	84 (31.6%)	
	Withdrawn	76 (23.2%)	48 (27.9%)		52 (22.2%)	72 (27.1%)	
Reason for refusal	Futile	59 (57.3%)	26 (54.2%)	0.282	28 (41.8%)	57 (67.9%)	0.004
	No beds	11 (10.7%)	2 (4.2%)		9 (13.4%)	4 (4.8%)	
	No need	33 (32.0%)	20 (41.7%)		30 (44.8%)	23 (27.4%)	
Reason for consultation	Inotropic support	105 (32.0%)	56 (32.6%)	0.901	60 (25.6%)	101 (38.0%)	0.003
	Ventilation	240 (73.2%)	118 (68.6%)	0.282	160 (68.4%)	198 (74.4%)	0.134
	Dialysis	38 (11.6%)	17 (9.9%)	0.563	32 (13.7%)	23 (8.6%)	0.073
	Advice	11 (3.4%)	10 (5.8%)	0.193	9 (3.8%)	12 (4.5%)	0.711
	Palliation	2 (0.6%)	2 (1.2%)	0.61	1 (0.4%)	3 (1.1%)	0.627
	Pre-op consult for post-op bed	44 (13.4%)	18 (10.5%)	0.342	35 (15.0%)	27 (10.2%)	0.104
Organ dysfunction	Cardiovascular	101 (30.8%)	68 (39.5%)	0.05	70 (29.9%)	99 (37.2%)	0.085
	Respiratory	157 (47.9%)	79 (45.9%)	0.68	103 (44.0%)	133 (50.0%)	0.181
	CNS	74 (22.6%)	58 (33.7%)	0.007	63 (26.9%)	69 (25.9%)	0.803
	Renal	102 (31.1%)	52 (30.2%)	0.842	71 (30.3%)	83 (31.2%)	0.835
	Liver/GIT	77 (23.5%)	27 (15.7%)	0.042	47 (20.1%)	57 (21.4%)	0.712
	Haematological	48 (14.6%)	27 (15.7%)	0.752	31 (13.2%)	44 (16.5%)	0.303
	Metabolic derangement	126 (38.4%)	61 (35.5%)	0.517	85 (36.3%)	102 (38.3%)	0.641
Primary reason for admission	Infective/sepsis	119 (36.3%)	47 (27.3%)	0.04	71 (30.3%)	95 (35.7%)	0.361
	Non-communicable	164 (50.0%)	89 (51.7%)		126 (53.8%)	127 (47.7%)	
	Trauma	45 (13.7%)	36 (20.9%)		37 (15.8%)	44 (16.5%)	
Any comorbidity		220 (67.1%)	97 (56.4%)	0.019	146 (62.4%)	171 (64.3%)	0.661
SOFA score		4 (3 - 7)	4 (2 - 6)	0.005	4 (2 - 6)	4 (3 - 7)	0.063
APACHE II score		18 (13 - 24)	17 (12 - 22)	0.136	17 (12 - 23)	18 (12 - 24)	0.662
History/examination missing					20 (8.5%)	56 (21.1%)	<0.001
Investigation missing					59 (25.2%)	98 (36.8%)	0.005
Any consult data missing					62 (26.5%)	110 (41.4%)	<0.001
MAP<65 mmHg		50 (15.2%)	32 (18.6%)	0.335			
SpO_2<90		108 (32.9%)	77 (44.8%)	0.009			
pH<7.0		28 (8.5%)	37 (21.5%)	<0.001			
Instability at time of consult		156 (47.6%)	110 (64.0%)	<0.001			

IQR = interquartile range; O&G = Obstetrics and Gynaecology; CSMO = community service medical officer; MO = medical officer; ICU = intensive care unit; CNS = central nervous system; GIT = gastrointestinal tract; SOFA = sequential organ failure assessment; APACHE II = acute physiological and chronic health evaluation II; MAP = mean arterial pressure; SpO_2 = oxygen saturation.

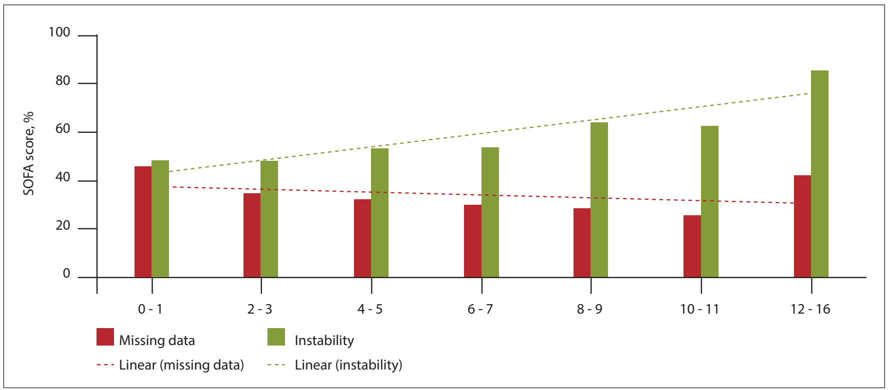

Fig. 1. Association between missing data and instability and SOFA score.

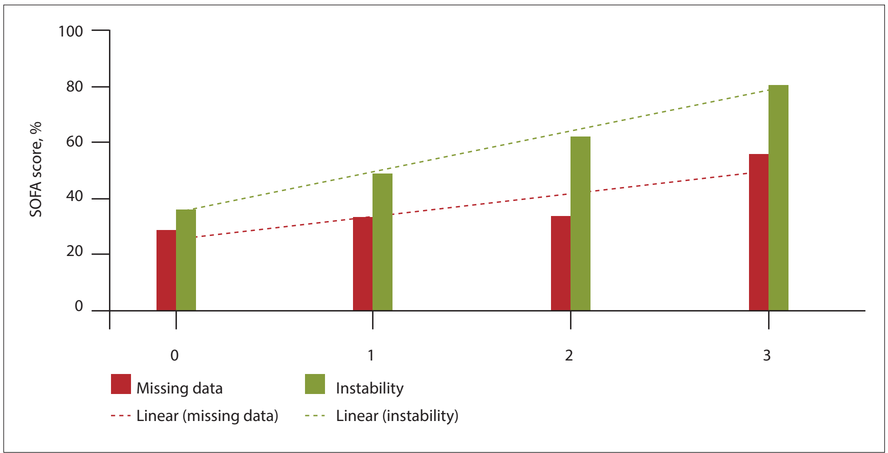

Fig. 2. Assocation between qSOFA and missing data and instability.

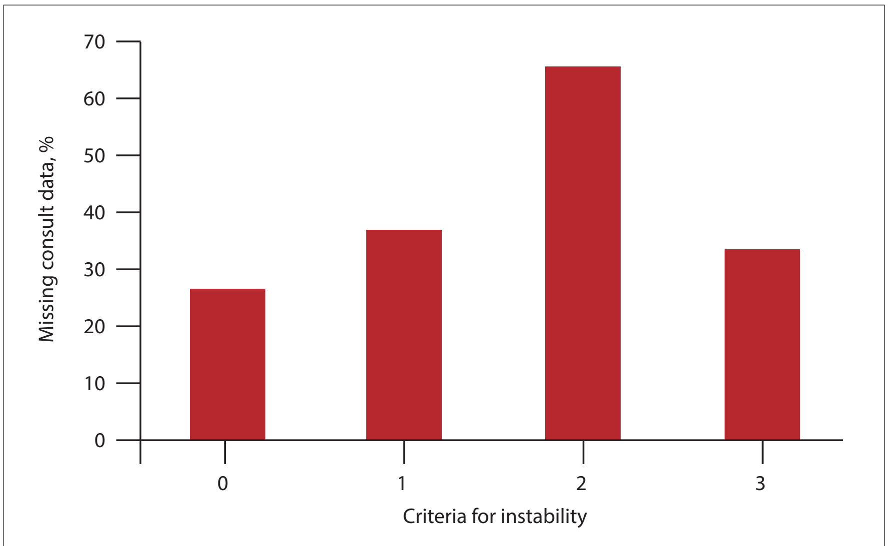

Fig. 3. Association between number of criteria for instability and percentage of patients with missing data.

referrals and inadequate optimisation of patients. In 33.9% of referrals, the patient had been discussed with another ICU. While this may be appropriate when the initial ICU has no beds available, the data presented suggest that multiple ICUs are also consulted concurrently. This is inefficient for both the referring doctor and the referral ICUs and speaks to the need for a clearer referral pathway and possibly a province-wide, centrally controlled system of bed allocation. The incorrect referral pathway was used in 16.4% of referrals. This not only creates inefficiencies and burdens on the healthcare system but also puts patients at risk as the inappropriate referral pathway leads to inefficiencies with respect to transport distances and times.[19]

The level of referral centre was significantly associated with the adequacy of the consult data. All referrals from clinics had missing information. This decreased to 36.8% for regional hospital, 27.4% for district hospitals, 12% for external tertiary hospitals and 35.9% for internal referrals. The rate of missing data is considered high, with the ICU team needing to make decisions on ICU admission with incomplete data in approximately a third of patients. This may be due to investigations not being available, or the referring doctor not requesting the investigation. The high rate of missing data from in-patient referrals may be because of a potential bias to more readily accepting a patient from within the hospital, or the physical evaluation of such a patient replacing the need for special investigations in certain circumstances.

The level of the referring doctor is significantly associated with missing data, with specialists showing the highest rate. This may reflect senior doctors relying on clinical information and more focussed investigations, while junior doctors follow a more algorithmic approach, or may reflect poorer quality consults from specialists. The availability of a consultant was, however, associated with a significantly lower risk of missing data.

The appropriate referral pathway was significantly less likely to have been followed in patients with missing data, suggesting either knowledge or system problems being more common in these situations. Patients with missing data were significantly more likely to have central nervous system (CNS) dysfunction, which is likely due to lack of availability of computed tomography (CT) scanners in district and some regional hospitals. In general, patients with missing data tended to have fewer comorbidities and lower severity of illness scores but were more likely to be unstable at the time of consult. The latter finding likely reflects the perception that unstable patients need to be referred to ICU immediately, and therefore investigations are not performed. This misperception should be addressed with a focus on attempts at stabilisation prior to ICU referral.

Patient clinical stability was related to the level of the referring institution. The trend of in-hospital patients being more unstable than patients from other tertiary centres is in keeping with international literature.[20] A possible reason may be a longer stabilisation period for external patients to mitigate risks before interhospital transfer.[19] Patients referred for inotropic support were significantly more likely to be unstable, with many on inotropic support yet hypotensive at the time of consult. This may necessitate education and training in more effective inotrope usage. qSOFA is significantly associated with increased risk of instability and may be a useful tool for non-ICU doctors to triage their patients. [21]

The majority of consults for ICU admission occurred after hours and is in keeping with other studies. [11,16,22] The greater instability of patients referred on Mondays and Tuesdays v. the remainder of the week is interesting. This may reflect a differential between staff and care over weekends and an increased referral on Monday and Tuesday of patients who had deteriorated over the weekend, but needs further investigation.

Study limitations

This was a retrospective, single-centre study, which may lead to bias and limit external validity. However, as a large referral unit for the second most populous province in South Africa, the study site may be reflective of critical care services in many areas of the country and other resource-limited settings. The ICU referral forms were filled in by any of the doctors in the ICU on the day. As doctors were of varying levels of experience, this may have resulted in bias when completing the referral form. Any missing information on the consult form was assumed to have been not available at the time of the consultation. This may not have been the case as the receiving doctor may have omitted the required information. The approach to missing data for the severity of illness scores may have resulted in a bias to reporting lower severity of illness scores. However, this was applied consistently and was deemed to be better than potentially falsely inflating severity of illness scores. While there are instances where deviating from the referral pathway may be necessary, it was not possible to assess this systematically from the consultation forms and thus we may have overestimated the number of inappropriate referrals.

Conclusion

In South Africa, the demand for intensive care services in state facilities exceeds the supply. As a scarce resource, appropriate referral is essential to ensure distributive justice and better outcomes for patients. This study describes the nature of cases referred to a single centre and that appropriate senior support may not be properly utilised or available. Patients referred for ICU care are often too unstable to transport and have missing data that are necessary to make an appropriate decision on ICU admission. More emphasis needs to be placed on the training of doctors to appropriately assess and stabilise critically ill patients. There are numerous factors that influence referral patterns, and more studies are required to identify factors that may improve resource utilisation and distribution.

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