

Abstracts of scientific presentations at the 2017 Annual National Congress of the Critical Care Society of Southern Africa

Opening the cubby-hole of curriculum development: Reflections on academics' experiences

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Background. As curriculum developers, academic lecturers are seldom included in the dialogues regarding curriculum development (CD).

In this study, CD was initiated to align new nursing and public health programmes to the Higher Education Qualification Sub Framework.

Objectives. The objective of the research was to explore the experiences of academic lecturers regarding CD.

Methods. A qualitative and exploratory design was used, following interpretivism. The participants were lecturers involved in CD in a specific department at an open distance learning (ODL) university. Ethical clearance was sought and obtained from the research ethics committees of the university and the department where the lecturers worked. Triangulation of roundtable group discussion with written narratives was done, followed by content analysis of data.

Results. The reflections on experiences revealed the challenges related to CD, which included programme classification typology, 'red tape' in organisational processes, and legislative and statutory body compliance.

Conclusion. The information obtained from this study provides a reflection on the pedagogic requirements for the development of new programmes, as well as staff development and support to achieve academic excellence and active citizenship in CD.

Early mobilisation practices of patients in intensive care units in Zimbabwean government hospitals: A cross-sectional study

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Background. For the successful implementation of early mobilisation programmes in intensive care units (ICUs) as routine care, a description of regional variations may help to better contextualise the working environment and may aid analyses of relevant barriers.

Objectives. To evaluate the structure and organisational practices of Zimbabwean government hospital ICUs and to describe early mobilisation practices in these units.

Methods. A cross-sectional survey was conducted in all government hospitals in Zimbabwe. Data collected included hospital and ICU structure, patient demographic data and mobilisation activities performed in ICU during the previous 24 hours prior to the day of the survey.

Results. A total of 5 quaternary-level hospitals were surveyed, with each hospital having 1 adult ICU – 4 of the units were open-type ICUs. Only 1 ICU (20%) had a patient eligibility guideline for early mobilisation in place. Across the ICUs, 40 patients were surveyed. The mean (standard deviation) age was 33.9 (14.9) years and 24 (60%) patients were mechanically ventilated. The primary reasons for admission to the ICU included acute lung injury ($n=12$; 30%) and perinatal complications ($n=10$; 25%). Mobilisation activities performed in the 24 hours before completing the survey included turning the patient in the bed ($n=39$; 97.5%), sitting over the edge of bed ($n=10$; 25.0%), marching on the spot ($n=3$; 7.5%) and walking away from the bedside ($n=2$; 5.0%). The reasons listed for treatment being performed in the ICU bed included sedation ($n=15$; 37.5%) and unresponsiveness ($n=16$; 40.0%).

Conclusion. Out-of-bed mobilisation activities were infrequent and mostly influenced by patient unresponsiveness and sedation.

Factors associated with out-of-bed early mobilisation of intensive care unit patients in government hospitals in Zimbabwe

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Background. Although the literature indicates that early mobilisation is safe and feasible in critically ill adult patients, not all intensive care units (ICUs) have adopted an early mobilisation programme as the standard practice for every ICU patient and it is not frequently practised.

Objectives. To determine the factors associated with out-of-bed mobilisation of patients admitted in government hospitals in Zimbabwe.

Methods. A cross-sectional survey was conducted in all government hospitals in Zimbabwe. Data collected included hospital and ICU structure, as well as mobilisation activities of ICU patients.

Results. A total of 5 ICUs were surveyed. Only 2 units (40.0%) reported that multidisciplinary rounds were conducted daily. A total of 7 physiotherapists were working in the five ICUs during the time of the survey. Five of the physiotherapists worked in 3 ICUs permanently, while the other 2 covered the 2 ICUs on a rotational basis. None of the ICUs had structured protocols in place for patient management. Out of the 40 surveyed patients, only 10 (25.0%) had out-of-bed mobilisation, with 29 (72.5%) of the patients having in-bed mobilisation activities. Level of mobilisation was found to be associated with the type of ICU ($\chi^2(1)=13.333$; $p=0.0003$). Other factors that were found to be associated with out-of-bed mobilisation in these units included the following: availability of a resident physiotherapist ($p=0.03$); conduction of multidisciplinary ward rounds ($p=0.01$); and non-invasive type of ventilation ($p=0.01$).

Conclusion. Successful implementation of early mobilisation is influenced by many factors that are not only patient-related.

Invasive fungal infections in the paediatric intensive care unit: Epidemiology, risk factors and outcome

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Background. Fungal infections and colonisation are common in the paediatric intensive care unit (PICU). Systemic antifungal agents have been used successfully to prevent invasive fungal infection by *Candida* spp.

Objectives. To describe the epidemiology, predictors and outcomes of invasive fungal infection.

Methods. A retrospective cross-sectional study was conducted at the Inkosi Albert Luthuli Central Hospital PICU, between January 2015 and December 2016. Cases had confirmed invasive fungal infection with positive fungal blood cultures; or probable invasive fungal infection, with at least two of the following indicators: elevated serum (1-3)- β -D glucan levels, positive urine culture, or positive endotracheal aspirate culture. Controls were those with bacterial, negative or mixed cultures.

Results. Invasive fungal infection was detected in 19 of 1 029 patients, with a prevalence of 1.85 per 100 admissions. Predisposing risk factors identified were central venous catheters (84%), urinary catheters (100%), previous surgery (63%), total parenteral nutrition (63%), and previous broad-spectrum antibiotics (vancomycin) in 47%. The in-hospital mortality rate was 16.5% (170/1 029) and the case fatality ratio was 36.8% ($n=7$) v. 16.1% (163/1 010) in the controls. The average length of stay for cases was 20.5 days v. 8.3 days for controls. **Conclusion.** Fungal infections contribute to increased mortality and morbidity. Risk factors identified in this study included catheter placements and the use of parenteral nutrition and broad-spectrum antibiotics.

The clinical utility of non-invasive pulse co-oximetry haemoglobin measurements in dark skinned critically ill patients.

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Background. Noninvasive devices which measure percutaneous haemoglobin (Hb) have been evaluated previously, predominantly in pale-skinned adults.

Objectives. To assess the clinical usefulness of a point-of-care device that measures haemoglobin non-invasively (SpHb) in critically ill participants with dark skin pigmentation.

Methods. A total of 149 adult and paediatric participants from a multidisciplinary intensive care unit had intermittent readings of non-invasive Hb measurements performed at 4-hour intervals. In total, 371 readings were performed. Concurrent blood samples were taken to assess Hb levels using a point-of-care blood gas analyser. Samples were analysed at the central laboratory. Bland-Altman plots were constructed to assess the agreement between results from the 2 point-of-care devices and the reference standard (laboratory Hb).

Results. SpHb exhibited significant bias when compared with laboratory Hb, while blood gas Hb did not. The mean bias for SpHb was +1.64 (limits of agreement, LOA -1.03 - 4.31) compared with blood gas Hb,

which showed a bias of +0.26 (LOA: -0.84 - 1.37). The magnitude of the bias for SpHb increased with increasing mean Hb levels. Of all the additional study variables assessed for their effects on bias, only the Apache II score in adult patients ($p<0.0001$) and mean arterial blood pressure ($p=0.001$) had an effect. Skin pigmentation did not have any effect on the magnitude of the bias.

Conclusion. Non-invasive Hb devices require further refinements to be clinically useful in dark-skinned critically ill patients with low Hb levels.

Low-molecular-weight heparin dosing in critically ill patients: Are we getting it right?

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Background. In critically ill patients there is a suggestion that conventionally recommended doses of low-molecular-weight heparin (LMWH) prophylaxis may be inadequate, yet routine monitoring of anti-factor Xa (anti-Xa) levels is not considered to be standard of care.

Objectives. To ascertain if the current prophylaxis regimen for enoxaparin produces adequate plasma anti-Xa concentrations in patients and secondly, to determine whether there is a correlation between creatinine clearance or body mass index (BMI) and achieved anti-Xa concentrations.

Methods. A prospective descriptive pilot study of 45 adult patients admitted to the surgical intensive care and high care unit was conducted at Steve Biko Academic Hospital. Anti-Xa levels were evaluated pre and post enoxaparin administration on days 2 and 4 following enoxaparin initiation. Creatinine clearance was simultaneously measured on days 2 and 4, with the collection of a 24-hour urine sample.

Results. Forty-five participants aged 18 - 70 years were recruited. The mean (standard deviation (SD)) APACHE 2 and SOFA Scores on admission were 11 (5) and 5 (3), respectively. Seven participants (16%) were receiving vasopressor therapy. The mean (SD) creatinine clearance was 150 (56) and 148 (62) mL/min on days 2 and 4, respectively. Anti-Xa levels were in the prophylactic range for only 10 (22%) and 18 (40%) participants on days 2 and 4, respectively. Only one participant demonstrated an adequate pre-dose anti-Xa level on day 4.

Conclusion. A large proportion of the participants exhibited sub-prophylactic anti-Xa levels. Anti-Xa level monitoring with dose adjustment is thus recommended for critically ill patients.

Pharmacokinetics and dosing simulations to evaluate cefazolin prophylaxis regimens for cardiopulmonary bypass surgery

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Background. There is no consensus regarding what constitutes an appropriate antibiotic prophylaxis regimen in the scenario of cardiopulmonary bypass (CPB).

Objectives. To describe the effects of CPB on serum concentrations of cefazolin during a bolus dosing regimen.

Methods. Patients undergoing CPB for elective cardiac valve replacement in an academic hospital in Johannesburg, South Africa were eligible for inclusion. Institutional ethics committee approval was obtained. Intravenous cefazolin (2 g) was administered pre-incision and repeated at 4 hours. Serial blood and urine samples were analysed using validated chromatography. Population pharmacokinetic modelling and Monte-Carlo simulations were employed using Pmetrics to determine the attainment of therapeutic exposures of cefazolin (probability of target attainment) against organisms known to cause surgical site infections. Minimum inhibitory concentration (MIC) data of the organisms from the EUCAST database were used.

Results. From the 16 included patients, 195 total and 64 unbound concentrations of cefazolin were obtained. The mean (standard deviation) fraction excreted in urine and CPB extraction ratio of cefazolin was 39.6% (0.2) and 3.2% (2.1), respectively. A three-compartment linear population pharmacokinetic model best described the data. We observed that the standard dosing regimen was suboptimal for *Staphylococcus aureus* and *Escherichia coli* at a creatinine concentration ≤ 50 $\mu\text{mol/L}$, and for *S. epidermidis* at any dose and creatinine concentration.

Discussion: Cefazolin 2 g at 4-hourly intervals was not able to maintain concentrations above the MIC for relevant pathogens in patients undergoing cardiac surgery involving CPB with normal creatinine and albumin concentrations. The simulations showed that optimised dosing should increase the dose and/or dosing frequency.

Muscle strength and endurance as potential predictors of successful extubation in mechanically ventilated patients: A pilot study

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Background. Since the inception of mechanical ventilators, it has been acknowledged that successful weaning is not always predictable. No single test in isolation has demonstrated to accurately predict the extubation outcome. Earlier studies have shown an association between peripheral and respiratory muscle weakness. To our knowledge, no study has explored the association between muscle strength (deltoid, sternocleidomastoid and trapezius), endurance and the readiness for extubation.

Objectives. To ascertain whether muscle strength and endurance may be used as possible predictors of successful extubation in mechanically ventilated patients.

Methods. Thirty patients were recruited in a prospective study conducted at a tertiary academic hospital. Deltoid, sternocleidomastoid and trapezius muscle strength were evaluated with the Oxford grading scale. Respiratory muscle strength was adjudged with the maximum inspiratory and expiratory pressures. Muscle endurance was determined by subjecting the patients to ride the MOTomed letto2 cycle ergometer for five minutes with the upper limbs. Ethical approval was obtained from the research ethics committee, University of Pretoria.

Results. Patients ventilated for >3 days with grade 3 muscle strength of deltoid and sternocleidomastoid muscles, respectively, had a 100% chance of successful extubation ($p=0.038$). Trapezius muscle strength ($p=0.366$) was not associated with successful extubation. Patients unable to ride the MOTomed letto2 cycle ergometer actively with the upper limbs for 4.5 minutes and covering a distance of 0.5 km demonstrated a linear trend ($p=0.006$) to fail extubation.

Conclusion. Muscle strength and endurance may be useful tools to predict the success of extubation.

The development of a framework for the improvement of intensive care delivery: A systemic intervention

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Background. Initiatives following the traditional reductionist approach to improve the complex delivery of intensive care has had limited success.

Objectives. To develop a systemic framework for the improvement of intensive care delivery.

Methods. Following approval from the Wits Human Research Ethics Committee, an understanding of intensive care delivery in South Africa was obtained by 'making sense of the mess' using a systems approach. Systemic intervention served as the meta-methodology and methods and techniques from interactive planning, critical systems heuristics, soft-system methodology and viable system model were employed. Making sense of the mess emphasised the complexity of intensive care delivery, both on a situational and cognitive level. It became clear that one methodology would not suffice, but that a pluralist methodological approach was required to guide improvement in intensive care delivery. Based on this understanding, nine principles were formulated to guide the development of the framework. The same systems, methods and techniques used in the understanding phase were used to build a systemic framework.

Results. Embedded in the proposed framework are matters relating to systemicity, complexity, flexibility, empowerment and transformation of intensive care delivery. It allows for multiple perspectives, including that of marginalised stakeholders and the mitigating of multi-vested interests and power relationships.

Conclusion. The proposed framework is both flexible and adaptable to promote learning about the complex problems of intensive care delivery.

It aims to facilitate sustainable improvement of intensive care delivery and to ensure the just use of resources that fosters distributive justice.

A comparison of haemoglobin monitoring by two point-of-care devices with standardised laboratory-based measurement

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Background. Point-of-care (POC) haemoglobin concentration [Hb] estimations guide acute decisions on red blood cell transfusion.

Objectives. We studied the accuracy of POC devices compared with laboratory [Hb] testing and how between-method [Hb] disagreements affected the decision to transfuse.

Methods. Institutional ethics approved a method comparison study of perioperative arterial blood sampling from 60 adult cardiothoracic surgical patients. Samples were handled as prescribed. [Hb] was measured by two IlexGEM Premier 3500 blood gas analysers (BGa and BGb) and the HemoCue Hb 201+ device (HCue) and our laboratory's Siemens Advia 2120 flow cytometry system. A between-method [Hb] difference exceeding 10% (1 g/dL at [Hb] of 10 g/dL) would likely erroneously inform the transfusion decision. Furthermore, one red blood cell unit represents the smallest transfusion risk and will increase the [Hb] by approximately 1 g/dL.

Results. The mean POC (HCue, BGa, BGb) [Hb] underestimated mean laboratory [Hb] by 0.79, 0.81 and 0.67 g/dL, respectively. The 95% confidence interval (CI) of the between-method difference revealed that, unlike the BGa (95% CI 0.45 - 1.15) and the BGb (95% CI 0.46 - 1.16), the HCue (95% CI 0.47 - 0.87) values did not breach the 1 g/dL predetermined limit. Bland-Altman analysis revealed similar between-method mean [Hb] differences. However, the HCue's upper and lower limits of agreement (LOA) were narrower, without encroachment on those of the BGa and BGb. Also, the 95% CI of the HCue's lower LOA was <1 g/dL; this device did not clinically overestimate lab [Hb].

Conclusion. The HCue was more accurate than the BG devices, with reduced potential for transfusion error.

Reliability of ultrasonic diaphragm thickness measurement in mechanically ventilated infants and children: A pilot study

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Background. Diaphragmatic atrophy in mechanically ventilated infants and children could be due to ventilator-induced diaphragmatic dysfunction, which could lead to extubation failure. Ultrasound may be used to identify diaphragmatic atrophy reliably and could be beneficial for further research that would ultimately lead to clinical practice changes. There are currently no data reporting on the use of ultrasound to monitor diaphragm atrophy in the paediatric population.

Objectives. To assess the inter- and intra-rater reliability of using ultrasound to measure diaphragm thickness in mechanically-ventilated infants and children.

Methods. Diaphragm thickness measures were compared between two individual researchers for inter-rater reliability and between multiple measures from a single researcher for intra-rater reliability. Measures were compared using intraclass correlation coefficients and Bland-Altman plots.

Results. Results indicated excellent reliability between measures for both inter- and intra-rater reliability, with slightly better reliability for intra-rater than inter-rater reliability. Intraclass Correlation Coefficients for inter-rater reliability were between 0.77 and 0.98, and 0.94 for intra-rater reliability.

Conclusion. Ultrasound measures of diaphragm thickness can be used to reliably measure diaphragm thickness in mechanically-ventilated infants and children. This modality could therefore be used as a reliable outcome measure in clinical research studies, with the ultimate goal of identifying children at risk for extubation failure due to ventilator-induced diaphragmatic atrophy.

Initial experience of extracorporeal membrane oxygenation service at a tertiary academic centre: Acase series of 7 patients

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Background. Extracorporeal membrane oxygenation (ECMO) is a complicated, expensive therapy with a significant expected mortality.

Objectives. To review all patients undergoing ECMO treatment at our institution.

Methods. Patient notes, ELSO registry data and nurse training initiatives were reviewed from the initiation of our ECMO service. Information relating to clinical condition, rescue interventions prior to ECMO initiation, details of each ECMO run and subsequent ICU and hospital stay was reviewed. All patients undergoing ECMO were individually consented for inclusion in the study.

Results. A series of 7 ECMO training workshops and twelve 1-hour refresher sessions were run over the study period. A total of 7 patients received ECMO during the period of 1 June 2016 to 1 August 2017. There were 3 veno-arterial (VA) ECMO patients and 4 veno-venous (VV) ECMO patients. All VA patients were post cardiomy with inability to come off cardiopulmonary bypass. There was 1 survivor in this group. All VV ECMO patients were successfully weaned from ECMO onto mechanical ventilation. Two patients with alveolar proteinosis had ECMO for inability to tolerate single lung ventilation for whole lung lavage, one patient had *Pneumocystis carinii* pneumonia and another patient had H1N1 pneumonia with refractory hypoxaemia and protracted runs of 48 and 30 days, respectively.

Conclusion. ECMO has clinical utility for carefully selected patients and good results can be achieved in resource-constrained environments with low patient volume where there is adequate training. Our results are in accordance with published ELSO registry data with worse outcomes shown for VA ECMO when compared with VV ECMO.

Renal transplantation from donors after circulatory arrest: The Initial Groote Schuur Hospital Experience

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Background. Critical shortages of deceased donor organs for transplantation have led to expansion of the donor pool through the use of extended criteria donors. One such extended criterion donor is a donor after circulatory death (DCD).

Objectives. The aim of this study was to review our experience with the use of DCDs by reporting on donor characteristics and kidney recipient outcomes.

Methods. Retrospective descriptive study of DCD referrals, donor characteristics and recipient outcome at Groote Schuur Hospital (from January 2007 to December 2016), utilising a donor referral and recipient registry.

Results. Compared with donor after brain death (DBD) referrals, DCD referrals were less likely to be eligible for kidney donation (33.0% v. 66.7%) and less likely to grant consent to donation (25.9% v. 33.4%). Over the 10-year period, there were 146 DBD procurements and 13 DCD procurements. No DCD kidneys were discarded. The cause of death was more likely to be traumatic in the DCD cohort with a terminal creatinine of 120.9 mmol/L (v. 100.6 mmol/L in the DBD cohort). There was an increased incidence of delayed graft function in the DCD cohort but transplant outcomes were acceptable.

Conclusion. DCD is an effective method of increasing the donor pool and expanding the number of patients who are offered transplantation. There is an increased incidence of delayed graft function but outcomes are acceptable.

Adverse event reporting system experienced by critical care nurses in KwaZulu-Natal, South Africa

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Background. Critically ill patients admitted to critical care units (CCUs) have life-threatening or potentially life-threatening problems. It is perceived that, irrespective of high percentages of occurrence of adverse events, the incidences remain under-reported. For those that are reported, little is done to prevent future recurrence as feedback may be lacking.

Objectives. This study explored the experiences of critical care nurses (CCNs) in relation to how the reported adverse events were analysed and handled in CCUs.

Methods. The study was conducted in the CCUs of 5 purposively selected hospitals. A qualitative design was used to obtain data through in-depth interviews from a purposive sample of 5 unit managers working in the CCUs to provide insights into their experiences. This study was a part of a larger study using a mixed-method approach. The recorded qualitative data were analysed using Tesch's content analysis.

Results. The main categories of information that emerged during data analysis were: (i) the existence of adverse event reporting system; (ii)

occurrence of adverse events; (iii) promotion and barriers of an adverse event reporting; and (iv) handling of adverse events. The findings demonstrated that there were major gaps that affected the maximum utilisation of the reporting system.

Conclusion. Our study provides an understanding of how the adverse events reporting system is utilised and highlights barriers that affect reporting. To improve adverse event reporting, a non-punitive and non-confrontational system should be promoted.

The effects of a stress management intervention on stress levels of nurses practising in intensive care units: A quasi-experimental study

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Background. South African professional nurses working in the intensive care unit (ICU) experience many physical and psychosocial hazards and risks. Stress provoked by failure to meet work demands leads to illness, injury and psychological suffering. It is therefore necessary to address the aspects leading to stress and work burnout. This study was conducted in the adult ICUs of a public-sector hospital.

Objectives. The purpose of the study was to develop and pilot test a stress management intervention for nurses practising in ICUs.

Methods. A quasi-experimental non-equivalent control group design was selected for this study. It comprised of pre-testing, development and implementation of the intervention and post-testing. Both groups of nurses were recruited from the same hospital by means of convenience sampling, and completed the Expanded Nurses Stress Scale (ENSS). The intervention group participated in the educational intervention on stress management. The control group received no intervention. Both groups completed the ENSS 4 weeks after the completion of the intervention. The quantitative data were analysed by means of descriptive summary statistics.

Results. There was clear evidence of significant differences ($p=0.000$) emerging in all nine subscale scores with respect to level of stress when considering the pre- and post-test scores. This indicates the stress management intervention had an effect on the stress levels of participating nurses. Evaluation of the stress management intervention workshop also revealed that an overwhelming number of nurse participants experienced all activities as meaningful, with contributory worth.

Conclusion. The study concluded that the stress management intervention had an effect on the stress levels of nurses practising in the ICUs at the selected study site.

Roles of specialist intensive care nurses in mechanical ventilation

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Background. Ventilation management is fundamentally described as a collaborative effort between doctors and specialist nurses. However, this is based on the perceptions and opinions of nurse managers in these studies, and not the viewpoints of individual nurses themselves. If nurses are to gain credibility in advanced practice they need to have a clear understanding of what is expected of them.

Objectives. The aim of this study was to describe the roles of specialist intensive care nurses in ventilation management.

Methods. A quantitative and cross-sectional survey design was utilised. The data were collected using a validated questionnaire developed by Rose *et al.* in 2011.

Results. Of the 165 surveys distributed, 110 were returned (response rate 66.6%). Most nurses agreed that nurses and doctors collaborated in key ventilation decisions, but not when decisions to extubate and initial ventilation settings are made. Regarding independent titrations of ventilator settings, findings showed that the nurses reported a frequency of >50% of the time for titration of respiratory rate, tidal volume, decreasing pressure support, increasing pressure support, titration of inspiratory pressure and ventilation mode changes. Nurses with higher levels of autonomy, influence in decision-making and years of experience scores, frequently (>50% of the time) made independent changes to ventilation settings ($p<0.05$).

Conclusion. The study concludes that specialist intensive care nurses need to reevaluate their role in ventilation management and focus on key ventilation settings as nurses could strengthen their contribution in the collaboration of key ventilator settings.

The association between diaphragm contractile activity and maximal inspiratory pressure in the intensive care unit – a pilot study

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Background. Ventilator-induced diaphragmatic dysfunction causes a loss of the force-generating capacity of the diaphragm and may contribute to weaning failure. Maximal inspiratory pressure is often used to measure inspiratory muscle strength. We investigated whether there is an association between diaphragm contractile activity and maximal inspiratory pressure (MIP).

Objectives. To determine whether the change in the contractile activity of the diaphragm during the course of mechanical ventilation was associated with post-extubation inspiratory muscle strength.

Methods. Diaphragm thickness was measured daily with ultrasound in the zone of apposition using a 5 - 12 MHz ultrasound transducer. Diaphragm thickness was measured at end-inspiration and end-expiration for three breaths. Diaphragm thickening fraction (DTF) was calculated as the percentage change between thickness at end-inspiration and end-expiration, and represents the contractile activity of the diaphragm. MIP was measured within 24 hours of extubation.

Results. A total 27 participants (16.59% male) were studied. The DTF decreased by a median (interquartile range (IQR)) of 0.4% (-2.60 - 1.15) per day. The mean age (range) was 44 (19 - 80) years and the median (IQR) duration of ventilation was 4 (3 - 7) days. There was an insignificant negative correlation between the rate of change in

DTF while intubated and MIP post-extubation ($r=-0.317$; $p=0.108$). The first ($r=0.17$; $p=0.39$), last ($r=-0.09$; $p=0.65$) and post-extubation DTF ($r=0.01$; $p=0.96$) were not significantly correlated with MIP.

Conclusion. Majority of participants showed a decline in DTFs during mechanical ventilation. Diaphragm contractile activity is not strongly correlated with volitional measures of inspiratory muscle strength.

Understanding the psychological contracts of intensive care unit nurses

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Background. Nurses, especially those in intensive care units (ICUs), are instrumental in managing the quality and efficiency of patient care and play a critical role within the South African (SA) public health system. Factors such as staff shortages and a lack of basic resources have the potential to impact negatively on their psychological contract and motivation levels.

Objectives. This paper examined the mutual obligations implicit in the psychological contract of ICU nurses and nursing management. Psychological contract fulfilment and its effect on the motivation of these nurses was also explored.

Methods. Data were gathered through semi-structured interviews with 44 ICU nurses at a tertiary hospital in SA. Nine senior nursing staff were also interviewed to provide a management perspective. Fifteen nurses declined to participate in the study. Thematic analysis was used to identify the relevant elements of the psychological contract and to establish connections with motivational aspects.

Results. Provisional analysis showed that the psychological contracts of most ICU nurses are relational in nature. Nurses experience sincere enjoyment of their work and are emotionally connected to their patients and the hospital. The nurses thrive on the challenges of the ICU and appreciate ongoing professional development initiatives. These factors underpin the high motivation levels of most nurses despite some interpersonal issues between themselves and their management.

Conclusion. ICU nurses want visible unit management with appreciation demonstrated in both tangible and non-tangible ways.

A 1-year audit of central venous catheter colonisation in the Dr George Mukhari Academic Hospital Intensive Care Unit, Ga-Rankuwa, South Africa

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Background. Central venous catheters (CVC) are used to access the vascular system for the delivery of medication, parenteral nutrition and haemodynamic monitoring in the intensive care unit (ICU). CVC colonisation rates as high as 63% have been reported, and are considered a prerequisite for the development of catheter-related bloodstream infection.

Objectives. To determine the incidence of catheter tip colonisation, the types of microorganisms, length of ICU stay in patients with positive cultures and their outcomes.

Methods. We conducted a retrospective study of all patients with positive catheter tip cultures from April 2015 to March 2016, as reported by the microbiology department.

Results. In total, 70 patients were reviewed. The mean (standard deviation (SD)) age of the patients was 40.46 (16.96) years. Of the total number of ICU admissions, 9.9% ($n=70$) had positive CVC tip cultures. Coagulase-negative staphylococci (42.9%; $n=30$), *Acinetobacter baumannii* (20.0%; $n=14$), *Klebsiella pneumoniae* (10.0%; $n=7$), and *Pseudomonas aeruginosa* (4.3%; $n=3$) were the most commonly isolated organisms. The mean (SD) length of ICU stay was 19 (15.29) days (range 8 - 87). The mortality rate was 37.1% ($n=26$).

Conclusion. Coagulase-negative staphylococci were the most frequent microorganisms that colonised the CVCs in our unit. These results must be interpreted with caution with regard to the clinical context, especially given the relatively high mortality rate. A blood, wound and urine culture must always be performed to correlate the results. Guidelines for the prevention of intravascular catheter-related infections should always be implemented.

Acid load and urinary chloride excretion during metabolic acidosis in critically ill patients

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Background. The administration of intravenous fluids is a common intervention in the intensive care unit. A high chloride content fluid may be associated with detrimental effects but the exact mechanism is unknown.

Objectives. To describe renal chloride handling in critically ill adult patients with metabolic acidosis.

Methods. A prospective experimental study was performed. Routine bloods and additional urine samples were collected. Urine pH, electrolytes and osmolality were measured. A physicochemical approach was used to calculate total acid load (standard base deficit, SBD_{acid}) and components. Urinary measurements were used to describe renal tubular acidosis (RTA) and its absence (no RTA). Finally, we assessed the independent predictors of urine chloride concentration (UCl).

Results. The median age was 44.5 years and the predicted mortality rate was 12.1% ($n=22$). The median lactate concentration was 4.5 mmol/L, while the median pH was 7.24. Chloride contributed 79.5% to the SBD_{acid}. Six of the 22 cases could be defined as RTA or no RTA. The median UCl (mmol/L) was 75 (no RTA) v. 115 (RTA). The median pH was lower (7.21 v. 7.26) and the lactate concentration (mmol/L) was higher (9.0 v. 3.1) in the no RTA group. Spearman correlations showed significant correlations between UCl and lactate concentration (inverse), SBD_{unmeasured anions} (inverse), estimated glomerular filtration rate (eGFR) and urinary sodium concentration (UNa). Applying these to a multiple regression model revealed that the independent predictors of UCl were lactate, eGFR and UNa.

Conclusion. UCl is reduced by elevations in lactate concentration and eGFR (increased unmeasured anions). Preferential excretion of other anions limiting chloride excretion may be adaptive rather than deleterious.

Sepsis and outcomes of admission to the paediatric intensive care unit at the Nelson Mandela Academic Hospital, Mthatha, South Africa

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Background. The paediatric burden of sepsis in developing countries is poorly documented.

Objective. To assess the contribution of sepsis to paediatric mortality in a paediatric intensive care unit (PICU) in a resource-poor tertiary hospital.

Methods. We conducted a retrospective review of records of paediatric patients (1 month to 13 years of age) admitted to the PICU at the Nelson Mandela Academic Hospital from January 2016 to December 2016. Patient demographics, sepsis prevalence, culture results, risk factors (including immunologic status and herbal medication use) and patient outcomes were analysed. The International Paediatric Sepsis Conference Group definition of sepsis was used.

Results. A total of 176 patients were included in the study. There were 85 (48%) females and 91 (52%) males; 122 (69%) patients were <1 year of age, 26 (15%) patients were aged 1 - 5 years, and 28 (16%) patients were >5 years of age. The sepsis prevalence was 57.14% (95% confidence interval 49.46 - 64.58), and the prevalence was higher in infants (63.11%). There was a high contamination rate with more Gram-positive than Gram-negative blood culture results. Extended-spectrum β -lactamase-producing (ESBL) *Klebsiella pneumoniae* and *Acinetobacter baumannii* were the most common Gram-negative isolates. The two most significant risk factors for sepsis were age <1 year and HIV infection. One hundred (56.8%) patients were discharged and 76 (43.2%) patients demised. Sepsis, length of stay <2 days and herbal medicine ingestion were the three significant predictors of mortality in the PICU.

Conclusion. Sepsis prevalence was high in this setting and is associated with high mortality. Age <1 year and HIV infection are significant risk factors. ESBL *K. pneumoniae* and *A. baumannii* were commonly associated with sepsis in this cohort.

A bicarbonate-based physiologically balanced fluid in critically ill patients

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Background. Most crystalloid solutions used in critically ill patients have a greater chloride (Cl^-) concentration than plasma, which may be detrimental. Replacement with some bicarbonate (HCO_3^-) may reduce Cl^- , but may have its own side-effects.

Objectives. To determine if balanced fluid resulted in increased PaCO₂ compared with the conventional fluid group.

Methods. A single-centre, open and randomised controlled trial was conducted in an academic adult intensive care unit (ICU), comparing balanced fluid (sodium (Na⁺) = 142 mmol/L; Cl⁻ = 99 mmol/L) with conventional fluid (Na⁺ = 130 mmol/L; Cl⁻ = 110 mmol/L).

Results. A total of 46 patients were allocated to the conventional fluid group and 40 to the balanced fluid group. At baseline, the two groups were well matched ($p > 0.05$) for age, weight, gender, severity of illness and organ support. There were no significant differences in PaCO₂ between the two fluid groups, overall or at D1, D5 or D7. The balanced fluid group showed a significant improvement in estimated glomerular filtration rate, between D0 and D5 ($p = 0.02$), while the conventional fluid group exhibited a significant decline ($p = 0.00$). There were no significant differences between the 2 groups with respect to fluid requirements, number of positive blood cultures, ICU renal replacement utilisation, ICU length of stay, ICU mortality and 28-day mortality.

Conclusion. The use of a physiologically balanced fluid containing 142 mmol/L of Na⁺, 99 mmol/L of Cl⁻ and 49 mmol/L of HCO₃⁻ did not result in an increase in PaCO₂ and appears to be safe in our population of critically ill patients. There appears to be a beneficial effect on renal function.

Patients' experience of mechanical ventilation

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Background. Mechanical ventilation is a life-saving and frequently-used treatment modality in a variety of medical diagnoses in the intensive care unit (ICU). Despite this, mechanical ventilation can be a distressing experience for the patient and may result in anxiety and discomfort.

Objectives. This study explored and described the experiences of patients on mechanical ventilation in the intensive care unit of a public-sector hospital in Johannesburg.

Methods. A qualitative, descriptive and explorative design was used, and 10 mechanically ventilated patients were recruited from the ICU. The data were collected using audio-taped in-depth interviews. The data was analysed using Clarke and Braun's 2013 descriptive method.

Results. Physical experiences were described in terms of experiences of breathlessness, mouth dryness, pain and physical discomfort as a result of being placed on the ventilator. Emotional experiences were described as experiences of bothering, fear of the unknown, anxiety, feeling shocked and frightened at the moment of waking up from anaesthesia. The administration of sedation to some of the participants affected their memory in recalling events that happened while in the ICU. Lack of sufficient information, short visiting hours and family presence also impact the emotional state of the participants. Amid these unpleasant experiences, most of the participants appreciated the caring attitude of the ICU nursing staff which gave them a sense of comfort and safety.

Conclusion. Physical and emotional experiences were the major challenges faced by patients on mechanical ventilation. Most of the participants' experiences were described as unpleasant.

