Liberation from mechanical ventilation – 2018 SICS trainee audit

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Identifying the readiness of patients recovering from critical illness for liberation from IMV is not always straightforward. Whilst guideline recommendations are based on limited evidence, the use of spontaneous breathing trials (SBT) is frequently advocated [1, 2]. Through the Scottish Intensive Care Society (SICS) trainee audit 2018, we conducted a Scotland-wide study to understand current practices relating to liberation from IMV.

Methods
Data were prospectively collected on patient demographics, indication for intubation, use of SBT and type of SBT performed, physiological markers at the time of extubation, ICU outcome and ICU length of stay. All patients >18 years admitted to a Scottish ICU and ventilated with IMV for > 24hrs from the 1st November 2018 – 30th November 2018 were eligible for inclusion. Exclusion criteria included extubation for end-of-life, death whilst still intubated and patients with tracheostomy pre-ICU admission.
Logistic regression was performed to detect factors associated with extubation failure. Univariate analysis was used and those factors with a *p*-value <0.1 were input into a multivariate model. Results were analysed using Excel 2010 and Stata v.14.1 (Stata, College Station, TX, USA). Patient Benefit and Privacy Panel approval was granted (No. 1819-0052). R&D and ethics approval were not required.

Results
A total number of 172 patients were included, 108 (63%) were male with a median APACHE2 score of 19 (IQR 13-23). Extubation failure at the first attempt occurred on 27 occasions (15.7%) of which 14 (52%) were male, with median APACHE2 score of 21(IQR 16.5-23.5). The most frequent indication for intubation was post-operative intra-abdominal surgery (n=34, 19.8%). The cohort with a successful first time extubation had a median ICU length of stay of 5 days (IQR 3– 9) and for the failed extubation col SMR ian of 10 days (IQR 7 – 12). Mortality for those with first time extubation success was 1.4% compared to 22.2% mortality in the failed extubation group.
SBT was performed in 103 (60%) of all patients and most frequently consisted of a trial of CPAP only without pressure supported breaths (n=64, 62%), compared to T-piece trial (n=9, 8.7%) and pressure support 5-8cmH_2O above PEEP (n=28, 27.2%). The median time from intubation to first SBT was 2 days (IQR 1-3).
Patients who did not get a SBT prior to extubation had higher odds of extubation failure (OR 2.52, CI 1.09-5.84, *p*=0.03); patient ventilation for <3 days also had a three times higher odds of extubation failure (OR 3.31, CI 1.09-10.1, *p*=0.03). Both variables were independently associated with extubation failure on multivariate analysis.

Discussion
This audit has described a reintubation rate of 15.7% in Scottish ICUs, which is within a 'reasonable' range [1]. Trial of extubation within the first 3 days and not performing an SBT were both independently associated with failure of first time extubation. SBTs were performed in 60% of cases, and most commonly consist of CPAP only trials, which is divergent from the pressure support over PEEP methods advocated in the literature. This audit adds to our understanding of contemporary common practice within Scottish intensive care units.

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Understanding trends in standardised mortality ratios in patients admitted to RIE intensive care unit.

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The RIE ICU team noticed variation in its standardised mortality ratios (SMR) year to year. While possibly attributable to chance variation, we were interested to identify if specific sub-groups of patients and month influenced changes in SMR. We aimed to: 1. identify if RIE unit SMR varied with time of year (month/season) and for specific subgroups; and 2. identify if changes in annual SMR could be attributed to changes in SMR in subgroups.

Methods
All admissions to RIE ICU from Jan 2009 to Dec 2018 which had an APACHE II score documented on WardWatcher were included. Data collected: admission date age, surgical status, diagnosis, APACHE II score, predicted and observed mortality. Annual SMR was calculated with 95% confidence interval (CI) and years grouped by tertile into low, mid and high SMR years. SMR over time was compared in subgroups (age ≥65, surgical status, admission diagnosis, month, predicted mortality ≤25%) and between tertiles. The project obtained governance approvals.

Results
Over the 10 year study period, there were 10169 admissions fulfilling inclusion criteria. Unit SMR for the period was 0.94 (95%CI 0.90, 0.98). Unit SMR was highest in the month of December, in those aged ≥65y (1.07, 95%CI 1.01,1.14), those admitted with a diagnosis of cardiac arrest with figure showing SMRs of overall cohort and selected subgroups. We found no evidence of variation by subgroups related to annual SMR in high/mid/low tertiles. In particular, there was no evidence that years with a higher SMR could be attributed to the subgroup with the lowest predicted mortality (≤25%).

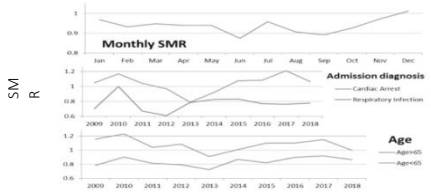

Figure 1. Variation in unit SMR by month (top), and stratified by admission diagnosis (middle) and age (bottom) over time.

Discussion
In our unit, older patients, cardiac arrests, and December admissions had higher SMRs. This was not related to changes in annual SMR. There was no evidence that annual SMR variation was attributable to those with the lowest predicted mortality. We would not recommend this as a trigger for further review until more work has been done.

Anaemia during and after Intensive Care

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Anaemia is prevalent in critically ill patients, being associated with poorer outcomes and longer length of Intensive Care Unit (ICU) stay. Management is subject of ongoing research; a restrictive transfusion practice currently favoured. There are limited reports in the literature of post-ICU management. This study aims to assess anaemia in longer stay ICU patients to identify potential impacts of patients being discharged with greater severity of anaemia, to identify current management strategies and opportunities for further research.

Methods
Patients admitted to our ICU between January 2017 and January 2019, with an ICU length of stay of seven days or greater and surviving to hospital discharge were identified via Ward Watcher. Haemoglobin (Hb) was reviewed at admission and discharge from ICU and at hospital discharge. Medicines initiated were identified via "Hepma" electronic prescribing system. Data are presented as median (interquartile range), and statistical analysis by Mann-Whitney U test.

Results
During the study period 645 patients were admitted to ICU, of whom 92 (37 females; 55 males) fulfilled the study criteria. Within the study cohort anaemia (Hb <120g/L females, <130g/L males) was present in 49 (53%) patients at ICU admission, 84 (91%) patients at ICU discharge and 76 (83%) patients at hospital discharge.
50 (54%) patients were discharged from ICU with Hb<100g/L, with median Hb of 87 (82-94) g/L compared to 42 patients discharged with Hb>100g/L, median Hb 112 (106-122) g/L. Hospital stay post ICU was 23 (13-38) days in the former (Hb<100g/L) patient cohort compared to 8 (4-23) days in the latter (Hb>100g/L) cohort (p-value =0.001). Hb at final hospital discharge was 102 (97-107) g/L compared to 116 (104-126) g/L respectively for these groups (p-value <0.001).
Within the subset of 50 patients discharged from ICU with Hb <100g/L, the low Hb was documented in only two (4%) of ICU discharge letters. 29 (58%) of the 50 patients were transfused (median 3 [2-4] units) in the ICU and 13 (26%) transfused (median 2 [1-2] units) post ICU discharge. Ten (20%) patients in this cohort were prescribed either oral iron or folate at some stage during or after ICU. The median Hb at ICU discharge for these ten patients was 89 (84-95) g/L versus 86 (81-92) g/L in the forty patients receiving no therapy (p-value =0.23). At hospital discharge median Hb was 110 (101-114) g/L in the iron or folate treatment patients versus 101 (95-104) g/L in patients not treated (p-value<0.001). No patients were prescribed intravenous iron therapy. Haematinic studies (ferritin, folate and B12 levels) were measured at some stage post-ICU discharge in nine (18%) of patients discharged from ICU with Hb <100g/L including two patients prescribed iron or folate; all results were normal.

Discussion
Similar to other reports [1] anaemia was common, prevalence increasing during ICU stay. Discharge from ICU with greater severity of anaemia was associated with increased duration of subsequent hospital stay and lower Hb at hospital discharge. Treatment of more severe anaemia with folate or oral iron was associated with higher Hb values at hospital discharge. Haematinic studies post-ICU were normal in all patients investigated and discharge documentation infrequently recorded anaemia. The study suggests potential for further research on iron (oral or intravenous) and folate treatment post-ICU and need for better documentation for discharge follow-up.

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SCARF: Supporting Community Recovery and Reducing Readmission Risk Following Critical Illness: From Research to Practice

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Survivors of critical illness can experience multidimensional disabilities including physical, psychological and cognitive decline, social challenges and reduced quality of life. Approximately 25% experience an early unplanned acute hospital readmission within 90 days after discharge home [1]. ICU survivors utilise around 50% more hospital costs than otherwise similar patients during the year after discharge. Recent research involving ICU survivors readmitted within 90 days of discharge highlighted multi-morbidity, polypharmacy, fragile social support, mobility and psychological problems prior to ICU admission increased readmission risk [2]. Post-ICU re-admission prevention programs have not been widely studied or adopted despite these high rates of readmission.

Methods
Following our previous research findings, we (i) developed an ICU holistic needs screening tool to facilitate early identification of ICU survivors most 'at risk' readmission; (ii) introduced in-hospital holistic needs assessment to identify clinical and psychosocial needs of 'at risk' ICU survivors; (iii) provided patients and carers with information on potential after-effects of critical illness prior to discharge home; (iv) developed improved and quicker communication links between ICU discharge nurses and the 'at risk' ICU survivor's GP, community pharmacist and community NHS multi-disciplinary support teams; (v) conducted telephone follow up of 'at risk' ICU survivors at 2 and 8 weeks after discharge home; (vi) conducted a quantitative evaluation of readmissions and a qualitative evaluation of patient/carer and health/social care professional experiences of the new ICU care pathway.

Results
Our newly introduced care pathway showed that a nurse-led simple screening tool (assessing multi-morbidity, polypharmacy, mobility, social support, and psychological issues) could be used to triage patients in ICU ('SCARF positive' versus 'SCARF negative'). We found (i) SCARF positive patients comprised 23% of ICU survivors admitted over 12 months (ii) SCARF positive patients had prolonged hospitalisations and a 50% unplanned hospital readmission rate within 3 months (compared with 20% for SCARF negative patients). These patients had a high prevalence of social deprivation, substance misuse and mental illness. Evaluation with patients and carers, GPs, community pharmacists, and community health-social care staff was very positive. Process control methodology suggests a downward trend in all readmissions following ICU discharge over the intervention period (around 4% absolute; 15% relative reduction).

Discussion
A targeted nurse led brief intervention to improve ICU survivors' education prior to discharge home improves their awareness of the potential after-effects of critical illness. ICU survivors and carers valued the follow up phone calls. Community partners (GPs, community pharmacists and community health and social care teams) noted the benefits of early alerts of a patient's admission to ICU and discharge from hospital. Reductions in 90 day early unplanned admissions were encouraging.

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Setting up simulation training in the Aberdeen Royal infirmary intensive care unit

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Simulation training is a staple method of teaching in many specialties and is becoming integral to intensive care medicine training. [1, 2, 3] Simulation training allows development of practical skills in a safe environment, away from patients, in addition to the development of essential "non-technical" skills. [1] The intensive care unit (ICU) at Aberdeen Royal Infirmary (ARI), previously conducted simulation training, however without a formal arrangement. As clinical teaching fellows, we aimed to organise and set-up a formal simulation training schedule and to obtain feedback from participants to inform further development and continuation of simulation training.

Methods
Participants included junior middle grade medical staff, advanced critical care practitioner trainees, and nursing staff. From previous simulation sessions, there was a pre-populated database of ICU scenarios which were used. Following each simulation, the facilitator conducted teaching on the scenario. Non-validated, five-point Likert scale questionnaires were used as pre and post-event surveys, collected from participants, and formal feedback obtained for the facilitator. A template for certificates for participants was created and a formal handover to successive teaching fellows was devised.

Results
Between April-June 2019, five sessions were conducted. There was a total of twelve participants and all facilitators were senior registrars. Scenarios covered were: accidental extubation, dislodged tracheostomy, asthma, post-operative anaphylaxis, hyperkalaemia, hypotension in pulmonary embolism, raised intracranial pressure, sepsis, tachyarrhythmia. From the surveys, three questions focused on experience and confidence pre and post simulation. The sample size was too small to conduct statistical analysis, however an increase of 16% and 8% agreed that confidence in assessing and manging acutely unwell patients and acutely unwell ICU patients, respectively, improved following simulation. 83% felt more confident with their non-technical skills. Feedback indicated a desire for more simulation training and suggestions for additional scenarios.

Discussion
The simulation training was appreciated by all participants. In addition to the training, it was also beneficial for participants to receive certificates, facilitators to receive feedback, and teaching fellows to gain experience in event organisation. Data collected was presented at the local project meeting and along with this, all documents were handed over to the succeeding fellows. It is anticipated that simulation in ARI ICU will continue and develop, and further data collected to identify any significant impact of simulation training. Difficulties encountered include need for a teaching fellow to be present on shift to ensure simulation was carried out. Additionally, if the unit was busy, simulation training was abandoned, and we were unable to reconcile a realistic way to have protected simulation time regularly.

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'NHS AACrit': a pilot app to improve the trainee experience in critical care for NHS Ayrshire & Arran.

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Smartphone use amongst medical professionals is commonplace with rates of use of up to 80% [1]. They present a means of rapid access to up-to-date guidelines and clinical decision-making tools [2]. This can be in stark contrast to hospital intranet systems, which are often slow to use and difficult to locate content. The aim of this project was to design and assess the usefulness of a smartphone application within critical care at my local institution.

Methods
A pilot app was designed using XCode and Android Studio (open-source development platforms for Apple and Android). An emphasis was placed on ease of use, and fast access to frequently needed information. The latest version includes features such as a functional hospital phone directory, team profiles, checklists, and guidelines (Figure 1). It also provides details on inter-specialty referral, organ donation, and paediatric drug dosing. Anaesthetists completed a survey on the perceived usefulness and difficulties of using such an app.

Figure 1 – Example of app checklist.

Results
Seven (37%) respondents found access to a computer was very easy, and 13 (68%) found that trying to locate intranet content was difficult or very difficult. Fourteen (82%) said that a smartphone app would be very useful, and 10 respondents (59%) said they would use it daily if available. General feedback was that security, and the ability to keep content up-to-date were important issues.

Discussion
Smartphone use is highly prevalent within the medical community and apps present a quick way to access useful information, whilst avoiding the limitations of hospital intranet systems. Some barriers to its use do exist such as upgrades to phone hardware and software, and content updates. Google Firebase has been utilised to provide authentication, database, and resource storage solutions, which addresses a number of the barriers raised during the survey. The app also has the potential to be portable to other sites. The iOS version is currently being vetted by Apple for release, and further development is required prior to release of an Android version.

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Factors affecting treatment failure of high flow nasal oxygen in patients not for escalation to invasive ventilation

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High flow nasal oxygen (HFNO) therapy has been increasingly used in critical care for the last decade and is generally well tolerated.[1] Before the introduction of HFNO, a previous audit in our centre demonstrated that the use of non-invasive respiratory support (NIV) in patients with acute hypoxaemic respiratory failure who were deemed unsuitable for escalation to invasive mechanical ventilation (MV) was rarely successful.[2] There has since been a year on year reduction in the use of NIV in this patient group.

However, HFNO is increasingly used to treat patients who would otherwise not be admitted to critical care and in whom escalation to invasive ventilation is considered inappropriate. It is unclear if factors identified at the time of assessment for HDU admission affect treatment failure.

We aimed to identify all patients admitted to HDU receiving HFNO who were not for escalation to MV and evaluate patient factors at or before the time of admission associated with mortality.

Methods

For this retrospective study, data were extracted from Wardwatcher supplemented with medical case note review. Population: all patients coded as receiving HFNO on the HDU during the period 15/5/2018-14/5/2019. Data collected and analysed included admitting diagnosis, consultant discussion before admission, and pre-admission non-respiratory organ dysfunction (defined as renal, liver, neuro SOFA≥2 and systolic BP<100mmHg). Outcome was HDU and hospital mortality. Associations with HDU mortality were reported as risk ratios (RR) with 95% confidence intervals (95%CI).

Results

160 patients over the study period were coded as receiving HFNO. Five were excluded as on review of notes there was no evidence of them receiving HFNO, and 80 were excluded as they received, or were suitable for, escalation to MV, leaving 75 patients. The mean age was 68, 53% had a pneumonia diagnosis, and mean length of stay was 3.2 days. HDU mortality was 35% (n=26) increasing to 39% (n=29) hospital mortality.

Diagnoses associated with highest mortality were ALD (80%), pancreatitis (67%) and sepsis (64%). Neither discussion of the decision to admit with a consultant nor pre-admission documentation of a non-escalation decision was significantly associated with mortality. There was a clear gradient between number of pre-HDU non-respiratory organ dysfunction and mortality (Table 1).

Number of organ dysfunction pre-admission	HDU deaths (n/total)	HDU % mortality	Risk ratio (95% CI)
0	3 / 30	10%	1 (referent)
1	8 / 24	33%	3.3 (1.0, 11.2)
2	8 / 11	73%	7.3 (2.3, 22.6)
3	1 / 1	100%	10 (3.4, 29.3)

Table 1- Number of pre-admission non-respiratory organ dysfunction and mortality.

Discussion

Patients receiving HFNO therapy in whom escalation to MV was not appropriate who also had evidence of pre-admission multi-organ dysfunction had very high mortality rates. This questions the benefit of use of HFNO as atherapy in this particular patient group.

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Implementation of a delirium tool in an ICU to improve patient outcomes by adhering to national delirium guidelines

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Delirium is experienced by up to 80% of patients in ITU [1]. The syndrome is often missed and is associated with prolonged hospital stay, increased mortality and risk for developing future cognitive impairment, including dementia [1, 2]. SIGN published a delirium guideline [3] emphasising the importance of delirium screening and non-pharmacological measures to prevent and treat the syndrome.
The aim of the project was to increase adherence to the national delirium guidelines in our ICU. We developed and implemented a delirium tool in form of a checklist, which is intended to be used daily for every patient admitted to the ICU.

Methods

A Quality Improvement (QI) expert was consulted and the project was approved by the local QI team, ensuring a robust process. Eight PDSA cycles were completed before the tool was rolled out unit wide. Throughout the process, staff feedback was actively encouraged. Data chosen to assess and monitor the success of the tool included four key aspects: CAM-ICU assessment completed; two hourly reorientation of patient; daily considerations of risk factors and causes; and good communication with patients. Audits were conducted throughout the process. To raise awareness we displayed a poster with the national delirium guidelines and reasons for implementing the tool, carried out one to one and group teaching, and hosted a delirium awareness day.

Results

The tool was successfully implemented in our ITU. Data collection showed a significant improvement in all four key areas with implementation of the tool, hence an increase in adherence to the national guidelines. This was demonstrated with the use of continuous run charts. Feedback from staff was overall positive, and especially new staff found the tool very useful.

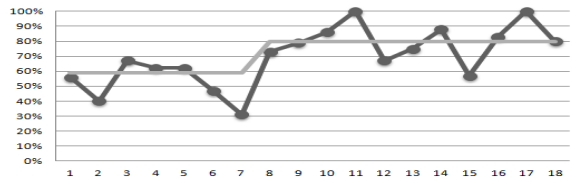

Figure 1 Run chart 'two hourly reorientation' compliance (black line). A significant increase was demonstrated and signalled a reset of the median (grey line).

Discussion

The QI approach to the project ensured a controlled roll out of the tool. By collecting feedback and analysing the PDSA cycles we were able to respond and adjust the tool accordingly and ensure staff felt involved in the process. After the initial project and a reorganisation in the delirium group turnover there is anecdotal feedback and observation suggesting problems with sustainability of the tool. For the future, recruitment of a variety of staff, further PDSA cycles and ongoing education is planned to ensure ongoing success of the tool.

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Validation of the CAHP (cardiac arrest hospital prognosis) score

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2008 data from our ICU suggested most survivors of out-of-hospital cardiac arrest (OHCA) had an initial rhythm of VF/VT [1]. Pre hospital care has transformed since 2008. The aim of this audit was compare our current outcomes with a recent Paris cohort and assess the utility of the CAHP (cardiac arrest hospital prognosis) score [2].

Methods
NHS Lothian identified this as an audit not requiring ethical approval. Patient management systems (Wardwatcher/TRAK) were used to identify patients over the period January 2018 to March 2019 and collect CAHP data [age; setting; rhythm; time from collapse to BLS (basic life support); time from BLS to ROSC (return of spontaneous circulation); initial arterial pH, Adrenaline dose, hospital outcome]. CAHP score performance against outcome was analysed using a ROC (receiver operating characteristic) curve and outcome predicted using the incorporated score (Group 1 score <150 good outcome 61%; Group 2 score 150-200 good outcome 19%; group 3 score >200 good outcome 0%) [2].

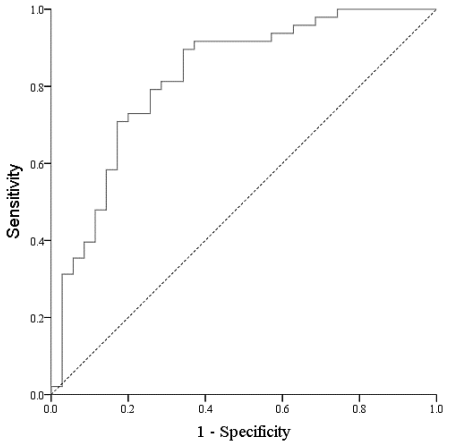

Figure: *ROC Curve. CAHP score and survival to discharge home. AUC=0.80 (area under the curve)*

Results
109 patients were admitted post OHCA with a full data set for CAHP score for 83 (76%). Survival to discharge home for the cohort was 43% (47/109). The figure shows the discriminating ability of the CAHP score. Our outcomes were similar to the Paris cohort: Group 1 68% (27/40) discharged home, Group 2 24% (7/29) and Group 3 7% (1/14). Rhythm alone was not sufficient for reliable predictions [VF/VT survival 52% (40/77) PEA/Asystole survival 22% (7/32)]

Discussion
The figure shows CAHP score is a good discriminator of outcome. CAHP can be quickly scored in the Emergency Department prior to ICU admission. This score maybe a useful 'rule in' tool for ICU admissions, facilitate communication and help prevent therapeutic nihilism. To this end we are developing a CAHP smart phone app.

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Predicting morbidity and mortality: Validation of a local CPET service for major colorectal surgery.

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Preoperative cardiopulmonary exercise testing (CPET) is used as a risk stratification tool prior to major surgery. Previous publications have considered the use of CPET results to predict length of stay and mortality in patients undergoing colorectal surgery [1]. The aim of this study was to validate our CPET results for elective colorectal patients assessing if local risk stratification predicts length of hospital stay and 90-day mortality in keeping with the current literature.

Methods
A retrospective review of CPET data collected for colorectal patients in a single district general hospital over a two year period from 01/01/2017 to 31/12/2018 was undertaken. Patients were classified as high risk if they had an oxygen consumption (VO_2) at anaerobic threshold (AT) <11mls/min/kg and/or a peak VO_2 of <14mls/min/kg, intermediate risk if VO_2 at AT between 11 and 14mls/min/kg and/or a peak VO_2 14 - 18mls/min/kg, and low risk if VO_2 at AT >14mls/min/kg and a peak VO_2 >18mls/min/kg. A Kruskal Wallis test was used to test the association between risk groups and length of hospital stay. Mortality at 30 and 90 days from the date of surgery was reported.

Results
Thirty-five patients were reviewed. The median [IQR] age was 72 [61-77.5] and 24 (69%) were male. Ten, 17 and 5 cases were categorised as high, intermediate and low risk respectively and had a median [IQR] length of stay of 10 [6-16], 7.5 [6-11] and 5.5 [4-7] days (p=0.1, see figure 1). Two patients [5.7%] both categorised as high risk were dead at 90 days. There was no mortality at 30 days.

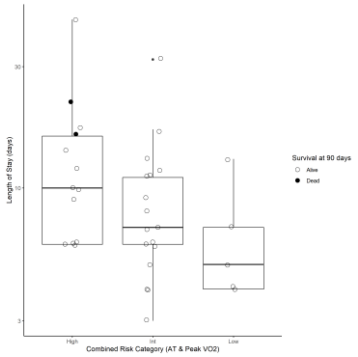

Figure 1. Boxplot and jitterplot of post-operative length of stay and 90-day mortality by CPET risk category.

Discussion
These results suggest that our pre-operative CPET risk categories correlate with increased length of stay, a surrogate marker for post-operative morbidity, and the deaths following surgery were both high risk. Although not statistically significant, likely due to a small sample size, it suggests our local results are consistent with other centres results. We aim to extend our analysis to include prospective data and other types of surgery. Ideally, a prospective national database of pre-operative CPET results and patient outcomes would allow for a better evaluation of CPET testing across Scotland.

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An audit in the management and follow-up assessment of patients who are receiving RRT therapy in ICU in order to determine an appropriate end-point to withdraw therapy

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There is currently significant ongoing research and evidence in when to start renal replacement therapy (RRT). Conversely, there is little evidence for when to cease RRT. We inspected the monitoring of creatinine and urine output of patients and looked at their correlation with when patients had their RRT withdrawn. The aim of this was to establish appropriate parameters to confidently withdraw RRT. This also provides an opportunity to assess how successful we have been at recording these values. This audit aims to look at what point RRT is withdrawn in ICU patients in relation to their renal function and consequently, assess the follow-up inspection of renal function following discharge from ICU.

Methods
At the time this study was conducted there were 513 patients identified who had received RRT since the Unit opened in 2015; and who had a period of 6-months post-discharge to allow for follow-up assessment. Patients discharged to the renal unit or mortuary were excluded – leaving 425 patients initially being included in the audit. Patient data was collected using 3 separate software systems: WardWatcher, our electronic patient case record system (IntelliSpace Critical Care & Anaesthesia (ICCA) and TrakCare. The data was then anonymised and collated using Microsoft Excel. Caldicott guardianship was approved for the data collected.

Results
152 of these patients were discharged to the mortuary (35.8% mortality rate). There were a further 94 (22.1%) patients discharged to the renal unit. Thus leaving 179 patients being included in the audit. For all of the patients, the mean number of days spent in hospital was 44.27 days. The average length of stay in the group who were not restarted on RRT (Group A), was 41.29 days. Conversely, for those restarted on RRT (Group B); it was 55.97 days. The average number of days that all 179 patients spent on RRT was 5.59 days; this is 4.23 days in patients whose treatment had been restarted. In all patients, the mean creatinine value was 212.84 at the point where treatment was withdrawn. In Group A, this value was 207.31 vs 225.84 in Group B. *Figure 1* outlines the relationship between urine output at discontinuation of RRT and recommencement of therapy.

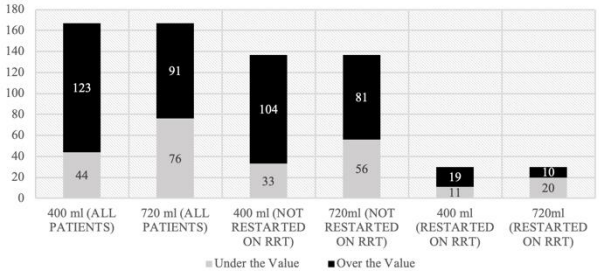

Figure 1 – 24hr urine output at first discontinuation of RRT

32 patients were restarted on RRT during their stay; 147 remaining off whenever they were initially taken off. 7 of the 32 restarted patients were restarted more than once. Assessing the readiness of patients to be stepped-down from RRT was achieved by looking at creatinine and urine output levels at first discontinuation. 44 patients were producing less than 400ml, therefore not ready to be stepped-down. There were also 139 patients who had a creatinine value over 100, also showing that they were not ready to be stepped down.

Discussion
84.4% of patients whose urine output was above 400ml were not restarted; compared to 88.3% of patients whose urine output was above 720ml who were not restarted. This would tend to suggest that 720ml per day is a more useful parameter to signify return to native renal function.

An audit to determine the impact on continuous renal replacement therapy (RRT) filter lifecycle following a change in dosing protocol

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A baseline audit of our RRT dosing using citrate-based anticoagulation in our intensive care unit (ICU) identified consistently higher dosing than recommended. In an attempt to reduce our dosing in June 2018 we introduced a new dosing guideline with two fixed dose options (a standard effluent dose of 25 ml/kg/hr and a higher dose of 35 ml/kg/hr for rescue) rather than being at the discretion of the prescribing physician. Following the guideline introduction our RRT dosing was successfully reduced with more receiving the recommended dose however there was concern that the reduced dosing has had a deleterious impact on filter set life. The aim of this audit was to determine the impact of our RRT dosing guideline on filter set lifespan.

Methods
The guideline was introduced in June 2018 so we identified 50 consecutive patients before (Group A) and after (Group B) the guidelines introduction. From our electronic patient case record system (IntelliSpace Critical Care & Anaesthesia (ICCA)) and WardWatcher database we collected the following data: patient age, gender, APACHE II score, the lifespan of each filter set for each patient and the reason each filter was replaced. The data was anonymised and collated in Microsoft Excel. Statistical analysis was performed using Minitab.

Results
Group A and Group B both included 50 patients. The mean age of Group A was 60.5y and Group B was 61.8y, $p = 0.65$. Group A were 62%/38% male/female and Group B 56%/44% male/female, $p = 0.55$. Group A had a mean APACHE II score of 27.0 and Group B had a mean score of 28.5, $p = 0.31$. The total recorded number of hours of RRT in both groups was 8,872 hours. There were 169 filter sets used in Group A and 89 filter sets used in Group B. The mean filter set life for Group A was 33.6 hours and 35.8 hours for Group B, $p = 0.49$. Only 16% of filters reached their expected lifespan in total. In terms of the reasons for the filters not reaching their maximum set life: 23 (13.6%) filters from Group A had no information regarding their withdrawal, 73 (43.2%) were withdrawn due to patient factors and 73 (43.2%) due to filter factors. Comparatively, in Group B, 20 (22.4%) filters were withdrawn for unstated reasons, 25 (28.1%) were withdrawn due to filter factors and 44 (49.5%) were withdrawn due to patient factors. In Group A 47 (28%) filters clotted, in Group B 15 (17%) clotted. Analysing the filters that were replaced due to filter factors revealed that their mean lifespan in Group A and B was 24.12h vs 31.96, $p = 0.113$.

Discussion
Our audit found that there was no statistically significant difference in filter set life following the introduction of the RRT dosing guideline. Furthermore, there was no statistical difference found between the demographics of the groups, suggesting that a similar cohort of patients were being analysed. The filter set life was actually numerically higher following the guideline introduction. Where the filter sets where changed prior to their maximum life, filter related reasons and specifically filter set clotting were less frequently the reason after the guidelines introduction.

We conclude from this audit that the introduction of the guideline has not had a detrimental impact on filter set life and benefits both patients and the unit from the improved compliance with recommended RRT dosing. We recognise that our filter set life could be improved and this is the focus of a quality improvement project focusing on optimising our RRT practice.

Post intensive care syndrome and the InS:PIRE experience in a specialist cardiothoracic unit

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Post intensive care syndrome (PICS) is well recognised following general ICU care [1]. Intensive Care Syndrome: Promoting Independence and Return to Employment (InS:PIRE) is a multidisciplinary complex intervention designed to address PICS [2]. With a paucity of evidence on PICS after cardiothoracic intensive care, this quality improvement project aims to evaluate PICS and the feasibility of the InS:PIRE intervention in this population.

Methods
InS:PIRE at the Golden Jubilee National Hospital was developed as a 5 week intervention with every patient receiving one to one contact from physiotherapy, nurse, doctor and pharmacist. A café area facilitated peer support. Caregivers and family were encouraged to attend. Psychology input was provided as group sessions, with individual input offered if required. A sixth week comprised a debrief allowing iterations for the following cohort. Primary outcome was quality of life measured by the EQ-5D-5L. Secondary measures included: pain, mental health and self-efficacy. Surveys at baseline, 3 and 12 months were analysed to describe health related quality of life. As a service development, ethical approval was not required.

Results
Over five cohorts, 27 patients attended the clinic, 18 patients were male (67%), median age 66 years (IQR 61–75) with median APACHE 2 score of 17 (IQR 14-18.5), and median ICU length of stay was 13 days (IQR 9-21). A total of 14 (53%) patients completed surveys at one year. Most admissions (56%) were represented by scheduled or elective cardiac procedures. The remainder were emergency admissions. Quality of life, as measured by the EuroQol EQ-VAS, demonstrated a mean score of 70/100 (SD +/- 18) with moderate or greater impairments seen by: 13 patients (48%) for mobility; 7 patients (26%) for self-care; 13 patients (48%) for usual activities; 11 patients (41%) for pain; and 11 (41%) for anxiety / depression. EQ-VAS quality of life improved to 78/100 (SD +/-16) by 1 year, however, there were ongoing issues with mobility (28%) and pain (21%). HADS demonstrated an anxiety rate of 44% and depression 30%. Brief pain inventory identified 14 patients (52%) with ongoing chronic pain. Mean self-efficacy was 32 (SD +/-6) at baseline with a minimal change by 12 months, 34 (SD +/-5).

Discussion
These results suggest that cardiothoracic intensive care patients have ongoing and persistent features of PICS. The effects on health-related quality of life are significant. This project also confirms the feasibility of delivering the InS:PIRE multi-professional complex intervention for patients and caregivers within this specialist group. Further work and analyses are required to evaluate the efficacy and mechanisms behind improving quality of life after cardiothoracic intensive care.

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Respiratory simulation training for physiotherapy staff at ARI.

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All physiotherapists are trained in managing patients with respiratory conditions however they may have limited exposure to critically ill patients. This causes a degree of anxiety amongst staff for covering on-call and weekend work, as this is when most are likely to be in contact with this patient group. Simulation based training, as recommended by the Department of Health [1] has shown to be an effective and safe form of teaching with regards to clinical reasoning and on-call competency [2]. As a result a training session was set up by senior physiotherapists using SIMman sessions within work time at the Suttie Centre. The aims of the project were:-

- To allow staff to take part in a scenario based assessment and treatment of a critically ill patient using SIMman to replicate a realistic on call or weekend treatment scenario.
- To allow staff to explore clinical reasoning and carry out treatments in a safe, group environment with expert support.
- To allow reflection and debrief sessions after the event.

Methods
A realistic case study was written by senior physiotherapists. Staff were invited to attend and divided into groups with a range of bandings. Each group was allocated 30 minutes to assess and treat the patient after patient information was given by phone call to simulate being on call.
Sessions were remotely facilitated by a senior physiotherapist with prompting and guidance given verbally as required.
Post treatment debriefs were carried out within the groups in an informal manner.
All staff were asked to complete a reflective feedback questionnaire.

Results
24 physiotherapists took part in the training including RGU students that were within ARI on placement.
All 24 found the SIMman sessions to be highly beneficial with all also stating they enjoyed the experience.
75% of participants were nervous prior to the session.
All reported at least one learning point on the management of a critically ill adult with a tracheostomy.
75% of participants reported feeling more confident for future on call or weekend work.

Discussion
Senior respiratory physiotherapy staff are now going to conduct a scoping exercise to determine future training needs of staff. From the feedback it is clear that simulation training is a beneficial and enjoyable teaching method. We plan to run further simulation training on other topics such as non-invasive ventilation and any other area identified by the scoping exercise. Formation of a SBAR (Situation, Background, Assessment, Recommendations) protocol for use during a phone call to help with information gathering and recommendations and advice to optimise the physiotherapy treatment will also be developed.

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Post intensive care syndrome: Assessing foundation doctors' education and awareness of the burdens of an ICU admission.

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Post Intensive Care Syndrome (PICS) describes the cognitive, psychological and physical consequences arising after critical illness.[1] In 2018, there were more than 45,000 admissions to critical care across Scotland.[2] With more than 20% of ICU patients suffering psychological sequelae and many gaining new functional disabilities or cognitive impairment,[3] this amounts to significant additional morbidity. We sought to identify the extent of foundation doctors' critical care education and awareness of PICS. From this we aimed to identify ways in which we can improve global medical awareness of the burdens of an ICU admission.

Methods
A ten question survey was sent out electronically to 186 foundation doctors in the East of Scotland. In addition to baseline demographics, we asked about prior critical care education, clinical encounters with patients discharged from ICU, confidence in identifying the post-ICU patient as well as their existing awareness and knowledge of PICS. A reminder email was sent after ten days.

Results
Fifty-eight responses (31.2%) were received of which 47 (81%) had completed their undergraduate degree in Scotland. Fourteen (24.1%) and 51 (87.9%) respondents did not receive any critical care undergraduate or postgraduate education respectively. The cohort of foundation doctors surveyed had regular contact with the post-ICU patient, with 45 (77.6%) respondents caring for more than four patients discharged from ICU over the past year and an additional eight (13.8%) stating they have looked after at least one patient discharged from ICU over the same period. Thirty (51.7%) were not confident in identifying patients discharged from ICU. The main barriers highlighted in identifying such patients are inadequate medical handovers and poor filing of patient's notes. Twenty-seven (46.6%) have heard of PICS but rate their knowledge as minimal. No respondents had any formal teaching on PICS.

Discussion
The data demonstrates that the significant impact and consequences of critical illness on patients have not been conveyed well despite a majority receiving undergraduate education in critical care. With the regular frequency at which foundation doctors are involved in the care of patients discharged from ICU, it is essential that we take steps to improve their ability to identify these patients. We aim to raise awareness of the structured handover and problem list that follows ICU patients and will trial the introduction of a downstream information leaflet. In addition, we have identified areas within the undergraduate critical care teaching programme where targeted teaching about PICS can occur. Beyond that, we need to fill in the gaps in postgraduate education of PICS, driving home the significant burden that patients may face following their discharge from ICU. After all, these foundation doctors are our future senior medical professionals who will be dealing with the fall out of critical care stays in the years to come.

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ICU Staff movement- Finding a safer way to practice in the wards using Improvement Methodology

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Through the introduction of a Value Management Approach in ICU we identified staff movement to ward areas to fill staffing gaps was becoming an in increasingly negative experience for ICU staff. This was predominately due to the lack of structure and uncertainty around safe practices when ICU nurses were deployed. This Quality Improvement (QI) project aims to improve nurse experience and wellbeing through the utilisation of a standard operating procedure (SOP) to ensure both nurse and patient safety.

Methods
Using Improvement methodology/Model for Improvement we devised a driver diagram defining our improvement plans:
Phase 1 - Baseline data gathered through ICU staff questionnaires
Phase 2 – Engagement with ward staff/management
Phase 3 – Development and roll-out of SOP
The following measures have been identified:
Outcome - % staff who report a good experience when moved to the ward.
Process- % of ward staff who report compliance with SOP criteria.
Balancing- % sickness and absence/staff retention

Results
Baseline data to date has revealed identified areas of unsafe practice that staff were asked to undertake while working in the wards:
88% of nurses had been asked to take responsibility for a caseload in a specialty they had never worked in before.
76% of nurses felt they had been asked to carry out a duty out with their scope of competence.
79% of nurses reported that they do not always receive a nursing handover when arriving on the ward.
74% of nurses had experienced disrespect or conflict when moved from the host ward.
14% of nurse reported a good experience when moved to the ward.

Discussion
This appears to be a well documented issue nationally for many ICU nurses however as of yet no real solution has been found (Critical Care Networks-National Nurse Leads, 2017).
Although still in its infancy this QI project will address the anxiety, uncertainty and safety issues that ICU nurses encounter when deployed to fill staffing gaps in ward areas that they have never worked in before. The development of a SOP will be an effective framework and tool for ensuring safe practice and improving wellbeing amongst many ICU nurses.

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Outcomes following Out of Hospital Cardiac Arrest

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The Golden Jubilee National Hospital is home to the West of Scotland Optimal Reperfusion Service and receives on average 40 out of hospital cardiac arrests per year. Intensive care admits all unconscious patients post out of hospital cardiac arrest (OOHCA) with outcomes varying significantly. Up until recently there had been no system to predict outcomes in the unconscious post OOHCA patient. However, following Martinell et al 2017 study the unit adopted the Target temperature management (TTM) risk scoring system. Patients TTM score was recorded on admission and outcomes documented on ICU discharge.

Methods
An ongoing prospective audit. All unconscious patients post OOHCA are admitted to ICU and are scored via the TTM scoring system. Outcomes are recorded at ICU discharge (survivor/non-survivor). The survivors are then followed up at 6 months where cerebral performance category (CPC) is scored via hospital electronic records.

Results
40 pts who were admitted to ITU following OOHCA over the course of a year. Median age was 58. 35 patients (87%) survived to ICU discharge. Of the 35 patients 57% had a CPC score 1-2 (independent to mildly disabled) and 43% had CPC score of 3-5* (Disabled, dependent on carers)

The audit found that patients with a TTM score < 8 was indicative of survival and a favourable CPC, where as a TTM score >13 indicated a poorer outcome with a CPC >2.

*score of 5 certified brain dead

Discussion
Whilst using the TTM risk scoring system has given us an insight into prognosis and overall outcome, it may be beneficial to look at the cause of arrest i.e STEMI/NSTEMI/Primary Arrythmia.

We recognise that there is a degree of patient selection before admission which may affect results (younger patients, predominantly VF/VT arrest and centre)

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Inter-rater agreement in chest x-ray interpretation and recommendation for ultrasound imaging of patients with pneumonia and effusions in the ICU

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The incidence of parapneumonic effusion or empyema in critically ill patients with effusions has previously been reported between 11% and 45% [1]. BTS Management of pleural infection guidance 2010 suggests a chest x-ray as an initial screening tool when suspecting pleural infection. It states ultrasound is more sensitive at detecting and localising pleural fluid and thus aids diagnosis of the pleural infection. Despite this it isn't always performed. As part of a review of diagnosis and assessment of parapneumonic effusions in the ICU [2], we assessed inter-rater agreement in interpretation of chest x-rays and recommendation for ultrasound imaging in patients with possible parapneumonic effusion in the ICU setting.

Methods
The Electronic Patient Record (EPR) was interrogated to identify patients admitted between 01/01/2017-01/07/2017 with a listed diagnosis of "pneumonia". Review of formal radiology reports for these patients identified those commenting on presence of pleural effusions and included these images for assessment.
Twenty-four chest x-rays were independently reported by two senior respiratory registrars (ST6 & ST7) using a simple questionnaire: effusion left/right, size of effusion, loculation, consolidation, should thoracic ultrasound be performed +\- thoracentesis. Reviewers were blinded to the formal reports. Case records were then reviewed identifying those who has a primary diagnosis of pneumonia. Data analysed with Cohen's Kappa and agreement functions in RStudio.

Results

Finding	Kappa All n=24	Agreement (%) All n=24	Kappa Pneumonia n=16	Agreement (%) Pneumonia n=16
Effusion L	0.33	68.00	0.5	75.00
Effusion R	0.75	88.00	0.76	87.5
Size L	0.01	31.58	0.3	46.15
Size R	0.18	53.33	0.11	44.44
Loculation L	0.08	45.83	0.23	50.00
Loculation R	-0.16	37.50	0.00	44.44
Consolidation L	0.38	72.00	0.33	68.75
Consolidation R	0.18	64.00	0.48	81.25
U/S for Tap	0.44	76.00	0.45	81.25

Kappa Interpretation: 0.81-1 = Almost Perfect, 0.61-0.8 = Substantial, 0.41-0.6 = Moderate, 0.21-0.4 = Slight, 0 = Chance, <0 =No agreement
Fig.1 – Inter-rater agreement (represented as Cohen's Kappa and percent agreement) in interpretation of all x-rays and those x-rays where the primary problem was pneumonia.

Discussion and Conclusion
The many confounding factors in the interpretation of chest x-rays in critically ill patients (projection, devices, etc) have likely resulted in the lower inter-rater agreement. Our results are limited by the size of the data set and number of assessors.
The agreement between reviewers regarding ultrasound assessment was moderate (κ=0.44 & κ=0.45). Given this variability in performance in an experienced group we recommend that point of care ultrasound of thorax should be used as standard when assessing parapneumonic effusions in critical care setting.

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Ionised calcium vs filter life – does the level affect the lifespan?

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Renal replacement therapy (RRT) is a vital treatment option for critically ill patients in intensive care. KDIGO recommends use of Citrate for Continuous RRT unless contra-indicated [1]. In our Intensive Care Unit at Queen Elizabeth University Hospital (QEUH) previous audit work has shown increased filter lifespan with use of Citrate anticoagulation versus Heparin. Calcium compensation is required with Citrate anticoagulation, and this has a high cost per day of Continuous RRT.

We wanted to establish if there was a correlation between filter lifespan and ionised calcium levels, to ascertain whether a reduced citrate dose could be used without compromising filter set life. This would potentially lead to cost savings by reducing the amount of Calcium replacement required.

Method
A retrospective audit of electronic patient records for patients on Continuous RRT in our ICU unit between June and December 2017. 18 patients were identified.

Result
A total of 37 filter sets were used, and the lifespan in hours was recorded (mean = 34.5, median 36). A total of 222 filter ionised calcium results were recorded (mean = 0.35, median = 0.33). The mean filter ionised calcium for each set was calculated and compared to the set life in hours. The correlation co-efficient for mean ionised calcium and set life was -0.0045.

Discussion
We demonstrated no clear correlation between filter set life and filter ionised calcium in this group of patients. As such it may be reasonable to trial a reduced citrate dose (currently start at 3mmol/L) to establish whether a cost saving can be made without compromising filter set life. A recently published single centre trial [2] showed that when a starting dose of 2.5 mmol/L citrate was used there no difference in filter life and some reduction in hypocalcaemia compared with starting dose of 3mmol/L.

Acknowledgements
Previous audit work by Drs Bannerman, K, Appleton, R, Black, E comparing Citrate and Heparin anticoagulation in our unit.

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"Interactive and fun": Utilising Creative Games to enhance learning in Undergraduate Critical Care Education

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The ability to manage acutely unwell patients and prioritise appropriately are key skills for junior doctors. Attachments to critical care can provide a wealth of experience in these areas, however, students can find this a challenging learning environment(1), and often lack confidence in these skills (2). Games in clinical education have been shown to provide learners with the opportunity for active experimentation in a less stressful learning environment, and as such can promote a better understanding of challenging concepts(3).
We designed and delivered a critical care teaching programme incorporating two educational games. The first aimed to engage learners in integrating the basic and clinical sciences to promote a better understanding of key concepts in managing unwell patients. The second aimed to help students develop their prioritisation skills..

Methods
An intravenous cannula game was designed to provide a visual demonstration of the relationship between diameter and flow rate. Students selected their "access of choice" to deliver a rapid fluid bolus and were challenged to a race to empty fifty millilitres of water into a bucket. A dynamic decision-making game was developed incorporating common scenarios junior doctors are likely to face. Teams were supplied with a list of tasks and had to prioritise these, with the addition of further tasks as the game progressed.

Students were asked for feedback regarding these learning opportunities.

Results
93 students attended, finding the game components "interactive and fun". The intravenous cannula game was felt to be a useful visual demonstration of a clinically relevant point, with students surprised at relative flow rates of intravenous access options. The dynamic decision-making game was felt to be relevant, and physically rearranging tasks in order aided visualisation of their relative importance.

Discussion
Games in undergraduate critical care education can add an "interactive and fun" element, whilst providing meaningful learning opportunities.

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Making the "Critical" difference in Undergraduate Education

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Intensive Care Medicine is a diverse, fast-paced speciality which on a daily basis utilises the generic skills of assessment, stabilisation and management of critically unwell patients. The Royal College of Anaesthetists and Faculty of Intensive Care Medicine recently jointly published a framework for undergraduate education, which is mapped to the General Medical Council's outcomes for graduates document. In response to this document, we designed and delivered a novel, multi-faceted near-peer teaching programme. We hypothesised that this would improve confidence and provide structured learning opportunities for students regarding critically ill patients.

Methods

Students attending the evening were asked to complete a pre-intervention evaluation form, which provided feedback based on their 5-day critical care attachment. This took the form of a semi-structured questionnaire with Likert scaling of attitudes towards learning objectives, learning opportunities, teaching structure, confidence in managing an unwell patient, and career aspirations.

Following this, students attended a near-peer (Anaesthetic/ Intensive Care Registrar) led teaching session which incorporated the following sessions : -

- Three simulation sessions
- A dynamic prioritisation game
- Small group teaching on pain and fluids
- Clinical skills teaching covering airway management and resuscitation
- A facilitated wellbeing session emphasising the importance of reflective practice

Following attendance at the session, students completed a post-intervention evaluation, which followed the same format as the pre-evaluation questionnaire.

Results

Between November 2018 - Jan 2019, 93 final year undergraduate students attended the teaching programme. The student: faculty ratio was 4:1.Feedback was overwhelmingly positive. Statistical analysis of the pre-and post-evaluation data showed a statistically significant improvement in median paired scores throughout all aspects of the Likert questionnaire ($p < 0.001$ for each stem). Qualitative feedback reflected that students appreciated the small student: teacher ratio found that neer peer tutors facilitated a relaxed and encouraging learning environment and that all sessions were relevant to their future practice as junior doctors.

Discussion

Introduction of a multi-faceted near peer led teaching programme led to an improvement in perceived achievement of learning objectives, increased learning opportunities and increased confidence in recognition and management of acutely unwell patients. Intensivists are in the unique position of caring for these patients day-to-day, and by teaching and imparting skills and attitudes, they can reinforce a strong foundation of good clinical care into undergraduates which can then be applied in a broad base of clinical specialities.

Development of a post critical illness recovery book for patients and relatives.

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The intensive care follow up clinic has been running in NHS Tayside for over ten years. During this time a wealth of knowledge regarding the impact upon patients and their families both during illness and the subsequent recovery period has been amassed.

In early 2018 patients and families were surveyed to identify 'what matters most during your recovery'. This revealed that whilst there are excellent ICU resources available, there were areas that our patients and families felt were inadequately addressed. We sought to build upon our local experience and address these issues by writing a recovery booklet for ICU patients and their families.

Methods

Following the initial survey, focus groups allowed key themes to be identified. These highlighted the physical and psychological sequelae of critical illness and lack of specific information about the natural recovery process and strategies to help themselves. There was also a lack of information directed at family members.

Research into booklet design was undertaken allowing us to focus on design, readability and content. Collaboration with a medical illustrator ensured the booklet was graphically pleasing and easy to read. Appropriate specialist advice was sought where required.

Multiple iterations of the booklet were reviewed by former ICU patients, medical and nursing staff before a final print run.

Results

Quantitative and qualitative assessment of the booklet was undertaken. The Baker Able Leaflet Design (BALD)[1] criterion is an internationally renowned tool that aids leaflet design. The maximum score is 31. Our booklet scored 25 reflecting good layout and design. The Flesch reading ease (FRE)[2] score assesses readability with a score above 60 demonstrating a standard readability. Our booklet scored 61.8. This score reflects some of the complexity of medical language which was difficult to alter despite our attempts to keep terminology as simple as possible.

Qualitative feedback from patients and families highlighted many positive features of the booklet including the use of graphics, quotes and self help tips.

Discussion

The booklet was not designed to replace the excellent resources that are already available through ICU Steps or the Critical care Recovery website, rather it was designed to compliment them. The readability, design and content of our booklet have all been commended and the patient feedback has been overwhelmingly positive. Strong points have been the addition of a Tayside specific contact/resource page and details of where to get help. We are in the process of collecting patient and family feedback on the booklet to identify areas for further improvement. We would encourage other ICU's to consider developing a resource specific to their patient population.

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Can improving satisfaction improve patient care and outcomes in our medical high dependency unit?

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The Scottish Intensive Care Society Audit Group (SICSAG) sets out two entities: minimum standards, targets expected of all level two and three units, and quality indicators, desirable targets that critical care areas should aim for to provide the best care. Recently these standards have been extended to all critical care units in Scotland and SIGSAG data highlighted a discrepancy in care between the intensive care units (ICU) and high dependency units (HDU). Our MHDU did not meet the quality indicator 'units should undertake regular patient/family experience surveys' [1]. Studies have shown increased satisfaction is associated with improved patient outcomes such as decreased length of ICU stay and perceived better end of life care [2]. The aim of this quality improvement (QI) project was to implement a satisfaction survey and use the data to develop interventions to enhance patient care.

Methods
A questionnaire to measure satisfaction was developed using a combination of the findings from the FREE study and FS-ICU questionnaire [2, 3]. These questionnaires explored satisfaction in: symptom management, family support, communication, involvement in decision making and end of life care. This survey was designed to evaluate all of the FS-ICU domains and underwent multiple revisions using the Plan-Do-Study-Act (PDSA) cycle. After an independent colleague reviewed the survey and a pilot survey was done with a small group of MHDU patients further changes were made and the final MHDU satisfaction survey was disseminated.

Results
During the pilot survey seven surveys were issued and four were completed (57.1%), half of respondents were patients. The reason for this relatively low response rate was not investigated but is an area that should be looked at in the future. The survey assessed three symptoms; breathlessness, pain and restlessness. From the responses 75% rated pain and breathlessness management as excellent. Restlessness was the symptom that was least well managed however 100% of respondents reported treatment was either good or very good. Although the number of respondents was small it was very reassuring that symptom control was so good. The initial results also ranked communication as excellent by 75% of respondents. Responses for inclusion in decision making were positive with 50% rating this as excellent. The atmosphere in MHDU was ranked as good by 50%. No respondents completed the section on end of life care. Data collection is ongoing with the most up to date survey.

Discussion
This QI project has introduced a questionnaire to evaluate patient experience in MHDU. This means our unit is fulfilling this SICSAG quality indicator. Furthermore the work has prompted further QI projects to improve patient care. From the initial feedback a project investigating the management of restlessness has been started. It is hoped from further responses additional areas of improvement can be identified to positively impact patient treatment and improve outcomes.

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Airway Management in the Emergency Department: Introducing Nasal High Flow Oxygen for Emergency Intubations

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Emergency department (ED) intubations are associated with a higher rate of difficult and failed intubations versus elective intubations [1,2]. Patients may have an anatomically difficult airways and almost all critically ill patients have 'physiologically difficult airways,' an imbalance between oxygen delivery and consumption leading to rapid desaturation. Subsequent hypoxia can cause arrhythmias, haemodynamic instability and death. Recent research indicates that preoxygenation via nasal high flow oxygen (NHFO2) is effective at reducing desaturation by prolonging the apnoeic window [3,4]. The aim of this quality improvement project was to investigate NHFO2 use, identify barriers to its use, redesign the RSI checklist and provide training so NHFO2 becomes an integral part of emergency intubations.

Methods
The use of NHFO2 oxygenation in RSIs was discussed at a combined ICU & ED meeting to understand current use. The ED RSI checklist was then revised to include NHF02 during preoxygenation and the recently modified difficult airway society (DAS) guidelines. To consolidate NHFO2 use in RSI, teaching for the nursing staff and junior doctors was arranged. This took the form of small group practical tutorials. A survey was distributed before and after teaching to ascertain knowledge of NHFO2 before and after sessions. To consolidate the use of NHFO2 joint ED and ICU simulation sessions have been set up.

Results
Baseline data prior to editing the RSI checklist revealed no anaesthetic registrar had used NHF02 during emergency intubations in the ED. The two main barriers to its use were lack of knowledge on machine setup and clinicians being unaware NHFO2 was available. Twenty two completed feedback forms were returned from the 28 nurses and doctors that attended teaching. From the feedback 86% reported very good knowledge of NHF02 indications vs. 100% having excellent after teaching. Knowledge of NHF02 setup and adjustment was variable with 27% having poor understanding but 91% ranked it good after teaching.

Discussion
This project identified NHFO2 was not being used during emergency intubations. The barriers of NHFO2 use were targeted by improving the RSI checklist, conducting small group teaching and consolidating learning with the planned simulation sessions. By considering the concept of the 'physiological difficult airway' we established an intervention to reduce complications related to hypoxia during RSI [3,4] and hope these changes decreased incidences of RSI desaturation.

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Improving General Practice awareness of the impact of ICU admission on patient health: adding read code #8H1..

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In 2018 there were over 45,000 admissions to Scottish critical care units[1]. Survivors of critical illness are known to be at increased risk of mortality over the months and years following ICU discharge with many experiencing a wide spectrum of enduring complex physical and psychological morbidities.
The ongoing care of these patients falls to the primary care team. With over 24% of ICU survivors at risk of early unplanned readmission[2] timely and accurate communication with primary care is vitally important. We were made aware that many of our patients' ICU admissions were not being added to their medical history despite an ICU generated discharge letter. We sought to quantify this and address the issue by providing the SCIMP read code for ICU admission (#8H1..).

Methods
All patients discharged alive from our unit between 01/07/18 and 31/12/18 were identified from the WardWatcher™ database. Clinical portal was accessed to establish 1) any documented reference to ICU admission in the clinical communications from the final discharging specialty and 2) if the ICU admission had been added to the patient's medical history.

Results
Over the six month period, 167 of 197 (85%) patients were discharged alive from ICU, 155 (79%) were still alive at the time of review and are included in the analysis. 123/155 (80%) had reference to their ICU admission in clinical communications (mostly initial discharge letters, some ICU follow up clinic letters). Access to each individual's coded medical history was possible in 122 (79%) of patients, with only 4 (3%) having their ICU admission coded and immediately evident to future healthcare providers.

Discussion
From our results, it is evident that communication with primary care fails to highlight the need to code an ICU admission which is a major life event. We postulate that within primary care there is a complete lack of awareness of the significant morbidity associated with critical illness hence the lack of coding. We sought to improve this by modifying our WardWatcher™ discharge letter, specifically asking GP's to "Please code ICU admission: #8H1..". To ensure 'buy in' from primary care this was discussed with the Local Medical Committee and an email explaining the rationale for coding an ICU admission was sent to all Tayside GP's. Feedback to date has been positive and we will repeat our audit in twelve months to assess the impact of our intervention. We would encourage other Scottish units to implore the primary care community to add an ICU admission to their patient's medical history.

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Making a memory

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A young family bereavement within our intensive care unit caused us to look at a service we could provide for bereaved families and identified that this was an area for improvement.

Methods
The organ donation service (ODS) would routinely, as part of the structure to support the grieving process, offer handprints and locks of hair to those families who wished to have these items. Our Intensive Care Unit (ICU) would also provide these keepsakes to bereaved families, but the practice was not routine. We also wanted to provide bespoke keepsakes to families in a box which personal memories could be added by the families over time. However, we did not have any specific place to readily store these items.

We wished to establish a system that allowed us to tailor what items we could include and the boxes in which they would be placed, to each family situation. We envisaged this as a box which could initially hold items such as locks of hair and handprints which were given to the family at unit level. Crucially, the family would then have a box within which they could place further items and memories once at home.

We did lots of research into the boxes and found these types of boxes were generally given to bereaved parents of young children, or made with the family to give at the end of a palliative illness. There appeared to be no other adult ICU doing this.

Results
We sourced a memory box from a children's charity. This provided us with a base from which we could gauge reaction.

These boxes, however, were designed for baby or child loss. These boxes were useful particularly when there were young children within the surviving family; the contents were not always appropriate within the wider context of adult ICU.

With further research and guidance, we developed an adult memory box which staff and family were able to choose what they wanted to add to the box.

No data or figures are collated as this project is difficult to audit. Other than the encouraging feedback and staff questionnaires we have no real figures to show this project is effective. However, feedback from families and HCPs since launching this memory box has been excellent and encouraging. We estimate we have given out over 20 boxes in the past year since they were introduced. We have received cards and letters from families detailing how they have treasured their memory boxes and that they have added various personal and bespoke memories. We have also receiving funds from relatives asking that they be used towards this program.

Discussion

Bereavement in ICU is very common and almost always unforeseen by families. Patients and relatives may never have the opportunity to say goodbye to each other. By giving them a small box to fill with memories, we hope this may help the recovery process for families.

Local audit: sleep quality in intensive care

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Sleep in the critical care setting is traditionally poor, while its importance in patient recovery is increasingly evident [1]. Lack of sleep is associated with delirium and increased mortality [2, 3], but can be improved with simple measures, such as those outlined in local trust guidance [4]. This audit assessed sleep quality and implementation of sleep aids against trust standards, with suggestions for further sleep-improving measures and closing of the audit loop.

Methods
Randomly selected patients admitted to a 20-bed intensive care and high dependency unit in Newcastle completed the internationally validated Richards-Campbell Sleep Questionnaire [5], as well as a survey on sleep-disruptive factors and sleep aids offered. Patients under sedation, GCS <15 or cognitively impaired were excluded.

Results
Initial findings from 23 patients show a mean RCSQ score of 58 out of 100mm on the linear visual analog scale. Noise and pain were the most disruptive factors. Trust-recommended sleep aids were not always offered to patients.

RCSQ parameter	Mean +/- SD (mm)
Sleep depth	53 +/- 35
Sleep latency	56 +/- 36
Awakenings	66 +/- 33
Returning to sleep	60 +/- 35
Sleep quality	57 +/- 37
Total RCSQ score (mean of 5 parameters)	58 +/- 30

Sleep-disrupting factors	Mean +/- SD (mm)
Noise	55 +/- 32
Pain	37 +/- 37
Light	22 +/- 28
Equipment alarms	35 +/- 31
Staff interventions	33 +/- 28
Other patients	26 +/- 29

Sleep aids offered	Number of patients
Earplugs	7 (30%)
Eyemask	9 (39%)
Sleeping tablet	4 (17%)
Nothing offered	6 (26%)

Discussion
Sleep in this critical care unit could be improved, with a focus on reducing noise and ensuring good analgesia. Simple measures like disposable earplugs should be offered to all patients. 'Lights-out' policies and plastic soft-close bins may also help. In the absence of national guidance on sleep optimisation in the critical care setting, regular review of local practices should be encouraged to promote better sleep and thus recovery for our patients.

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HEALTHCARE staffs perceptions of children visiting a critically ill relative in ICU/HDU

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Intensive care units have been identified as extremely stressful environments for patients and their families [1]. Nonetheless, families can provide reassurance to those who are critically unwell [1]. Moreover, allowing a child to visit can help the nurse care for the whole family [2]. However, historically within ICU/HDU under 14's have been deterred from visiting.

Methods
Fifty-two members of the healthcare staff in ICU/HDU were surveyed. A return of fifty-eight percent was achieved. Data was collated, with the quantitative data transcribed to percentages and qualitative grouped into themes.

Results
Of the surveyed staff fifty-nine percent believed children less than 14 years should be allowed to visit a critically unwell relative with ninety-three percent identifying those over 14 years as suitable to visit. Many reasons were given to restrict children, including infection issues, psychological stress and the nature of the patients' illness. The majority of staff believed the ICU/ HDU environment to be frightening for children. Furthermore, the relationship and physical condition of the patient was a factor in restricting children's access. Finally, there was a great variance in the staffs' experience of facilitating a child visitor.

Discussion
Overall, the consensus amongst the staff was that children should be allowed to visit ICU/HDU, despite the risk of being frightened. The decision should be made in conjunction with the child, their family and the patient. Moreover, the visit should be planned with appropriate preparations made including information for staff and relatives. Therefore, an adaption of Chelsea and Westminster Hospital NHS Foundation Trusts children's visiting leaflet was generated and in agreement with nursing and medical staff within ICU, is to be implemented.

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Citrate-based renal replacement therapy in pre-existing hypercalcaemia: a case report.

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Citrate-based renal replacement therapy (RRT) is used in critical care units in the UK to treat acute kidney injury. Citrate is a naturally occurring anticoagulant which prevents clotting in the extracorporeal circuits. It chelates ionised calcium preventing activation of coagulation cascades. The calcium-citrate complex is freely-filtered during RRT and is lost in the ultrafiltrate. A systemic calcium infusion is required to replace the lost calcium [1]. The patient's ionised and filter calcium are measured to maintain anticoagulation without compromising their electrolyte balance. Citrate and calcium doses are adjusted accordingly. In hypocalcaemia, calcium substitution can be used to correct serum levels prior to commencing RRT. In hypercalcaemia, there is no simple corrective procedure. We present our experience using different anticoagulation methods for RRT in a patient with pre-existing hypercalcaemia.

Methods
The patient's case notes were reviewed. Written consent was obtained from his next of kin as the patient unfortunately died.

Results
A 72-year-old male presented with a three-week history of back pain, confusion, urinary retention, acute kidney injury, anaemia and hypercalcaemia (3.88mml/l). Diagnosis was a presumed multiple myeloma. He was treated with intravenous fluids and Pamidronate. He deteriorated requiring transfer to Intensive Care for intubation and ventilation for pulmonary oedema caused by a non-ST-elevation myocardial infarct. He became oliguric and was commenced on citrate-based RRT. However, the circuit clotted due to the high ionised calcium (1.94mmol/L). The RRT anticoagulant was switched to heparin. He developed PR bleeding from the heparin. An endoscopy showed no bleeding point. The calcium level reduced slightly (1.59mmol/L). He was given further Pamidronate. His renal function remained deranged with hyperkalaemia and he was switched back to citrate-based RRT. The calcium infusion was decreased by 10% and RRT continued successfully reducing ionised calcium to within normal range (1.32mmol/L). Due to his poor prognosis, his treatment was switched to end of life care. He died after nine days.

Discussion
The Kidney Disease: Improving Global Outcomes guideline recommends regional citrate anticoagulation for patients receiving RRT [2]. No clinical guidance exists on how to manage citrate-based RRT in pre-existing hypercalcaemia. Based on the expertise of clinical staff, the decision was made to switch to heparin anticoagulation to allow the patient's hypercalcaemia and acute kidney injury to be treated effectively. Heparin has its own complications including bleeding. Research shows citrate RRT compared to heparin has similar circuit duration and less bleeding. However, in certain circumstances, a combined anticoagulation approach can be used in RRT for a patient with co-existing kidney injury and hypercalcaemia.

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An evaluation of a pharmacy intervention at a post-intensive care clinic.

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The mortality in intensive care units (ICUs) has been falling during recent decades [1]. With an increasing number of patients surviving, survivorship is viewed as the defining challenge of modern-day critical care [2]. Medication related problems (MRPs) are common in ICU patients, and these continue to cause problems in the post-discharge setting. Post-ICU clinics have been set up to help address these problems [3]. The aim of this project was to categorise and determine the prevalence of MRPs in ICU survivors; assess the severity of these problems; explore risk factors for having a MRP; and examine the prescribing of analgesia in these patients.

Methods
Intensive Care Syndrome: Promoting Independence and Return to Employment (InS:PIRE) is a multidisciplinary rehabilitation programme for ICU survivors. Eighty eight patients enrolled in In:SPIRE at Glasgow Royal Infirmary were reviewed by a pharmacist. Medication related problems (MRPs) were addressed and categorised by drug class, and type and significance of intervention. The patient's analgesia was examined, and demographic data was collected to predict factors associated with MRPs. IBM SPSS Statistics 24(24) was used to perform McNemar's test and calculate confidence intervals. Logistic regression was used for the predictive analysis.
Ethics approval was given by The North West (Liverpool Central) Research Ethics Committee, REC Reference Number: 17/NM/0199.

Results
70% (n=62) of patients required at least one pharmacy intervention. There were 122 MRPs identified in total. The most common intervention was to clarify the duration of treatment (n=22), followed by a drug omission (n=20) and then requesting of monitoring (n=19).71% of those interventions were clinically significant. The drug class most associated with MRPs was neurological (n=33), followed by cardiovascular (n=26), and gastrointestinal (n=20). 29.5% of patients (n=26) were prescribed analgesia pre-admission, and this increased to 58.0% (n=51) post-admission, a significant increase of 28.4% (95% CI 17.5% to 39.3%, $p<0.0001$). Prior to admission 15.9% (n=14) were prescribed an opioid analgesic, compared to 37.5% (n=33) post-admission. This is a significant increase of 21.6% (95% CI 11.8% to 31.4%, $p<0.0001$). Prescribed weak opioid medication post-ICU was predictive of an MRP (OR 6.94, 95% CI 1.54 to 31.35, p=0.012).

Discussion
Neurological, cardiovascular and gastrointestinal drugs are the most common classes of MRP. Common MRPs are omission of chronic treatments and continuation of inappropriate treatments. Patients are more likely to be prescribed analgesia post-admission, and that analgesia is more likely to be an opioid. A pharmacy intervention at a post-intensive care clinic is an effective way of detecting and resolving these problems.

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Predicting mortality in patients admitted to ICU with pneumonia: a retrospective cohort study

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Patients admitted to ICU with pneumonia have a mortality rate of around 30% due to the risk of multi-organ failure and ARDS [1, 2, 3].
Tension-based methods such as PaO_2/FiO_2 ratio are most commonly used to assess severity of illness but content-based methods such as effective shunt (ES) fraction are more accurate [4]. With this in mind, a novel way of inferring shunt fraction has recently been developed by the work of Chang et al., 2019 [4]. We compared the predictive ability of different severity markers – APACHE-II score, PaO_2/FiO_2 ratio, and ES fraction, in correctly predicting mortality in this cohort.

Methods
Ethics approval was not required as study was retrospective and anonymised. Information collected for participants included demographics, outcome and severity marker information. ES fractions were calculated using the online tool developed by the work of Chang et al., 2019 [4]. All analyses were performed using the Wizard Software tool. Chi^2 testing was used to measure the correlation between severity markers and mortality. ROC curve analysis was used to compare the predictive abilities of severity markers in predicting mortality. Linear regression using a single variate was used to determine the sensitivity and specificity of each of the severity markers in predicting mortality.

Results
One-hundred-and-six participants were included for final analysis. APACHE-II score was found to have no significant correlation with either PaO_2/FiO_2 ratio or ES fraction. However, a strong negative correlation was observed between PaO_2/FiO_2 ratio and ES fraction ($r = -0.888$, $p < 0.001$). Chi^2 testing showed all severity markers to be significantly correlated with mortality (all p-values <0.001). Predictive ability varied between markers – median ES fraction was shown to have the greatest predictive ability with an AUC of 0.8140. APACHE-II score was found to have the worst predictive ability with an AUC of 0.6996.

Discussion
It has already been demonstrated widely that content-based methods are more accurate than tension-based indices when quantifying pulmonary oxygenation and severity of illness. However, the correlation between such markers and mortality is less well-established. This study contributes evidence which suggests ES fraction to be the best tool in correctly predicting mortality in this cohort. It is a feasible an easy method for measuring respiratory severity of illness and could be considered for implementation into clinical practice on a large-scale.

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Survey of critical care admissions in an Ethiopian hospital

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A high prevalence of critically ill patients has been reported in the least developed countries, with an Intensive Care Unit (ICU) mortality of 43.7% seen and a younger patient group [1]. Use of mechanical ventilation (MV) has been reported to be relatively low, 18.7%, but with associated high mortality [2]. An essential aspect for progression of health care delivery in low- and middle-income countries (LMICs), as identified by the Lancet commission, is the parallel development of critical care services [3]. Gathering the epidemiology of critical illness in LMIC settings will provide guidance on appropriae interventions to improve care.

Methods
Data was collected for 109 patients over a five-month period (July-November 2016) from a six bed ICU at Felege Hiwot Hospital (FHH), Ethiopia. Information was gathered on admission and each patient was followed through to outcome. This was compared against data for 109 patients collected from a database of information for a six bed ICU at Hereford County Hospital (HCH), UK. Points of comparison included gender, age, presentation, use of MV and outcome. Permission from both institutions was granted for the collection and use of the data for this survey.

Results
Admission by gender demonstrated a greater number of male admissions (FHH 57%, HCH 58%) to female (FHH 43%, HCH 42%). Average age was lower in FHH, 43 years, compared to HCH, 67 years. This both represents the lower age of admissions and no separation of adult and paediatric services at FHH. HCH demonstrated a relatively even admission between medical (56%) and surgical (44%), whereas FHH admissions were largely medical (84%) compared to surgical (16%). There were no post-arrest admissions to FHH compared to six (5.5%) at HCH. Infectious diseases were more frequently seen in FHH (19%) relative to HCH (6%). There were more admissions to FHH for self-poisoning (11%) compared to HCH (7%). At HCH MV was used more frequently (30%) compared to FHH (14%), but mortality when MV was used was double for FHH (87%) compared to HCH (45%). Overall mortality on the ICU unit was also double at FHH (37.6%) compared to HCH (18.3%).

Discussion
Development of critical care support is required to achieve the Lancet commission goals of closing the gap in healthcare and address the burden of surgical need in LMICs. This will not be achieved with immediate export of high resource systems. Such an example is seen with the low use of MV but high mortality. Context specific developments are required to improve MV safety and possibly avoid intubation with development of alternatives to MV where able [4]. Regional needs assessment and development of critical care solutions are required that are locally applicable, evidence based and led by on-site healthcare teams.

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Daily dashboard produces sustained improvement in rate of critical incident/learning event reporting for morbidity and mortality review

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Background/Objectives
Critical incidents/learning events are common in critical care. Analysis can assist staff in reducing potential harm (1). Previous research has shown that the use of structured reporting tools can improve learning (2). We aimed to improve the rate of reporting and analysis with daily surveillance tools in parallel with an intensification of morbidity and mortality (M&M) review processes.

Methods
We undertook a Quality Improvement Project in an eight bed Level 3 Intensive Care Unit in the East of Scotland over 24 months. Five improvement cycles included: (1) monitoring baseline reporting (2) five-question multidisciplinary ward round safety brief (3) moving the brief to handover (4) introducing a twelve-item dashboard of defined critical incidents/learning events with weekly M&M meetings and monthly written dissemination of learning points (5) reducing written dissemination to bimonthly. Data were collected and analysed in Microsoft Excel 2017.

Results
All critical incident/learning event reports were included. Mean staff concordance with the daily safety brief was low at the ward round (22.8%) and handover (30.0%), but very high with the daily dashboard (94.3%). This was similar after reducing written dissemination from monthly to bimonthly (96.2% before, 91.8% after). The baseline rate of critical incident reporting was initially low (0-1/month, mean 0.2) and did not increase with the use of a safety brief. The safety brief did record a significant number of incidents (0-13/month, mean 6.9) but did not capture detail. The daily dashboard, however, did increase the rate of detailed formal reporting (8-29/month, mean 15.9).

Conclusions
Daily dashboard use was associated with a dramatic improvement in staff engagement in critical incident reporting compared to safety briefing. The concurrent weekly M&M meetings and written summary reporting will have reinforced and rewarded daily dashboard use. Surveillance, regular review and dissemination forms part of the Ottawa M&M Model (3), recommended by the Scottish Mortality and Morbidity Programme (4). This systematic approach to critical incident/learning event reporting can also be used to monitor future interventions and outcomes.

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Changing the Culture in ICU - Introduction of a Value Management Approach to Quality Improvement

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Our Intensive Care Unit (ICU) has been driven to provide safe, effective and patient-centred care therefore we felt there was a compelling case to introduce quality improvement methodology as a framework for change. As a result, over the last few years, we have been working towards making quality improvement part of our daily core business. A Value Management Approach (VMA) is currently being tested as a means to co-ordinate our projects into a meaningful strategy. The approach, adapted from a similar model, used in NHS Highland, offered a simplified method to understand quality, cost, and workforce capacity on a weekly basis. (1)

Methods
Underpinned by improvement methodology, we aim to test and implement an infrastructure for a VMA co-designed by clinical staff, patients, families and QI support. Improvement projects are identified under one of four headings from NHS Ayrshire and Arran's 4 pillars: Quality, Service, People and Finance. Following staff, patient and family feedback we prioritise projects in the context of what is of value or important. This strategy alone encourages staff wellbeing and also allows patients and families an opportunity to influence change.

Results
This is still very much work in progress however early results have suggested:
A reduction in amount of blood samples acquired.
Increased compliance with early sedation breaks
Improved communication.
Increased staff wellbeing/joy in work

Discussion
Pivotal to the success of a VMA is regular feedback and report-out of the ongoing results to determine whether the change results in improvement or not. A weekly report-out consists of verbal presentation of progress in each of the four areas in front of the multi-disciplinary team.
Introducing a VMA has allowed us to ask "What matters to....." staff, patients and families. Many of the projects identified are aimed at improving both patient and family experience. Combined with a weekly report-out of results we are observing improvements in real time which is communicated to staff at all levels.

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Renal replacement therapy for acute kidney injury in the intensive care unit

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Acute kidney injury (AKI) is well known phenomenon with a high reported incidence of 55-60% within the intensive care unit (ICU) [1]. Severe AKI requiring renal replacement therapy (RRT) is associated with high mortality rates; a previous Scottish study assessed outcomes of all inpatients and found 90-day mortality to be as high as 48% [2]. This project sought to determine the outcomes of patients admitted to intensive care who underwent RRT for AKI.

Methods

SIGSAG Wardwatcher database was queried for patients aged 16 or older admitted to Glasgow Royal Infirmary and Queen Elizabeth University Hospital ICUs in a 3 year period. These patients were added to Strathclyde Electronic Renal Patient Records. Data were extracted from both databases and merged. Patients with any documented renal support days were identified. Established renal failure (ERF) patients were excluded. Reason for admission and demographics were gathered. Raw mortality for in-ICU, 90-days and 12-months was determined. Median and interquartile ranges (IQR) were calculated for length of stay and number of days on renal support. NHS Research and Ethics committee granted approval for this project prior to starting.

Results

In total, 515 patients were identified. Median age of patients admitted was 61 (IQR = 48-70); 308 of patients were male (59.81%). Medical specialties accounted for 289 admissions (56.12%); sepsis was the most common reason for admission (213 patients – 41.36%). Median eGFR from preceding year was available for 389 patients; 243 had an eGFR >60 (62.47%). In-ICU mortality occurred in 215 patients (41.75%), 90-day mortality in 261 (50.68%) and 12-month in 287 (55.73%). Median number of renal support days was 3 (IQR = 2-7); median length of stay was 3 (IQR = 2-12). 21 of 300 survivors subsequently developed ERF (7%); 16 (5.33%) of these started chronic dialysis within 90 days. Re-admission occurred in 45 of 300 survivors (15%). The median length between discharge and readmission was 27 days (IQR = 6-165).

Discussion

The raw in-hospital mortality rate is significantly higher for ICU patients undergoing RRT for AKI than for ERF (55% vs 24%) [3]. In-ICU mortality was higher compared to SIGSAG data for the ICU population during the study period (15-20%). 90-day mortality was comparable to a previous study encompassing all inpatients (50.68% vs 48%) [2]; the rates of patients developing ERF within 90 days were lower than in this prior study (5.33% vs 12%). This may be down to the differences in patients; AKI associated with critical illness may be more likely to recover than AKI due to primary renal aetiology. Future work comparing outcomes of patients with varying lengths and severity of AKI would help further inform this area of study.

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Plasmapheresis in the Management of Diabetic Ketoacidosis with Hypertriglyceridemia-induced Pancreatitis

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As the rates of diabetes mellitus continue to rise, conditions such as diabetic ketoacidosis (DKA) are becoming increasingly common.[1] Although most patients respond appropriately to standard DKA protocol based management, a proportion go on to develop complications, requiring further intervention. Here, we present a case where a patient with DKA developed a combination of hypetriglyceridaemia and acute pancreatitis, requiring management in an intensive care unit and treatment with plasmapheresis.

Case Presentation

A 29 year old man with no significant past medical history presented with a history of nausea, vomiting and abdominal pain. Blood tests showed a severe metabolic acidosis (pH 6.97, ref. range 7.35 –7.45) with hyperglycaemia and ketonaemia. A diagnosis of diabetic ketoacidosis was made. Initial amylase levels at presentation were normal. Despite management with intravenous insulin and fluids, and a reduction in serum glucose and ketone levels, the severe acidosis persisted, and the patient required transfer to an intensive care unit. This management was complicated further by inaccuracies in the lab analysis of sodium, potassium and glucose plasma concentrations, as a result of grossly lipemic blood samples. Triglycerides levels taken were markedly raised (75.8 mmol/L, ref. range 0.8-3.0 mmol/L). Repeat amylase levels were elevated, suggesting an evolving hypertriglyceridemia-induced pancreatitis. Early CT Abdomen showed non-specific changes, but a later CT scan confirmed the diagnosis of acute pancreatitis. Two sessions of plasmapheresis were performed to correct the hypertriglyceridaemia. This led to resolution of the pancreatitis, metabolic acidosis and acute kidney injury. The patient was discharged with a subcutaneous insulin regime, oral fibrate and outpatient follow up with the diabetic team.

Learning Points

This case posed several management challenges and highlighted a number of key learning points:
- A rare combination of diagnoses: New onset of type one diabetes with ketoacidosis, hypertriglyceridaemia and acute pancreatitis in a patient with no prior medical history
- Metabolic acidosis out of keeping with the expected clinical course of DKA
- Hypertriglyceridaemia leading to inaccuracies in the lab analysis of sodium, potassium and glucose plasma concentrations
- Challenging management of significant electrolyte derangement and fluid deficit with a coexistent acute kidney injury
- Plasmapheresis as an effective treatment strategy in the setting of severe hypertriglyceridaemia, acute pancreatitis and DKA
- Plasmapheresis of severe hypertriglyceridaemia is liable to saturate filters and require more than one circuit per filter per treatment in spite of effective anticoagulation.
- The hazards of cognitive bias and persisting with protocol based management when a patient has not responded to treatment

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An audit of endotracheal tube and tracheostomy cuff pressure monitoring in a surgical Intensive Care Unit.

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Background
Endotracheal (ET) and tracheostomy tubes have inflatable cuffs at the distal tip of the tube. When inflated, the seal with the wall of the trachea facilitates positive pressure ventilation and prevents the passage of gastric contents into the airways below. The ideal pressure range at which the cuff should be inflated is between 20 and 30 cmH_20. Excessive cuff pressures can lead to tracheal wall ischaemia, ulceration or rupture. However, underinflated cuffs increase the risk of respiratory infections. Therefore, adequate monitoring and recording of cuff pressures is a relatively simple and inexpensive method of reducing these preventable complications. The aim of this audit cycle was to identify and improve on any deficiencies identified in ET and tracheostomy cuff pressure monitoring in a Surgical Intensive Care Unit (SICU) at Tygerberg Hospital, South Africa.

Methods
Ethics approval was obtained from the local ethics committee in Tygerberg Hospital. This was a two cycle clinical audit. Intubated patients were identified each day in the SICU. A manometer was used to measure the cuff pressure. Additional data was gathered on record keeping within the notes. A total of 50 patients were identified for each audit cycle. Once the initial audit was completed, an intervention was implemented in the form of posters, presentations and increased accessibility to manometers within the SICU.

Results
Out of the initial 50 tracheal cuff pressures measured, 16(32%) were within the recommended range and one (2%) set of notes contained a pressure reading. After intervention, a further 50 cuff pressures were measured as part of the audit loop. In the re-audit, the number of correctly inflated cuffs rose to 40(80%) and cuff pressures were recorded within 29 (58%) sets of notes.

Conclusion
The standard of cuff pressure monitoring in this SICU has improved considerably. This audit cycle has been of clinical benefit and the interventions placed will contribute positively to patient care. In order to maintain and build upon this improvement, further interventions in the form of improved documentation and nurse led cuff pressure monitoring will be considered. In addition, further audit cycles are planned for the near future.

ABC of DAS in ICU! A survey of nursing staff knowledge of guidelines for intubation in the critically ill.

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The 4th National Audit Project (NAP4) of the Royal College of Anaesthetists and Difficult Airway Society (DAS) highlighted a significantly higher incidence of adverse outcomes and shortcomings in airway management in intensive care units compared with theatre settings [1]. The DAS guidelines for the management of tracheal intubation in critically ill adults were published in 2018 in response to these findings [2], and stress the importance of a team approach to airway management in ICU. We surveyed nursing staff working across both ICUs in NHS Tayside, looking to first assess the level of familiarity with the guidelines and their recommendations, and then target any additional training needs of our team.

Methods
A one page anonymous survey was circulated among ICU nursing staff over a two month period in 2019. In addition to gathering basic demographic data (nursing grade, number of years ICU experience, approximate number of intubations in the last year), respondents were asked if they were aware of the DAS guidelines. More specific questions regarding knowledge & application of the guidelines' recommendations were also asked. These pertained to the use of checklists, methods of pre-oxygenation, attempts at laryngoscopy, failed intubation, use of supraglottic airway devices (SAD), and front of neck access (FONA). Responses were collated by transcription to Google Sheets.

Results
There were 25 respondents (35% uptake), with ICU experience ranging from six-months to 30 years (median of 11, mean of 13). Of these, 19 (76%) were aware of the DAS guidelines.
Of 25 respondents, 22 (88%) felt confident or very confident using checklists to plan for intubation; 21 (84%) felt confident or very confident with contents of the airway rescue trolley; 20 (80%) correctly identified SAD as first choice rescue in failed intubation; 20 (80%) correctly stated the location of the FONA set.
However, only 14 (56%) would feel confident suggesting front of neck access in a 'can't intubate can't oxygenate' situation; only 16 (64%) could correctly identify the equipment required for emergency FONA. Regarding intubation, 11 (44%) correctly stated that three attempts at laryngoscopy could be performed before declaring failed intubation; the remaining 14 (56%) stated that just two attempts could be performed.

Discussion
Our results demonstrate our ICU nursing staff have a good level of awareness of the DAS Guidelines and are familiar with the equipment and attitudes required to follow these guidelines. There are however some knowledge gaps, particularly around declaring failed intubation and preparing for front of neck access. Of note, knowledge was poorer among those members of nursing staff with less than five years experience in ICU, but there were only 6 respondents in this subgroup. While some of these findings are reassuring, there is certainly a role for greater emphasis and education on the key points of the DAS guidelines and their application within our team. We will be tackling these knowledge gaps in future training days and will repeat the survey to assess the impact of our intervention.

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Outcomes of renal transplant patients admitted to the intensive care unit

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Renal transplant has been previously described as the preferred mode of renal replacement therapy (RRT) for suitable patients with established renal failure (ERF) in terms of both long-term mortality and quality of life when compared with patients on continued dialysis [1]. Rates of survival post renal transplantation have been found to be 95% at 1 year and 90% at 3-5 years [2]. This study sought to determine how outcomes of renal transplant patients differed if they underwent an intensive care unit (ICU) admission post-transplant.

Methods
The SICSAG Wardwatcher database was searched for patients admitted to Glasgow Royal Infirmary ICU or Queen Elizabeth University Hospital ICU between 1st July 2015 and 30th June 2018. All identified patients aged 16 or over were added to the Strathclyde Electronic Renal Patients Records (SERPR) database. Data on these patients were extracted from both databases. Demographics and reason for admission were gathered for each patient. Raw mortality was calculated for in-ICU, 90-day and 12-month time periods. Length of ICU stay, length of time from transplant to admission, number of renal support days and number of mechanical ventilation days were calculated in terms of median and inter-quartile ranges. Ethical approval for this project was granted NHS Research and Ethics committee prior to starting this project.

Results
35 total patients with kidney transplant were identified as being admitted to ICU. 22 (62.86%) of these patients were male; the median age was 60 (IQR = 55-67). 21 of the 35 patients (60%) were admitted from medical specialties. Most common reason for admission was sepsis which was the case in 16 patients (45.71%); renal causes for admission were identified in five patients (14.29%). In-ICU mortality occurred in eight (22.86%) patients; 90-day mortality occurred in 11 patients (31.43%) and 12-month mortality rose to 17 (48.57%). Median length of ICU stay was 3 days (IQR = 2-5). Median number of mechanical ventilation days was 2 (IQR = 0-3) and median number of renal support days was 1 (IQR = 0-3). The median length between kidney transplant and admission to ICU was 470 days (IQR = 54.5 – 1929.5). Of the 18 survivors at 12 months, six patients (33.33%) subsequently required chronic haemodialysis.

Discussion
In comparison to previously available data, the mortality rate of renal transplant patients was significantly higher than that of renal transplant patients in the general population. In addition, the in-ICU mortality was found to be higher than reported in-ICU mortality rates across Scotland for the general population during the study period (10-15%). Sepsis and other infection was the most common cause of admission; patient's immunocompromised state due to anti-rejection medication may have contributed to this. The rate of survivors requiring further chronic haemodialysis was also higher than expected. Further studies into this area over a longer study period would allow help to identify significant trends in outcomes and potential opportunities for intervention.

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An analysis of outcomes of chronic dialysis patients admitted to the intensive care unit

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Renal replacement therapy (RRT) is a key management strategy within the intensive care unit (ICU). Previous systematic reviews have examined the outcomes of ICU patients on chronic dialysis for established renal failure (ERF) compared to RRT for acute kidney injury (AKI) and found both long- and short-term mortality to be better in the ERF population [1]. This study sought to determine the outcomes of ERF patients on chronic dialysis who were admitted to the ICU.

Methods
The SICSAG Wardwatcher database was searched for patients aged 16 or over admitted to Glasgow Royal Infirmary or Queen Elizabeth University Hospital ICUs between 01/07/2015 and 30/06/2018. These patients were added to the Strathclyde Electronic Renal Patients Records (SERPR) database. Data on these patients were extracted from both databases. Only patients who were on long-term dialysis for ERF prior to admission to ICU were included in this study. Demographics and reason for admission were gathered. Raw mortality was calculated for in-ICU, 90-day and 12-month time periods. Length of ICU stay, length of time from start of dialysis to admission, number of renal support days and number of mechanical ventilation days were calculated in terms of median and inter-quartile ranges (IQR). Ethical approval for this project was granted NHS Research and Ethics committee prior to starting this project

Results
In total, 61 patients were identified. Of these patients, 36 were male (59.02%) with a median age of 58 (IQR = 49-69). 55 of the patients (90.16%) were undergoing haemodialysis whilst six were on peritoneal dialysis. The admitting specialty was medical in 35 patients (63.03%). The most common reason for admission was documented as sepsis in 16 patients (26.23%). 14 patients died whilst in ICU (22.95%). 90-day mortality was seen in 20 patients (32.79%) and 12-month mortality was observed in 26 patients (42.62%). Median length of stay in ICU was 2 days (IQR = 1-4). The median number of mechanical ventilation days was 1 (IQR = 0-3), and median number of renal support days was 2 (IQR = 1-4). The median length of time between starting dialysis and admission to ICU was calculated as 495 days (IQR = 180 – 1235). Of the 35 survivors at 12 months, 11 patients (31.43%) went on to undergo renal transplants.

Discussion
The crude in-ICU mortality rate for ERF patients was comparably higher than the raw mortality rate across Scotland during the study period (10-15%). Indeed, at 12 months the mortality rate had risen to 42.62% in spite previous studies finding that the increased mortality risk in ERF patients admitted to ICU did not extend beyond 6 months [2]. In addition, previous systematic reviews have compared ERF against RRT for AKI rather than the general ICU population. An extended period of study is needed to attempt to discern any significant differences in long term outcomes in this patient cohort.

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Critical Care Referrals – perceptions vs. Reality

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The National Confidential Enquiry into Patient Outcome and Death[1] made several recommendations on critical care referral and admission, including consultant physician involvement in all critical care referrals and reporting any delay in review or admission as a critical incident. Our current practice was compared to these recommendations.

Methods
Retrospective data on referrals to a 16 bed adult critical care unit were collected over 5 weeks. Data were collected on timing of referral, grade of clinician referring, involvement of parent team consultant, outcome of referrals, and completion rate of referral documentation. Data on referrals were taken from the referral proforma which is documented on the electronic patient record. WardWatcher was used to gather data on unit admissions. The findings were compared to recommendations for practice, previous audit findings and clinician perception of referrals.

Results
46 referral proformas and 68 admissions were analysed. Of those admitted from the ward 17(54%) had a documented critical care review.
Prior to this study, there was a perception among medical staff that 'most of our referrals come from very junior members of staff'. Data showed that 6(14%) of referrals came from foundation year doctors, 8(20%) from core trainees, 24(52%) from registrars and 3(6.5%) from consultants. There was parent consultant review or discussion prior to referral in 17(37%) of cases. Therefore, the majority of referrals are from senior registrars but most do not have consultant involvement.

Of the patients reviewed, 18(39%) of patients were admitted to ICU, 21 (45%) did not require ICU and 7(15%) were not suitable for ICU. When there was consultant involvement prior to referral, 59% of patients referred were admitted to ICU vs. 27% with no consultant involvement.

There was also a perception that the majority of referrals were happening out hours. During this period, 18(39%) of referrals occurred in daytime hours, 19 (41%) in the evening and 12(26%) overnight. This is a change since 2014 when only 25% of referrals occurred in daytime hours. There was inadequate documentation to determine time between referral and review, and between acceptance and transfer to ICU.

Discussion
The data has shown that most of our patients do not have parent team involvement prior to critical care review, as recommended by the NCEPOD enquiry. Early consultant involvement in the management of deteriorating patient can facilitate earlier critical care referral or anticipatory care planning if more appropriate. We plan to share these findings with our hospital colleagues and find ways of working together to improve critical care reviews and patient experience. Previously, low parent consultant involvement was thought to be due to referrals mainly happening out of hours but this trend appears to have changed and the rate of consultant involvement remains low.

We plan to make several improvements to our practice and documentation. Our main process measure will be to improve the rate of critical care review documentation from 54% and capture information on time of referral, review and admission on the review proforma, to ensure that timely reviews and admissions are happening. The data collected has challenged some of our perceptions of timing and source of referrals and has shown the importance of collecting accurate information about what is happening in the hospital. We are looking into ways to gather this information electronically to monitor trends in referral and admission practice.

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Critical Care Multi-professional Simulation Pilot Study at St John's Hospital and Royal Infirmary of Edinburgh

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Simulation training has been shown to improve the safety and efficiency of clinical teams. In situ simulation can provide this training in the actual clinical settings where these teams work. Clinical teams training and rehearsing scenarios in the environment they normally work allows for increased familiarity with the equipment and protocols that are available to them. It can also allow an interrogation and refinement of the protocols and systems to support patient care. [1,2]

Methods
We asked of 30 members of our critical care multidisciplinary (CCMDT) team what they felt was the most significant barrier to effective delivery of patient care. Ninety percent (90%, n=27) felt that not learning together or not knowing each other (80% n=24) were the most significant barriers to effective team work. A CCMDT simulation programme was piloted in at St Johns Hospital and Royal Edinburgh Infirmary. A small faculty of medical and nursing staff developed a number of scenarios which were delivered during an afternoon each month to medical and nursing staff working within the ICU. Each scenario was followed by a team-based debrief which included some clinical teaching relevant to all members of the team participating. The scenarios were all designed to involve an immediate first responder role, who could have been any member of the MDT team. The attendees were asked to complete feedback at the end of the session.

Results
The programme has run across two sites in NHS Lothian over 14 months. 80 members of the CCMDT have attended a teaching session (42 doctors-in-training, 30 staff nurses, 8 advanced critical care practitioners). Sixty eight (68) participants provided feedback: all n=68 (100%) agreed or strongly agreed that sessions were relevant, enjoyable, improved their confidence in managing scenarios, 68 (100%) felt attendance would help their future practice, improved team building, and would recommend the session to colleagues. Qualitative feedback offered additional benefits which included improved working relationships between staff groups and developing confidence to ensure their observations are heard during clinical emergencies.

Discussion
Initial feedback from these pilot sessions has consistently shown that attendees from all clinical backgrounds have benefited from learning together. As a result, we plan to develop the programme further by widening access to more staff groups in Critical Care, increasing the number of opportunities for team-based learning and to implement a diverse range of scenarios reflecting our location patient population. We hope to see that this 'systems thinking' or human factors approach can lead to measurable improvements in outcomes for patients and the cohesiveness of the teams that care for them.

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Admission pause: a quality improvement project to improve patient safety in intensive care

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Breakdown in communication during the handover process can adversely affect patient safety. The NICE quality standard for Emergency and Acute Medical care advises using a structured handover to mitigate this [1]. The lack of a structured process was identified as a concern by our ICU staff. In an online survey with 146 responses the majority of staff (80%) had concerns that there were multiple handovers and 94% believed a structured handover would improve patient care. The aim of this Quality Improvement project (QIP) was to develop a structured bedside handover.

Methods
NHS Lothian Quality Improvement team identified this as a QIP which did not require ethical approval. We carried out three audit / intervention cycles. Intervention one: a structured handover checklist and a multidisciplinary education package. Intervention two: further staff education, including to the referring teams, and inclusion on the ICU nursing safety brief. Intervention three: a modified laminated checklist was attached to the pendant at each bed space.

Results
Pre-implementation 5% of admissions had a full team in attendance (see figure 1) with only 15% receiving a single structured handover. Following the interventions a structured bedside handover occurred in 73% of cases. Staff attendance increased across all grades (see figure 1). A repeat survey (59 responses) showed that over 90% of staff believed that the admission pause had improved handovers and that safety had improved.

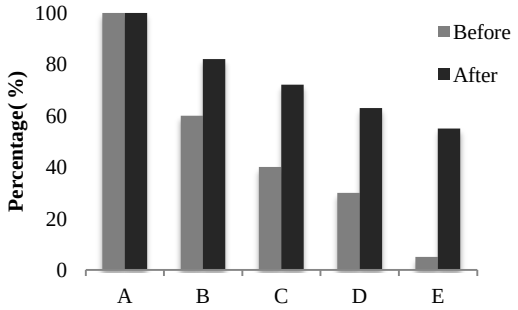

Figure 1: *Staff attendance during patient admission; A Bedside Staff Nurse, B Charge Nurse, C Junior Medical staff, D Senior Medical Staff, E All four in attendance*

Discussion
The implementation of the Admission Pause resulted in an increase of staff presence at handovers and removed the need for multiple separate handovers. We hope this will minimise communication errors which should ultimately improve patient safety. There has been a notable increase in senior medical attendance at the bedside, rather than separately in the doctors' room. This facilitates timely decision-making and the earlier setting of treatment targets.

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Incorporating a wellbeing session in undergraduate critical care education: "Creating a platform to improve mental health"

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It has been recognised that critical care can present a challenging learning environment for medical undergraduates, and may present their first exposure to complex ethical decision making and distressing morbidity [1, 2]. Burnout amongst medical students continues to be a problem, and the wellbeing of the healthcare workforce presents an ongoing challenge and area for development. The use of structured debrief has been shown to promote reflective practice, enhance empathy and improve the wellbeing of medical students and healthcare professionals [3]. We aimed to evaluate the implementation of a wellbeing session in undergraduate critical care education.

Methods
Ethical approval was sought from the University of Edinburgh Research Governance and was waived as this project was deemed to be quality improvement. Students attended a pilot teaching programme which covered multiple aspects of critical care. A wellbeing session was included, following a semi-structured debrief format whereby students were offered the opportunity to discuss challenging clinical situations in which they had been involved. Sessions were facilitated by a near peer trainee, and students were encouraged to reflect on their own experiences and on how the wider team may have felt in those situations. Discussion with regards to points of pastoral contact and resources for further reading and support were offered to all students. Anonymous, written qualitative feedback was requested to determine the aspects of the sessions students found beneficial and how the session might be improved. Qualitative responses were analysed using inductive thematic analysis.

Results

Sixty-four final year students attended the teaching programme, with 99 individual written responses to open questions. Qualitative analysis revealed four major themes, each including at least three subthemes. Students appreciated the opportunity to discuss their experiences in an open environment and to "hear peer stories". They felt this was something they had limited exposure to elsewhere and acknowledged that "We don't take enough time to think about some of the challenging cases we see". Students commented that they felt reassured by listening to some of the experiences of peers and facilitators and that it was "Good to hear for the future that there is support available". Students also felt this session fostered reflective practice, and allowed them to "[talk] about emotionally difficult cases – good chance to reflect on them".

Discussion
Incorporating a wellbeing session into undergraduate critical care education can help to provide students with reassurance regarding their future careers, offer an opportunity to discuss challenging cases, promote reflective practice, and help in "Creating a platform to improve mental health".

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Psychological resilience level of intensive care unit survivor patients: a cross sectional study

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In a recent study investigating hospital readmission triggers in intensive care unit (ICU) survivors, many patients described 'struggling to cope' after ICU[1]. Resilience is an individual's ability to maintain their mental health and adapt after difficult experiences[2]. It has been associated with decreased depression, anxiety, and fatigue in cancer patient populations[3]. However, research in ICU populations is limited. ICU-survivors differ substantially from cancer populations, but in principle resilience could be important as it may be modifiable[3]. Higher resilience may help ICU-survivors adapt to life post-discharge. This study aimed to investigate the resilience level of ICU-survivors.

Methods
Formal ethical approval was not required as this study was embedded in an ongoing quality improvement project. As this was an exploratory study no power calculation was conducted. The population was English-speaking ICU-survivor patients discharged to an Edinburgh Royal Infirmary ward for at least two days. Exclusion criteria were patient or nurse-in-charge refusal. Eligible patients were identified from WardWatcher and approached at bedside on the acute ward. Demographic variables (age, length of ICU-stay, APACHE-II score, sex) were recorded from WardWatcher. Participants completed a questionnaire consisting of the 10-item Connor-Davidson Resilience Scale (CDRISC)[4]. Questionnaires were collected over seven weeks. The primary outcome was the total CDRISC-score. Associations between CDRISC-score and demographic variables were tested with Pearson product-moment correlation-coefficients.

Results
188 patients were discharged from ICU 21/01/2019-13/03/2019. 41/140 (29.3%) patients approached completed questionnaires. Main reasons for refusal were tiredness (51/99 patients (51.5%)) and 'not feeling well-enough' (16/99 patients (16.2%)). Questionnaires were completed a median four days post-ICU discharge (2-4 [1-8]). Baseline characteristics were comparable between patients who completed questionnaires or not. The median CDRISC-score was 35/40 (28-38 [7-40]) (high-normal). Correlations between baseline variables and CDRISC-score were weak and insignificant ($p>0.05$).

Discussion
This study suggests ICU-survivors have relatively high resilience levels. The small sample size, low participation rate, use of a self-reported tool, and measuring resilience at just one timepoint risked bias. The CDRISC is a validated tool, but no gold standard is defined so this may have been limiting[4]. Non-participants may have had lower resilience, causing an overestimation of the population resilience level. The risk of this inclusion bias was suggested by the common reasons for non-completion. Larger prospective studies measuring resilience, ideally achieving higher enrolment, are warranted to further investigate resilience and its effect on outcomes in ICU patients.

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A feasibility study to introduce pet therapy into a tertiary general and neuro-ICU.

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Modern intensive care has increased patient survival, but the treatment burden of inpatient care and rehabilitation in ICU remains high. Neuro-intensive care is associated with an increased length of stay and complex rehabilitation needs[1]. Pet therapy forms part of a multi-modal approach to humanise the patient and family experience in ICU, with potential impact on wellbeing and patient outcome [2]. We implemented a programme of regular pet therapy over a four-month period in a tertiary general and neuro-intensive care unit in Edinburgh.

Methods
Petal, the therapet, underwent a period of training and was formally registered with the relevant body (Canine Concern Scotland). Visits occurred to the intensive care unit in Western General Hospital weekly over a four-month period (April-July 2019). Nursing staff were recruited as "Petal Pals" to identify candidate patients and families for visits. A logbook for Petal's visits was recorded, including data on duration of visit and whether the visit involved patients, families or staff. A series of qualitative, semi-structured interviews were conducted with patients, staff and relatives to characterise their views on the introduction of pet therapy, and subsequent thematic analysis performed.

Results
There were a total of 16 visits to a total of 34 patients over the period of this project. There were no adverse safety events. A total of 22 nursing staff were recruited as "Petal Pals" over the course of the project. There were 15 semi-structured interviews conducted, and the common themes identified were: Infection Control; Pet Phobia; Effect On Mood; Occupation; and Pet Behaviour.

Discussion
The introduction of pet therapy appears to be feasible in our intensive care unit. Appropriate safety concerns were raised by staff and patients alike, many of which are already addressed effectively by local Pet Therapy policy [3]. A history of pet ownership appeared to be the main determinant of whether pet therapy was well-received. Further work would look to quantify the degree of positive impact this intervention has on ICU wellbeing for both staff and patients, potential effects on outcome, and identify acceptable alternatives for those patients/families where pet therapy is unsuitable.

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A retrospective review of Pabrinex® prescribing within the intensive care unit (ICU) at the QEUH

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Pabrinex is a parenteral preparation of vitamins B and C used to treat severe depletion or malabsorption of these vitamins. Within ICU at the QEUH, Pabrinex is used for two main indications; to treat, or as prophylaxis against, suspected or diagnosed Wernicke-Korsakoff syndrome and to reduce the risk of refeeding syndrome in patients who are malnourished. Pabrinex is included within the automatic order set of prescribed medications for patients admitted to ICU at the QEUH. We conducted a retrospective review to assess Pabrinex prescribing trends. This project aims to standardise Pabrinex prescribing and produce an ICU specific guideline for its' use.

Methods
A literature search was undertaken to identify dosing guidelines from different health boards for the use of Pabrinex. All patients who were admitted to ICU at the QEUH between March 1st 2018 and 31st August 2018 were identified and those who received greater than or equal to 72 hours of Pabrinex treatment were included in data analysis. All details in relation to Pabrinex prescribing were obtained using Phillips ICCA® and NHS GG&C Clinical Portal. Results of the initial data collection were presented to the ICU consultant group and, in collaboration with one of the ICU consultants, a new ICU specific guideline was produced. This guideline was implemented and a re-audit was undertaken between the 11th and 28th March 2019. Ethics approval was sought and given for this project.

Results
A total of 12 UK health board guidelines were found for the use of Pabrinex in refeeding syndrome and 15 guidelines for the prophylaxis or treatment of Wernicke's encephalopathy. There was large variation in dose and duration recommendations in these guidelines. Out of 122 patients admitted to ICU within the data collection time-frame, seventy-seven met the inclusion criteria. Three patients were excluded due to specialist indications for Pabrinex. Forty patients (54%) did not have a recorded indication for Pabrinex treatment while twenty-eight (37.8%) had recorded history of alcohol excess and six patients (8.1%) had recorded malnutrition. Six varying dosage regimens were observed from 10ml (one pair) OD to 20ml (two pairs) TDS and continued for up to 15 days. Twenty-two patients (28%) were transferred out of ICU whilst still on active Pabrinex treatment. Only 25 (34%) patients who received Pabrinex were continued on oral thiamine after discontinuation. A new guideline was produced stating that every ICU patient should receive 10ml of Pabrinex once daily for five days, with different guidance specifically for the treatment of Wernicke's encephalopathy. Thirty-eight patients were included in the re-audit and twenty-one (55%) received Pabrinex treatment during their ICU admission. Five varying dosage regimens were observed but the majority of patients (fourteen (67%)) received the new guideline recommended dose of 10ml once daily.

Discussion
This project aimed to standardise Pabrinex prescribing within ICU at the QEUH. There was no specific intensive care guideline and this may have been a contributing factor to the variation in dosage and duration observed. The ICU order set was identified as a potential reason for prescriptions without an indication. A clear improvement in the consistency of Pabrinex dosing was seen after the introduction of the new guideline with 67% of patients receiving the correct dose. The new Pabrinex guideline was designed to ensure appropriate dosing for all indications and minimise the risk associated with the inability to assess patient's requirements for Pabrinex on admission to ICU. This project was limited by the small data collection period for the re-audit. A continued re-audit and further work is required to ensure adherence to the new guideline.

Using emotional touchpoints to understand and improve trainee experience in Intensive Care

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Nationwide there is increasing interest in improving the workplace experience of doctors. Poor experiences impact not only on workforce wellbeing but on patient safety and patient satisfaction (1). In order to effectively improve experience, a thorough understanding of the current "workplace experience" is required. We used emotional touchpoints to identify priority areas to be targeted for focused quality improvement.

Methods
We asked trainee doctors working in one ICU department to share their experiences at key "touchpoints" of a normal day on ICU (e.g handover, night shift, ward round) and on other important issues that can shape the experience of a trainee doctor's rotation (e.g rota, workload). Their comments were recorded and divided into positive and negative comment groups.

Results
We collated the results and illustrated which issues most substantially contributed to positive and negative workplace experiences. We selected one of the most negatively rated issues (the rota) and after identifying the main problems, developed a new rota. We also selected one of the most positively rated issues (a daily 5 minute teaching session), which we recognised was not delivered reliably, and set up a successful quality improvement project to improve the frequency with which this was delivered.

Discussion
Emotional touchpoints are increasingly used within healthcare to improve patient experience, but as far as we are aware, they have not been used before with reference to staff (2). We have demonstrated that emotional touchpoints are a useful tool to develop a detailed understanding of workplace experience, allowing identification of issues where improvement will be of most value. Doctors responded very positively to being involved in emotional touchpoint exercises, reporting that being asked about their day to day experience made them feel valued. We anticipate repeating the emotional touchpoints exercise to measure the change in trainee experience over time.

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An international study exploring the roles and experience of survivors of critical illness as volunteers within ICU recovery services

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Many clinicians have implemented follow-up and aftercare to support patients following ICU. Some of this care is supported and facilitated by peer volunteers (1). There is limited contemporary work which has explicitly explored volunteer roles within ICU recovery services, or the experience of volunteers undertaking these roles. We sought to explore the experience of survivors of critical illness, as volunteers, involved in Intensive Care Unit (ICU) recovery services and understand their motivation for undertaking these roles.

Methods
The study design and protocol were approved by the Western Health Low Risk Human Research Ethics Panel (Australia); the University of Vanderbilt Institutional Review Board (US coordinating site) and the South West (Cornwall and Plymouth) Research Ethics Committee for all UK sites. In-depth, semi-structured interviews with patients and caregivers who had adopted peer volunteer roles, from seven sites, in three continents were undertaken. The study design used an inductive content analysis process (2). We also documented the roles which were adopted by volunteers in each site involved in the study.

Results
Twelve patient and caregiver peer volunteers were interviewed. Four key themes were identified. These themes related to the experience of volunteers within ICU recovery services and their motivation for undertaking these roles: 1) self-belief and acceptance; 2) developing peer support; 3) social roles and a sense of purpose and; 4) giving back. There were international differences in the motivations to take up volunteering roles.

Discussion
Peer volunteers undertake a variety of roles in ICU recovery services and during recovery more generally. These roles appear to be of direct benefit to those in these roles. Future research is needed to develop these roles and fully understand the potential impact on the service as a whole, including the impact on other patients.

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Can ICU follow-up care impact in-ICU care? A qualitative study

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Over the last decade there has been a proliferation of ICU follow-up programmes internationally. These have been predominantly in the form of peer support groups and ICU follow-up clinics [1,2]. Limited data has explored the impact of these programmes on the staff who facilitate them. This service evaluation aimed to explore the experience of the multi-disciplinary team (MDT) who worked in one ICU follow up programme.

Methods
After discussion with the Chair of the West of Scotland Ethics Committee and the Scientific Officer for the West of Scotland Research Ethics Service, this project was deemed a Service Evaluation. We undertook in-depth semi structured interviews with the MDT in a single centre. Interviews were undertaken with those who had been involved in the Intensive Care Syndrome: Promoting Independence and Return to Employment (InS:PIRE) programme in Glasgow Royal Infirmary (GRI). All interviews were audio recorded and transcribed verbatim. Framework analysis was used to analyse the data [3].

Results
10 interviews were undertaken with the MDT at GRI. Each interview lasted between 15-30 minutes. Four themes were generated from the data: the impact on individual staff; the impact of the service on caregivers and families throughout the journey; the impact on in-ICU care for patients and finally- the impact on the ICU team. Staff discussed that the programme not only improved the outcomes of patients and family members following critical care, it also influenced in-ICU care. Staff also explored how InS:PIRE has changed their outlook at work and had helped changed their practice in a positive way.

Discussion
This single centre service evaluation has demonstrated that the benefits of creating an ICU recovery service may be wide reaching. There appeared to be positive consequences for the individual patient and caregiver, as well as the staff involved in delivering the intervention. More research is required in this area, specifically, how ICU follow-up care may potentially improve other outcomes across the patient journey.

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Introduction of a new 24 hour daily patient record of care chart in ICU University Hospital Crosshouse

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According to the Health Foundation (2013) improving quality is about making healthcare safe, effective, patient-centred, timely, efficient and equitable. (1) The aim of this Quality Improvement project was to increase the safety and reliability in the care provided by improving the daily MDT communication and documentation.

Methods
Using Improvement methodology we devised a driver diagram that defined our improvement plans:
Development of MDT working group
Staff consultation/feedback regarding improved documentation
Testing of new documentation
Documentation roll-out
Evaluation of QI project
Using PDSA methodology helped us to understand specific aspects of our system better and address issues.

Results
An MDT approach was adopted to consider what information should be included in the new document. Thereafter the document was tested and is about to be rolled out for use within our ICU. Changes included:

- Tailored person centred care plan
- The 24 hour observation chart allows new data to be recorded for the newly implemented Hamilton ventilators.
- The SICSAG Quality indicators (afternoon ward round, CAM ICU, RASS and CPOT, early mobilisation) are all included in the chart.

By simply utilising a MDT approach to documentation, we have collectively made an impact on communication hope this will improve patient safety within ICU.

Discussion
The aim of this project was to improve the ICU documentation that was already in place and to have a reference to all patient information required in one document. Improvement of multi-disciplinary collaboration has hopefully improved patient outcomes resulting in the best possible ICU environment for 'Every Patient, Every Time'
We now plan to evaluate the effectiveness of change by obtaining staff feedback and measuring compliance with completion of daily safety bundles.

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The prevalence, risk factors and outcomes of diuretic-associated hypernatraemia in critically ill patients

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Between 2-6% of patients are hypernatraemic on admission to the intensive care unit (ICU) and a further 4-8% develop it during their admission. These patients have an increased ICU length of stay and mortality rate [1]. Diuretics are a cause of ICU-acquired hypernatraemia, but this subgroup has not been extensively studied [2].

Methods
A retrospective cohort study was conducted of 599 consecutive patients aged ≥18 years who were admitted to a large medical-surgical ICU over a two year period and had an ICU stay of seven calendar days or greater, which included at least one level three day. Hypernatraemia was defined as serum sodium ≥150mmol/l. Data collected included urea and electrolytes, length of stay, ICU, hospital, 28 day and 60 day mortality, age, sex, APACHE II score and mortality prediction, reason for admission, and diuretic prescription in the ICU. Additionally, for patients who were prescribed diuretics, weight, pre-hospital diuretics, sodium load, fluid balance and diuretic dose, route, type, and duration were recorded. Confirmation of exemption from ethical approval was received. Two sample t-tests, Mann-Whitney U tests, two-proportion t-tests and logistic regression models were used.

Results
Three hundred and thirty two (55.4%) patients were prescribed diuretics, of whom 311 (93.7%) were prescribed furosemide boluses and 81 (24.4%) were prescribed furosemide infusions in their first episode of diuretic use. Patients prescribed diuretics were more likely to be female ($p<0.001$) and had a higher APACHE II mortality prediction ($p=0.044$). Forty nine (14.8%) patients prescribed diuretics developed hypernatraemia during their first diuretic episode, labelled diuretic-associated hypernatraemia (DAH). Compared to patients prescribed diuretics with no hypernatraemia in the ICU, these patients had a longer ICU length of stay ($p<0.001$) and a higher hospital ($p=0.012$) and 60 day mortality ($p=0.036$). Pre-diuretic sodium and urea, total furosemide dose and furosemide infusion were independent risk factors for the development of DAH.

Discussion
The majority of critically ill patients in this cohort were prescribed diuretics, of whom approximately 15% developed DAH. Raised serum urea was a risk factor for DAH which may suggest it is associated with volume status. Patients with DAH had a greater ICU length of stay in hospital and 60 day mortality than patients prescribed diuretics with no hypernatraemia in the ICU. This may be due to greater severity of illness which required higher doses of diuretics. Alternatively, hypernatraemia may decrease myocardial contractility and worsen multi-organ failure [3]. Further research must establish whether hypernatraemia is causative of mortality. This would determine whether strategies for the prevention and management of DAH are necessary or harmful. This study also suggests that the cause of hypernatraemia must be considered in any future research.

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The value of routine blood-borne virus (BBV) testing in the intensive care unit (ICU)

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In the intensive care unit (ICU), patients with acute kidney injury require renal replacement therapy (RRT). Despite the use of disposable components, there is a risk of blood-borne virus (BBV) transmission via sharing RRT equipment. This mainly relates to Hepatitis B (HBV), Hepatitis C (HCV) and human immunodeficiency virus (HIV). As such, ICU patients are screened for BBVs before commencing RRT with dedicated RRT machines allocated for patients with specific BBV statuses. Since 2012, all patients routinely undergo BBV screening upon admission to the Glasgow Royal Infirmary (GRI) ICU. Routine BBV testing informs patients of their BBV status, which is beneficial to both the individual and society. HCV is a pertinent health issue in Scotland. The Scottish government aims to eliminate HCV by 2030 and is researching innovative and cost-effective methods to identify undiagnosed infections [1]. The aim of this study is to determine if routine BBV testing in ICU patients contributes to the discovery of undiagnosed patients with BBVs.

Methods
This single-centre retrospective observational study examined prospectively collected clinical data from 1069 ICU admissions. Postcodes were matched on the Scottish Index of Multiple Deprivation (SIMD) 2016 Index Lookup to determine its allocated deprivation quintile. As all required information was routinely available and the results of the study would be fully anonymised, this study was confirmed to not require approval by an NHS Research Ethics Committee prior to data collection. Proportions were compared using a two-proportion z-test and a logistic regression model was carried out to determine if deprivation quintile was independently associated with the seroprevalence of BBVs.

Results
Of 1069 admissions, at least one BBV test was performed in 899 admissions. The seroprevalence of each BBV in the cohort studied: 0.45% (HBV), 11.7% (HCV), 0.91% (HIV). The seroprevalence of HBV in the cohort studied was similar to that of Scotland (p=0.11), but the seroprevalence of HCV (p<0.001) and HIV (p=0.01) were statistically significantly higher than that of Scotland [2]. Due to the small number of reactive test results for HBV and HIV, the relationship between deprivation and BBV seroprevalence was explored for HCV only. The only independent variable associated with a reactive anti-HCV test result was "current or previous illicit drug use" (adjusted odds ratio of 40.2; 95% confidence interval of 21.1-76.4; p<0.001).

Discussion
Although this observational study shows that routine BBV testing in the GRI ICU is useful in discovering new reactive BBV test results, the costs should be considered in a holistic evaluation of its usefulness. The BBV seroprevalence in the cohort studied is higher than that of Scotland. Current or previous illicit drug use was the only independent variable associated with higher anti-HCV seroprevalence. This is the first observational study focusing on the value of routine BBV testing in an ICU setting to our knowledge.

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The relationship between frailty at ICU admission and 2-year mortality. A retrospective observational cohort study.

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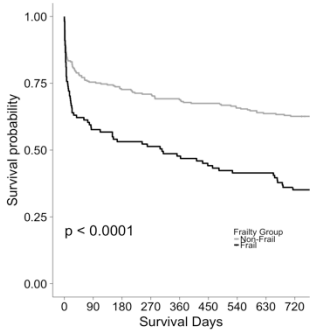
Frailty is characterised by decreased resilience to stressors and increased susceptibility to adverse events. Our previous study demonstrated that frailty was significantly associated with greater hazards of 1-year mortality, with most of the between-group differences stemming from the first 30 days from ICU admission. Since mortality differences stabilised thereafter, we hypothesised that the effect of frailty on mortality between 1 and 2 years would not be significant. Determining the magnitude and timeframe of the effects of frailty on mortality, particularly in the longer term, could aid outcome prediction and therefore decision making. This study primarily aimed to investigate frailty's impact on 2-year mortality.

Methods
This single-centre retrospective observational study examined prospectively collected data from a previously studied cohort of 400 ICU patients, extending the follow-up period from 1 to 2 years. Frailty was assessed using the Clinical Frailty Scale[1] (CFS) and defined as CFS ≥5. Unadjusted and adjusted analyses tested the relationships of frailty, covariates and mortality.

Results
27.8% of patients were frail and 72.3% were non-frail. Frail patients were older, had higher APACHE-II scores and were more likely to be female. Frailty was associated with increased mortality to 2 years (64.9% vs 37.4%, p<0.001). **Contrary to our hypothesis, mortality between 1 and 2 years remained significantly higher for frail patients (25.0% vs 8.5%, p=0.003).** Frailty significantly increased 2-year mortality hazards in unadjusted analyses (HR 2.12; 95%CI; 1.57-2.86; p<0.001) and covariate adjusted analyses (HR 1.53; 95%CI 1.13-2.11; p=0.007). Point-by-point increases in CFS scores were significantly associated with a greater hazard of 2-year mortality in both unadjusted analyses (HR 1.2; 95%CI 1.1-1.3; p<0.001) and adjusted analyses (HR 1.1; 95%CI 1.01-1.20; p=0.024).

Discussion
Death rates for frail patients remained significantly higher between 1 and 2 years, indicating a persistent hazardous effect of frailty on long-term mortality. The magnitude and significance of the independent effect of frailty on mortality was higher at 2 years than 1 year. Point-by-point analyses were a more sensitive way of determining hazards for individual CFS increases and this information may be more clinically useful than use of a dichotomised scale alone. Frailty scoring remains a promising tool to increase accuracy of short and long-term outcome prediction, allowing for more informed decision making in the critically ill.



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A clinical pharmacy follow-up service for adult inpatients discharged from ICU utilising critical care trained pharmacists

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Admission to the intensive care unit (ICU) often leads to multiple medication changes which can contribute to a variety of ICU-specific pharmaceutical care issues (PCIs) for patients[1]. An inpatient follow-up review of post-ICU patients by a specialist critical care pharmacist (SCCP) may address many of these issues prior to hospital discharge. The objective of the study was to identify the potential clinical impact of a post-ICU follow-up service utilising SCCPs for adult inpatients at the Queen Elizabeth University Hospital, Glasgow. The study was conducted over a 3 month period between January and March 2018.

Methods
Patients were identified using ICU electronic medical records. A data collection tool was prepared to collect information on ICU-specific PCIs, the interventions undertaken to address these PCIs during a SCCP follow-up as well as time of follow-up and patient demographics. The pilot post-ICU follow-up was conducted over a 3 month period using this tool. A questionnaire was prepared which described all the PCIs encountered and the action taken to rectify them during the SCCP follow-up. Respondent information was gathered from medical, nursing and pharmacy staff on their perception of the potential clinical impact of interventions (low, medium, high or life saving). All available discharge prescriptions were reviewed to assess the persistence of ICU-related PCIs to hospital discharge.

Results
Fifty-one patients were identified and included in the SCCP post-ICU follow-up pilot. In these patients, 58 individual PCIs were identified resulting in 61 interventions to address them. Follow-up was on average 1.7 days post-ICU discharge. It was found that 40 (78.4%) patients had at least one ICU-specific PCI. There were 19 (37.3%) patients did not have medication reconciliation plans in place at ICU discharge. The 3 most common categories of ICU-specific PCIs were: 15 (25.9%) instances of no medication for a present indication, 13 (22.4%) issues with duration of therapy and 9 (15.5%) prescribed medications with no indication. A total of 26 hospital staff members responded to the questionnaire (12 pharmacy, 8 medical and 6 nursing). The majority of interventions, 49 (79.6%), were scored as being of moderate potential clinical impact or higher with 40 individual instances of questionnaire respondents marking interventions as being potentially "life saving". Thirty-Six discharge prescriptions from hospital were available for analysis, of which 4 (6.6%) had ICU-specific issues and 1 specific situation required urgent remedial action involving contacting the general practitioner.

Discussion
Follow-up by an SCCP found ICU-specific PCIs in 40 (78.4%) of the post-ICU inpatients. Identification of these led to moderate to high potential clinical impact interventions in the majority of cases. Improvements to ICU discharge medicines reconciliation were identified as required and this has feed into changes to induction training for new staff and a review of ICU discharge documentation. The identification of serious ICU-specific PCIs, which persist beyond hospital discharge, highlights the need for a SCCP follow-up service as a targeted and effective use of specialist staff. Current outpatient post-ICU pharmacy follow-up models enact broadly similar interventions at a much greater interval from ICU-discharge [2].

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It's time to suck-a quality improvement project on suction catheter readiness

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Suction catheters are of key importance in maintaining a patent airway, particularly when high secretions or gastric contents threaten aspiration. As such, they should be ready at the point of use in 100% of available areas. The availability of suction catheters at point of use was tested in September and October at Borders General Hospital.

Methods
Ten areas of the hospital were tested-theatres, anaesthetic rooms, recovery, ITU, surgical ward one, surgical ward two, medical ward one, medical assessment unit, A&E and CT scanner. Only beds with patients present or emergency areas (that may be needed at any given point such as resuscitation bays) were included at the point of testing. Suction units were checked for the presence of clear tubing, yellow tubing, suction catheter, collection bag and working wall mount.

Following the initial data collection, staff education was performed on each ward. Re-testing was subsequently performed.

Results
Encouragingly, seven of the ten areas achieved 100% readiness at both initial and repeat testing. These were theatres, anaesthetic rooms, ITU, recovery, A&E, medical assessment unit and CT scanner.
Of the wards, surgical ward one achieved 100% on initial testing but dropped to 85.7% (12 of 14) readiness on re-testing.
Surgical ward two showed a notable improvement from 37.5% (6 of 16) to 77.8% (14 of 18).
Medical ward one also showed an improvement from 73.7% (14 of 19) to 93% (27 of 29).
It was also shown that on re-testing when the suction devices were not ready at point of care, fewer parts were missing than on initial testing. This amounted to one piece missing in four cases and two pieces missing in ten cases on initial testing compared to one piece missing in six cases and two pieces missing in two cases on re-testing.

Discussion
It was encouraging that a number of areas achieved 100% at both initial and re-testing. However, hospital wide, this target is not being achieved and was noted to be particularly poor on some of the wards. Whilst not specifically part of the quality improvement question, it was noted that side rooms appeared to be more likely to have components missing than the main ward areas and this could be looked into further in future cycles. Ongoing importance needs to be given to staff to take responsibility and regularly check suction catheters are ready to use as part of their normal ward management.

Dosing of Continuous Renal Replacement Therapy in ICU.

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Between 5-10% of critically unwell patients with AKI in ICU will require RRT. According to GPICS and KDIGO guidelines released following the ATN and RENAL studies the recommended effluent dose of CRRT is 20-25ml/kg/hr [1, 2]. Despite this evidence we identified that we frequently exceeded the recommended dose. In June 2018 we introduced a simplified dosing guideline aiming to improve compliance with the recommended dosing. The purpose of this audit was to determine whether introducing simplified dosing guidance could improve adherence to international guidelines on CRRT dosing.

Methods
This audit compared 3 groups of patients; a baseline period (Group A, 16 patients, 14/11/16-20/12/16), a 6-month period prior to introducing the guideline (Group B) and the 12-month period following the guidelines introduction (Group C). Data was collected from IntelliSpace Critical Care & Anaesthesia (ICCA) and anonymised. Patient demographics were analysed to determine if groups were comparable in age, sex and APACHE II score. Daily median dose was calculated for each patient. Each day was then assigned into below (<20ml/kg/hr), at (20-25ml/kg/hr) or above (>25ml/kg/hr) recommended dose and expressed as a percentage of days in each category. Mean dose, standard error and standard deviation was calculated for each patient each day. F-Tests were performed to determine if variance was equal and appropriate T-Tests selected to compare compliance to the guidelines. Further analysis using one-way ANOVA's for all groups median and mean doses was also completed. Throughout all analysis a significance level of $p<0.05$ was applied.

Results
The audit included all patients over the identified periods; 16 patients in Group A, 57 patients in Group B and 165 patients in Group C. In total more than 19,020 hours of CRRT in the unit were analysed, equating to a total of 1139 days on CRRT. There was no significant difference in patient demographics across the groups. Percentage of days in compliance with the recommended dose were; Group A - 2.8%, Group B 13.8% and Group C 33.7%. There was a significant improvement following the introduction of the guidance with Group C spending 19.9% more days in compliance than Group B ($p<0.01$). There is also significant improvement from previous audit data between Group B and Group A (11%, $p<0.01$). The mean doses (ml/kg/hr) were; Group A - 37.2, Group B – 36.5 and Group C – 28.8. There is a significant reduction (7.7) in mean dose between Group B and C ($p<0.01$) and no significant difference in mean dose between Groups A and B.

Discussion
There has been a statistically significant improvement in compliance over the entire audit period, with the greatest improvement since the unit guidance was introduced. The reduction in mean dose is only demonstrated since the introduction of the guidance and supports the efficacy of guidance in improving compliance to guidelines. Improved compliance to CRRT benefits patients and ICU by reducing side effects, cost and workload. By including all patients during the given period, the quality and validity of the audit can be assured to be representative of practice in the unit. Study into the utilisation of unit guidance may be the next step in improving adherence to international guidelines.

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