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Abstract

Background: Quality of care is a major focus in the intensive care unit.

Aim: To describe a nurse initiated quality improvement project that improved the care of critically ill patients in a New Zealand tertiary intensive care unit.

Design: A framework for quality improvement was developed and implemented as part of a practice change initiative.

Methods: Audit data was collected, analysed and reported across seven nurse-influenced patient care standards. The seven standards were enteral nutrition delivered within 24 hours of admission, timely administration of antibiotics, sedation holds for eligible patients, early mobilisation and three pressure ulcer prevention strategies.

Results: Comparison of audit data collected in 2014 and 2015 demonstrated improvements in five of the seven standards. Those standards with the largest practice improvements related to the following standards: all eligible patients have enteral nutrition commenced within the first 24 hours of ICU admission (3% increase); all eligible patients receive antibiotics within 30 minutes of prescription time (6% increase) all eligible patients have a daily sedation interruption (24% increase), and all eligible patients are mobilised daily in their ICU stay (11% increase in percentage of patients mobilised daily).

Conclusions: The nursing initiated quality improvement project demonstrated improved ICU patient care in relation to early enteral nutrition commencement, daily sedation interruptions, and early and daily mobilising.

Relevance to clinical practice: The use of a nursing quality improvement framework incorporating audit and feedback is one method of evaluating and enhancing the quality of care and improving patient outcomes. This initiative demonstrated the improved quality of nursing care for ICU patients, particularly in relation to early enteral nutrition commencement, timely antibiotics, daily sedation interruptions and daily mobilising. It is thus highly relevant to critical care nursing teams, particularly those working to create a culture where change is safe, achievable and valued.

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INTRODUCTION

Critical care is a complex, fast-paced and constantly evolving environment. Providing nursing care that is of high quality which positively impacts patient outcomes is challenging. Achieving the best care possible for patients and their families provides the foundation for quality improvement initiatives that are driven locally (e.g., Capital and Coast District Health Board, 2016a), nationally (e.g., Ministry of Health, 2016) and internationally (e.g., World Health Organisation, 2012).

Whilst quality improvement initiatives which positively influence patient outcomes are valid aspirations, in reality they are complex and multifaceted. Time and resource constraints and insufficient communication threaten the integrity of quality improvement strategies (de Vos et al., 2013). Nevertheless, with improving patient outcomes at the forefront of practice innovation, developing ways to create an environment where change is considered safe, acceptable, achievable and valued is a worthy venture. We describe an Intensive Care Unit (ICU) quality improvement project that includes a framework for practice change, the development of nurse initiated, evidence based and reportable standards, and the results from 2014 and 2015 audits.

Measuring quality in an ICU

To measure and evaluate quality and safety at a national level in New Zealand, the Health Quality and Safety Commission employ a set of quality and safety indicators. Nursing sensitive quality indicators are measures identified as relating particularly to nursing care. These indicators have been described as valid and reliable in the support of nursing care quality and performance measurement (Heslop and Lu, 2014). Some of those indicators measured and reported in NZ include reducing healthcare associated infections, perioperative harm, harm from falls, surgical site infections and medication errors (Health Quality and Safety Commission, 2015). Whilst these quality indicators are well established at a national and bi-national level in enhancing healthcare performance (e.g., Australian Council on Healthcare Standards and Health Services Research Group, 2014, Australian and New Zealand Intensive Care Society Centre for Outcome and Resource Evaluation, 2015), at local levels there remains an opportunity to improve processes, especially at the frontline. Key aspects highlighted as barriers to the success of quality improvement initiatives in ICU include communication delays, poor reporting and difficulty measuring the impact (van der Veer et al., 2013). To mitigate some of these barriers, a framework evolved during this local ICU quality improvement initiative.

(*see Figure 1*. ICU quality improvement programme).

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METHODS

Context

This practice change initiative was developed in an 18-bed general ICU in a New Zealand tertiary level hospital. The patient population included both adults and paediatrics from a variety of specialities including neurosurgery, cardiothoracic surgery, complex medical and general surgery. The senior nursing team is responsible for key portfolios such as infection control, and health and safety. Specifically, nationally led initiatives and health targets (e.g., Ministry of Health, 2016, Health Quality and Safety Commission, 2015) are managed by these portfolio holders. Initiatives include minimising inpatient falls, improving hand hygiene practices (infection control), offering smoking cessation advice, and measuring pressure ulcer prevalence. One of the key portfolios is 'quality and audit' and this portfolio led to the inception of this project.

Intervention

Practice change is inherent to the local quality and audit portfolio. This project integrated models of change management and local practice change strategies to improve the quality of nurse-influenced patient care.

Practice change development

The framework for this project was developed using commonly recognised models of change management (e.g., 8 steps of change, Kotter, 2007), constructive feedback (e.g., Linehan and Wilks, 2015's communication technique of Describe, Express, Assert, Reinforce, Mindfully, Appear, Negotiate; D.E.A.R.M.A.N.), quality improvement (e.g., Ministry of Health, 2002's Plan, Do, Study, Act; PDSA). A cyclic, four stage process (see Figure 1) outlines the stages and key considerations throughout the project.

Project implementation

In the first stage, *initiate*, the Quality Improvement (QI) team was developed and included the local stakeholders. The seven key nurse-influenced cares were highlighted from a comprehensive literature search and review. The project titled "nurse-influenced cares" was used to reflect seven specific and measurable fundamental ICU patient care standards which includes:

1) All eligible patients have enteral nutrition commenced within the first 24 hours of ICU admission;
2) Prescribed antibiotics are administered within half an hour of prescription time;
3) All eligible patients have a daily sedation interruption;
4) All eligible patients are mobilised early in their ICU stay and daily;
5) All eligible patients are repositioned within three hour intervals;
6) All eligible patients have endotracheal tubes repositioned and re-tied 12 hourly;
7) All eligible patients have nasogastric tubes repositioned and re-taped 12 hourly.

Literature review

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A comprehensive literature search of electronic databases (PubMed, Cochrane, EMBASE) identified evidence underpinning each of the standards. Meta-analyses, systematic reviews, randomised controlled trials, observational studies, retrospective and prospective cohort studies, guidelines and quality improvement studies were obtained on each of the nurse-influenced cares. The evidence underpinning these standards is now summarised.

1. *Enteral nutrition delivered within 24 hours of admission to ICU*

The provision of enteral nutrition to critically ill patients has been explored from a variety of perspectives. For example, timing, volume, assessment of nutritional efficacy, tolerance to feeding and method of nutrition delivery (McClave et al., 2016). Randomised controlled trials and meta-analyses have shown improved patient outcomes when enteral nutrition was delivered within 24-48 hours of admission to ICU (Doig et al., 2009, Khalid et al., 2010, Marik and Zaloga, 2001, McClave et al., 2016, Chiang et al., 2012, Kim et al., 2015, Vicic et al., 2013, Lee et al., 2014, Li et al., 2014, Yin et al., 2015). Specifically, there was a significant reduction in mortality and infectious complications across multiple patient populations (Doig et al., 2009, Khalid et al., 2010, Marik and Zaloga, 2001, McClave et al., 2016). The majority of studies define early enteral nutrition as within 24 -72 hours of admission to ICU. Locally, the QI team developed *Standard one: All eligible patients have enteral nutrition commenced within the first 24 hours of ICU admission*.

2. *Antibiotics given within half an hour of prescribed time*

The link between mortality and timing of antibiotic administration remains tenuous with great disparity between optimum timing and patient outcomes (Bloos et al., 2014, Corona et al., 2010, Puskarich et al., 2011, Sterling et al., 2015, Vilella and Seifert, 2014) (Ferrer et al., 2009, Garnacho-Montero et al., 2006, Kumar et al., 2006). What is clear is that critically ill adult and paediatric have worse outcomes when appropriate antibiotics are delayed (Ignatavicius et al., 2012, Perron et al., 2014, Tigen et al., 2013, Weiss et al., 2014, Muszynski et al., 2011). Unfortunately, these delays in antibiotic administration are common (Cullen et al., 2013, Larochelle et al., 2009). Locally, the QI team developed *Standard two: Prescribed antibiotics are administered within half an hour of prescription time*.

3. *Daily sedation interruptions for all eligible patients*

The management of sedation, analgesia and delirium has become a major focus for clinicians in the ICU over the past ten years (de Biasi et al., 2015). There is clear evidence that medications such as sedation, opioids, and benzodiazepines are a significant risk factor in the development of delirium and highly prevalent in the ICU (Rea et al., 2007). The evidence around daily sedation interruptions (DSI) yield favourable patient related outcomes when compared to continuous infusions of sedation. Reduced mechanical ventilation days, shorter length of stay and increased survival are shown in several studies both randomised and non-randomised (Kress et al., 2000, Yiliaz et al., 2010, Jones et al., 2014, Khan et al., 2014). However, the use of sedation protocols and algorithms that target continuous light levels of sedation also show improved patient outcomes (de Wit et al., 2008, Burry, 2014, Mehta et al., 2012), Minhas et al. (2015). Two recent meta-analyses question the benefit of DSI in addition to the use of sedation protocol, but suggest either should be considered rather than

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keeping the patient heavily sedated (Aitken et al., 2016, Aitken, 2015). International guidelines agree that in ICUs where protocolled sedation is not used, DSI should be performed in all eligible patients (Barr et al., 2013, Baron et al., 2015). In this ICU, a sedation protocol is not used, thus DSI utilised instead.

4. *Early and daily mobilisation for all eligible patients*

Lean muscle mass loss, acquired weakness and poor functional outcomes are well known sequelae of immobilisation during critical illness (Cameron et al., 2015, Parry and Puthucheary, 2015). These complications lead to a longer duration of mechanical ventilation and longer length of stay, exercise intolerance and decreased quality of life (Cameron et al., 2015). Randomised studies, systematic reviews and meta-analyses have shown trends towards fewer days on mechanical ventilation, better functional status and shorter periods of delirium with early mobilisation strategies (Calvo-Ayala et al., 2013, Burtin et al., 2009, Cameron et al., 2015, Denehy et al., 2013, Boots et al., 2013, Li et al., 2013, Schweickert et al., 2009). Beneficial effects are echoed in other non-randomised studies although the extent of effect is variable amongst them (Clark et al., 2013, Fraser et al., 2015, Hodgson et al., 2015, Klein et al., 2015, Needham et al., 2010, Titsworth et al., 2012). This is especially so when combined with a daily sedation hold or sedation protocol (Balas et al., 2014). Establishing early mobilisation strategies into the culture and practice of intensive care and developing protocols to guide safe practice remains a priority for clinicians (Hodgson et al., 2015). However, knowledge around the optimum timing, degree and length of mobilisation is yet to be established by the literature. Expert consensus and critical care guidelines promote the early daily mobilisation of patients in the ICU where appropriate (Hodgson et al., 2015, Barr et al., 2013).

5. *Pressure ulcer prevention*

Risk factors in the development of pressure ulcers in critically ill patients include patient age, severity of illness, and length of ICU stay, mechanical ventilation, vasopressors, cardiovascular disease and co-morbidities (Cox, 2015, Cox, 2011, Cremasco et al., 2013). The onus is on assessment of individual risk using a validated scale and pressure area relieving techniques (García-Fernández et al., 2013, Bergstrom et al., 1987, Waterlow, 1985, Hyun et al., 2013, Reddy et al., 2006, Sullivan and Schoelles, 2013). Locally, pressure ulcers of the sacrum, and device related ulcers to the mouth (endotracheal tube) and nose (nasogastric tube) are the most commonly reported. Sacral ulcers account for 10-36% of all annually reported pressure ulcers (locally) with those of the mouth and nose 25-50% and 2-12% respectively. The standard locally is patients have a daily Braden score completed, regular staff education by a dedicated wound care team and an alternating air mattress within 24 hours of ICU admission. Attentive care and repositioning of medical devices that come into close contact with the skin mucosa is also an additional prevention strategy (Dyer, 2015). The National Pressure Ulcer Advisory Panel (NPUAP) suggest repositioning the medical device every 12 hours (or more frequently based on individual risk) (National Pressure Ulcer Advisory Panel et al., 2014). This has become the standard in our ICU.

Repositioning (turning) of the patient a minimum of every three hours is the local standard to reduce pressure on bony prominences, sacrum and back. However, much of the research around the optimum turning time and the impact on pressure ulcers remain inconclusive. Anywhere between 2-

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4 hours is the most common time interval studied in the research (Defloor et al., 2005, Gillespie, 2015, Kim and Jeong, 2012, Manzano et al., 2014, Moore et al., 2013, Still et al., 2013, Vanderwee et al., 2006). Locally, the QI team developed *Standard five: All eligible patients are repositioned within three hour intervals; Standard six: All eligible patients have endotracheal tubes repositioned 12 hourly*; and finally *Standard seven: All eligible patients have nasogastric tubes repositioned 12 hourly*.

Study of the Intervention

In the second stage, *engage,* the vision was communicated to the ICU team in team meetings, electronic dashboards, and a monthly e-mailed update. By focussing the nurse's attention to the nurse-influenced cares through overt collection and reporting of the data, it was anticipated that compliance would improve, and subsequently positively influence patient outcomes. This is thought to be from exploitation of the Hawthorne effect (Zhong and House, 2012, Kompier, 2006, Hagel et al., 2015, Kohli et al., 2009). The effect of the practice change initiative was measured by a documentation audit.

Measures

In the third stage, *enable*, a data collection tool was developed for each standard and education given to the auditors. Prior to project roll out, there was pre-specified eligibility criteria defined for two of the standards; sedation holds and daily mobilisation. Eligibility was assessed by the same auditor each time using pre-defined criteria. The pre-defined criteria reflected those of de Wit et al. (2008), Burry (2014) and Mehta et al. (2012). Exclusion for sedation holds included (but not limited to) traumatic brain injury requiring sedation for management of raised intracranial pressure/ neuroprotection, haemodynamic instability, active haemorrhage, active cooling or hypothermia, status epilepticus, palliation, concurrent neuromuscular blockage, ventilation management that required ongoing sedation (high FiO_2, high PEEP), or any situation where the medical and nursing team did not feel it appropriate or safe to de-sedate the patient. If the patient tolerated the sedation hold, it continued until extubation or until re-sedation was necessary because of agitation, discomfort or haemodynamic and/or respiratory compromise.

Eligibility for mobilisation was also pre-defined prior to audits commencing, and reflected those of Cameron et al. (2015) and (Hodgson et al., 2014). Patients were deemed eligible for mobilisation if they were extubated or on long term ventilatory weaning with a tracheostomy, if they were neurologically, cardiovascularly and respiratory stable, and with adequate pain control. Each episode of mobilisation continued for as long as the patient tolerated.

The initial audit of patient flow charts commenced in 2014 and provided a baseline measure. The data collection tool provided a quantitative measure for studying the impact of the practice change initiative. The fourth stage, *sustain*, included the continuation of data collection and feedback to nursing and medical staff through a variety of different methods. To reach the widest ICU audience, the "nurse-influenced care initiatives" dashboard was displayed at the same location as medical and nursing handovers were held. This was in addition to quarterly and annual data analysis, ongoing education and feedback in the unit. Further initiatives include adaptation of the 24-hour flow chart

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to highlight the importance of nursing-influenced cares, nursing education on the importance of mobilisation and sedation interruptions and inclusion of this information in the orientation booklet for all staff new to the ICU. In 2016 an electronic dashboard was established to complement the existing project and data presentation.

Ethical considerations

Audits were registered within the local hospital and involved data collection from the patient's ICU flow chart once per month. Only two auditors collected the same data each month with a dedicated audit collection tool. Permission was requested from the patient at the bedside where possible and the patients attending nurse. According to local policy, ethical approval was not required for this project due to the primary interventions being standardisation of existing practice, and audit of documentation (Capital and Coast District Health Board, 2016b). Only data related to standards, the patient's admission date and reason for admission was collated using the data collection tools. No other patient identifiers were recorded.

Results

Comparison of the 2014 and 2015 data for each of the seven standards measured are illustrated in Figure 2. Each of the standards had different numbers of patients and episodes reported. The raw data for each of the standards is tabulated under the graph of percentage results.

The largest practice improvements related to the following standards: all eligible patients have enteral nutrition commenced within the first 24 hours of ICU admission (3% increase); all eligible patients receive antibiotics within 30 minutes of prescription time (6% increase) all eligible patients have a daily sedation interruption (24% increase), and all eligible patients are mobilised early in their ICU stay and daily (11% increase in percentage of patients mobilised daily). Along with the data on daily mobilisation, data was collected on the day patients were first mobilised to gain an understanding of how early this practice was occurring. In addition to daily mobilisation, it appears the greatest percentage of patients are mobilised early, between day 0-3 of their ICU stay (79% of patients in 2014 and 53% in 2015). In relation to the three remaining standards (the 3 pressure ulcer prevention strategies) there have been improvements, but this appears to be much more variable from quarter to quarter and annually. The reasons for this are complex and multifaceted, influenced potentially by contextual factors such as ICU patient flow and acuity, and nursing staffing levels.

Discussion

Analysis of the data has demonstrated the most significant nurse-influenced care improvements in the following four standards: all eligible patients have enteral nutrition commenced within the first 24 hours of ICU admission, all patients receive antibiotics within half an hour of prescription time, all eligible patients have a daily sedation interruption and all eligible patients are mobilised early in their ICU stay and daily. The provision of early enteral nutrition for critically ill patients is an important initiative that has been built upon, and is complementary to, a previous practice change project (see Jarden and Sutton, 2014). This previous project was successful in improving the provision of enteral nutrition to critically ill patients and was instrumental in highlighting the benefits of starting enteral nutrition early in the unit. The complexities in healthcare practice change

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initiatives make it challenging to directly attribute specific audit findings to the project, as highlighted by Hughes (2008) and (Dixon-Woods et al., 2012). Nevertheless, publication of this project will add to the current practice change literature. Where possible the authors have adopted the SQUIRE guidelines for reporting improvement studies in healthcare to support completeness and transparency in documenting the project (Davidoff et al., 2008, Oermann, 2009).

Early and daily mobilisation is a practice gaining momentum in critical care and challenging previous assumptions that critically ill patients should not be mobilised. Emerging evidence supports the clinical benefits of mobilisation and is safe and feasible (Hodgson et al., 2015). Locally in the ICU, culture and practice is changing. It is envisaged through projects such as this, mobilisation of the critically ill patient would become engrained into practice. Certainly, the results show early mobilisation is occurring for the greatest percentage of patients in our unit around day 0-3. This may be related to the large numbers of cardiothoracic and elective surgical patients who are routinely mobilised on day 0-1. Whilst inclusion of these surgical patients could be considered to have influenced the data, what we have found is the routine practice with this group of patients has actually contributed to the overall change in culture of early mobilisation for all patients in this ICU. Daily sedation interruptions are also becoming engrained into our practice. This in itself may be impacting on the concomitant increase in early mobilisation, as the patient may liberate from mechanical ventilation early.

With the improvements seen in the delivery of early EN, antibiotic administration, daily sedation holds and daily mobilising an important point was identified. These aspects are integrated into the medical team handover by use of a daily checklist and discussed at the bedside by both the nursing and medical team. What this reinforces is that a team approach to patient care with dual decision making related to a daily plan, improves compliance and challenges the culture of care. The success of the team approach to patient care is not new to the ICU, for example, see the commentary on interprofessional collaboration (Rose, 2011).

In relation to the rate of reported pressure injuries over the last two years, the number of pressure injuries remains unchanged. However, the reasons for this may be related to an increased drive and awareness of the reporting of pressure injuries into the local hospital “Reportable Events” reporting system. This in itself is an on-going improvement initiative by the risk management portfolio holder. The local hospital’s reporting system is highly valued in the local ICU and there is great onus placed on ensuring all pressure injuries are entered into the system by the nursing staff. There continues to be audit and feedback around pressure injuries and projects aimed at assessment and prevention continuously in the ICU.

Limitations of the project

Limitations to this project include, firstly, using point prevalence audits to collect data. As data was collected once-a-month, this resulted in small patient numbers in the data analysis. Whilst increasing the frequency of data collection would have undoubtedly improved this, additional resources would have been required negating the advantages of a rapid, easy to use audit system already in place. The rapid collection of data ensures issues can be addressed by quality improvement projects as a rapid response. Secondly, the rather crude reporting of the raw data as percentage compliance may

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also appear over simplistic. Whilst it is acknowledged statistical analysis of the data in relation to showing validity and statistical significance would have been advantageous, we believe the project as a whole has been a success based on the data reported. Finally, adopting an approach that incorporates behaviour change strategies (e.g., French et al., 2012) may have improved the design of the project and further improved compliance with the standards.

Conclusion

Previous local initiatives, education strategies (Jarden and Sutton, 2014) and implementation strategies (Jarden and Quirke, 2010, Jarden and Sutton, 2014) were used as a framework for this practice change initiative. The results show that the framework including audit and feedback improved early enteral nutrition commencement, timely antibiotic administration, daily sedation interruptions, and early and daily mobilising. When combined with a team approach focussing on key areas such as data collection, teaching, reporting of results to the unit, through the ICU dashboard have all proved successful in raising the level of compliance with these key components of nursing care. However, we recognise the impact of teamwork on the improvements in the nurse-influenced care initiatives described. Undoubtedly, the involvement of key allied health and teams such as medicine, physiotherapy and dietetics have a profound effect on driving culture change in an ICU where strong positive relationships are fostered.

What this paper adds:

1. Improved quality in critical care can be achieved with a frontline and local team initiating practice change.
2. A framework using audit, feedback, education and dashboarding are strategies which improve the delivery of nurse-influenced care to the critically ill patient.

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