

Factors to drive clinical practice improvement in a Malaysian intensive care unit: assessment of organizational readiness using a mixed method approach.

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ABSTRACT

This study assessed organisational readiness and factors to drive clinical practice improvement for VAP, CRBSI and PU in a Malaysian intensive care unit (ICU). A mixed method study approach was undertaken in a 16 bed ICU in regional Malaysia using an environmental scan, key informant interviews, staff surveys, and patient audit to elucidate factors contributing to planning for clinical practice improvement. Measurements of sustainability of practice and regard for the practice environment were assessed using validated measures. An environmental scan demonstrated high patient occupancy and case load. Nineteen percent of ICU patients developed complications according to validated measures. Survey results indicated that the majority of nurses had a good knowledge of strategies to prevent ICU complications and a positive attitude toward change processes. Engaging executive leadership was identified as crucial in priming the clinical site for practice change. Providing nurses with tools to monitor their clinical practice and empowering them to change practices are important in improving clinical outcomes.

Key words: clinical practice improvement, intensive care unit, organizational readiness, professional practice environment, mixed methods

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INTRODUCTION

Ventilator-associated pneumonia (VAP), catheter-related blood stream infection (CRBSI) and pressure ulcers (PU) are well recognized complications of admission to an intensive care unit (ICU). These complications, many of which are preventable, contribute to a complicated recovery, prolonged length of stay, increased costs, morbidity and mortality (Graves, 2010; Graves et al., 2010; Laupland, Kirkpatrick, Church, & Ross, 2004; Soo Hoo, Wen, Nguyen, & Goetz, 2005; Warren et al., 2006; Warren et al., 2003). Internationally, initiatives have been undertaken in Europe (McHugh, Hill, & Humphreys, 2010), North America (Solomkin et al., 2010), Australia (Butvila, Reilly, & Sturman, 2008) and New Zealand (West, 2009) to address preventable complications in the ICU. These initiatives predominantly focus on translating the best available evidence into strategies to improve the quality of patient care (American Thoracic Society, 2005; Berenholtz et al., 2004; Eman, Theo, & Ruud, 2009; Mermel et al., 2009). These recommendations have been consolidated as evidence-based guidelines which serve as constructive tools to achieve effective and efficient patient care (Barsanti & Woeltje, 2009; Erasmus et al., 2010; Lugtenberg, Burgers, & Westert, 2009).

International reviews have shown that guideline implementation results in significant improvements in the process of care (Grimshaw et al., 2006). However, implementing EBP is not always easy and can be challenging for a range of reasons. Implementing strategies to promote guideline adherence will result in improved patient outcomes (Lugtenberg et al., 2009). Analysis of barriers and facilitators to uptake of guidelines have found obstacles to change in practice at patient, professional, health care team, health care organization and practice environment levels

(Grol, 1997). Pronovost and Sexton (2005) have identified the importance of understanding safety culture factors. These factors include understanding staff characteristics, the patient care area, the department and variations in hospital culture. Singular research approaches do not allow the understanding of the complex and multifaceted clinical milieu, therefore, mixed method approaches are ideally suited to increasing the understanding of these contextual factors (Andrew & Halcomb, 2009).

Although studies have evaluated adherence to clinical guidelines in the Western world (Cason, Tyner, Saunders, & Broome, 2007; de Laat et al., 2007; Grol & Grimshaw, 2003), in a developing country with different organisational culture backgrounds such as Malaysia, the readiness of the organisation to accept and implement prescribed clinical guidelines is less well understood. Organisational factors and cultural influences that can potentially hinder or support EBP need to be identified (Evans-Lacko, Jarrett, McCrone, & Thornicroft, 2010; Wond & Macaulay, 2010). Therefore, it is important to assess environmental readiness, especially barriers and facilitators for implementation of EBP, within the context of developing countries. This study describes organizational preparedness and factors to drive clinical practice improvement in a Malaysian intensive care unit, focusing on preventing three major ICU related complications: VAP, CRBSI, and PU.

METHODS

Study design

This study used a mixed methods approach including an environmental scan documented as field notes, interviews with stake holders, patient profiling and a nurse survey to assess for organisational readiness and factors to drive clinical practice improvement. The mixed methods

approach was selected for this study because it can accommodate the disadvantages of certain individual research methods synergistically (Andrew & Halcomb, 2009). Moreover, contemporary health care is complex and dynamic, and so the use of both qualitative and quantitative methods of data collection can assist in understanding these complexities (Greene & Caracelli, 1997).

Study setting

The study was conducted in December 2009 to February 2010 in a 16-bed ICU in a Ministry of Health teaching hospital in Peninsular Malaysia. This general ICU caters for the critical care needs of the entire State and contains mixed medical and surgical units classified as Level Three (Ministry of Health Malaysia, 2008) with facilities for multiple organ support (e.g. mechanical ventilation and renal replacement). There are approximately 70-90 admissions per month. The intended nurse to patient ratio is 1:1 or more in complex cases, however, this ratio cannot be maintained at all times due to staff shortages.

The ICU has seven single rooms equipped with positive or negative pressure and nine open beds. Two single rooms share one hand washing sink which is located at the staff entrance at each room. There is total of ten hand washing sinks available in this ICU. Antiseptic hand rub usually is positioned on a small table (a place for cardiac monitor) at the end of each ICU bed but it is not always fixed at one location (which is at the end of patient bed) especially if traction is needed for the patient. Masks, aprons, and gloves are positioned at each patient's bedside.

In this ICU the heads of department are responsible for overall administrative management and two intensivists provide clinical care. The ICU nursing administration is head by one matron subordinate to another chief matron in the hospital. Five ward managers

coordinate nursing services in the unit and medical assistants are responsible for cleaning and maintenance of the equipment in the ICU. Nurses are predominately diploma and certificate-qualified nurses. Only three (3.6%) of 83 nurses have a baccalaureate degree. There is a wide range of clinical experience amongst these nurses.

Quantitative data collection

Patient profiling

All patients admitted to the ICU during December 2009 were screened using the CDC diagnostic criteria for VAP (Centers for Disease Control and Prevention, 2009) and CRBSI (Centers for Disease Control and Prevention, 2002a). All patients were assessed for PU during night shift at midnight until discharged from ICU (Waterlow, 2005). Detected cases of VAP, CRBSI and PU were followed-up by the researcher (KLS) until patients were discharged from hospital.

Patient information for those with VAP, CRBSI or PU provided a baseline for quality improvement initiatives. The baseline data collection form developed by the researchers (KLS, PMD, GL) consisted of two sections: general demographic patient information and disease-specific information including patient data, type of complications, diagnosis on admission, co-morbidity, blood investigations, status on discharge, Glasgow Coma Score, Simplified Acute Physiology (SAPS II), Sequential Organ Failure Assessment (SOFA) and Charlson Comorbidity Index score.

SAP II, a severity of disease score, and SOFA, organ dysfunction score, scoring systems have been developed for use in critically ill patients (Fueglistaler et al., 2010). Organ dysfunction

and organ failure are the major problems affecting the outcome of patients in the ICU (Ferreira, Bota, Bross, Melot, & Vincent, 2001).

The SOFA score calculates a summary value of repeatedly assessed routine variables defining the severity of dysfunction for six organ systems in critically ill patients over time (Vincent et al., 1996). The SOFA score includes fewer parameters than most other scores, thus offering a simpler way to evaluate morbidity (Fueglistaler et al., 2010).

The Charlson co-morbidity index predicts the one-year mortality for a patient who may have a range of co-morbid conditions such as heart disease, AIDS, or cancer (a total of 22 conditions). Each condition is assigned with a score of 1, 2, 3 or 6 depending on the risk of dying associated with this condition. The Charlson index is frequently used in critical care research and is consistently associated with patient mortality (Needham, Scales, Laupacis, & Pronovost, 2005). These measures enabled baseline data for patient severity to allow planning for future health care interventions.

The Malaysian Registry of Intensive Care has reported surveillance data from 2003 to 2008 that mean SOFA scores collected from this ICU at 2007 to 2008 was 5.7 and 6.3 respectively. The mean SAP II scores from 2003 to 2008 were 42.1 to 37.6, respectively, which indicates little change over this time period. The average mean SAP II score in Ministry of Health hospitals was 35.2; which has a predicted risk of in-hospital mortality of 27% (Malaysian Registry of Intensive Care, 2009). The ICU reported a mean of length of stay of 4.1 to 4.2 days from 2004 to 2008, respectively. Mean length of ICU stays in Ministry of health hospitals was 4.7 days which remained stable over the past six years (Malaysian Registry of Intensive Care, 2009). Mean length of hospital stay (16.6 and 16.7 days from 2004 to 2008, respectively) was also reported to have remained unchanged in this ICU (Table 1).

Nurse survey

The survey for nurses comprised of four sections; nurses' socio-demographic information, professional practice environment, sustainability index, and knowledge of prevention of VAP, CRBSI, and PU. Socio-demographic information collected included age, qualification, role in the unit, length of service as a nurse and length of service in the ICU. All nurses working in the ICU between 3rd to 28th February 2010 were invited to participate in the study. Participant information sheets, surveys, and translation sheets were distributed to the nurses by ward managers. All questionnaires were returned to a box located in the ward manager's office.

The Revised Professional Practice Environment (RPPE)(Erickson, Duffy, Ditomassi, & Jones, 2009) scale was used to describe the professional practice environment and is a validated measure of 39 items involving handling conflict (9 items, 2 negatively worded), internal work motivation (8 items), control over practice (5 items), leadership and autonomy in clinical practice (5 items), staff relationships with physicians (2 items), teamwork (4 items, three negatively worded), cultural sensitivity (3 items) and communication about patients (3 items). Nurses rated items on a Likert scale regarding the extent to which they agree or disagree each statement (1 = strongly disagree; 4 = strongly agree). The RPPE provides a more comprehensive picture of current professional practice environment in acute care settings and identifies issues related to conflict resolution and inter-professional practice (Erickson et al., 2009). Feedback provided from the RPPE serve as effective information that can help nursing leader to improve the various components in the department (Erickson et al., 2009).

Issues related to sustainability were assessed using a Sustainability Index developed and validated by the United Kingdom Institute for Innovation and Improvement (Institute for Innovation and Improvement, 2006). This instrument consists of 10 items to assess the sustainability of a workplace change. The items are grouped into three categories including process, staff, and organisation with maximum scores of 31.5, 52.0 and 16.9, respectively (Maher, Gustafson, & Evan, 2003). The total scores from three categories is a maximum score of 100. Total score closest to 100 indicating higher chances of successful sustainability. A score of 55 or above suggest reason for optimism while a score of 45 or lower suggests that some action needed to increase the likelihood improvement initiative will sustain (Maher et al., 2003).

The knowledge component of the survey was assessed using a 14-item investigator-developed questionnaire following review of available evidence-based practice guidelines for prevention of these three complications in the ICU (Barsanti & Woeltje, 2009; Carling, Parry, Bruno-Murtha, & Dick, 2010; Centers for Disease Control and Prevention, 2002b, 2009; Chan, Ruest, Meade, & Cook, 2007; Eman et al., 2009; Gastmeier & Geffers, 2007; Hutchins, Karras, Erwin, & Sullivan, 2009; Ramritu, Halton, Cook, Whitby, & Graves, 2008; Reddy, Gill, & Rochon, 2006; Riordan & Voegeli, 2009; Walz, Memtsoudis, & Heard, 2010; Wip & Napolitano, 2009; Zilberberg, Shorr, & Kollef, 2009; Zingg et al., 2009). These practices include hand washing, elevation of head of the bed more than 30 degrees, the benefit of barrier precautions during insertion of central venous catheter, and use of chlorhexideine. Nurses were asked to rank on a Likert Scale of 1 to 10 (1 = strongly disagree; 10 = strongly agree) the importance of EBP in nursing practice.

The survey was sent for evaluation of face validity to five leading Malaysian nurses with critical care backgrounds including two nursing directors from the Malaysian Ministry of Health,

one nursing lecturer from a public university, one nurse educator from a private hospital, and one nurse manager from Malaysian Ministry of Health hospital. All reviewers agreed with the relevancy and appropriateness of the questionnaire. Three of the reviewers suggested translating selected words to help the nurses understand the questions. Approximately 18 words were translated into Bahasa Malaysia.

Qualitative data collection

Environmental scan and interviews with key stakeholders

An environmental scan was undertaken which included a review of policies and administrative documents, assessment of ICU setting, number of staff, and nurse patient ratios. Interviews were held with the head of department, intensivists, microbiologists, ward managers and nurses regarding diagnostic criteria use in the unit for VAP and CRBSI and key barriers and facilitators to change. Diagnostic criteria for VAP (Centers for Disease Control and Prevention, 2009) and CRBSI (Centers for Disease Control and Prevention, 2002a) were selected as these criteria were used by all Ministry of Health hospitals. Because the participating ICU did not have any tool to assess PU, it was decided that the Waterlow Pressure Ulcer Risk Assessment (Waterlow, 2005) would be used. Field notes were taken during the environmental scan and interviews with the key stakeholders. Key stakeholder interviews were systematically documented in an issues log (barrier, facilitator, action, and resolution).

Ethical considerations

This study was approved by the Curtin Human Research Ethics Committee and Malaysian Ministry of Health Research Ethics Committee. Informed verbal consent was obtained

from key-stake holders prior to interviews. Nurses were given information sheets prior to completing the survey. The return of completed surveys was considered consent to participate. Patient consent was not sought because assessments were considered part of usual care provided in the ICU.

Data analysis

Data collected from the survey and medical records were analysed using descriptive statistics. Interviews of key stakeholders were analysed using thematic analysis (Hsieh & Shannon, 2005). Data sources were then interpreted as a whole to resolve ambiguities and to elicit confirmation of observations and identify divergence and convergence of views, opinions and observations (Creswell, Plano Clark, Gutmann, & Hanson, 2003). Emergent themes were discussed among the research team and assumptions verified from both qualitative and quantitative data sources.

RESULTS

Environmental scan

The environmental scan and interviews with stakeholders identified key barriers and facilitators to ICU change implementation (Table 2). Interview participants discussed challenges such as the high demand for ICU beds, limited resources and a high patient turnover rate. Some patients were denied ICU beds which meant they had to be ventilated outside in another unit and care for by untrained staff in the wards. This caused stress and frustration for both medical and nursing staff.

The guidelines from the CDC are used by the medical staff for diagnosis of VAP and CRBSI, nurses indicated that they were unfamiliar with this resource. Despite this finding, the ward manager indicated that nurses were exposed to VAP and CRBSI criteria, except PUs risk assessment tool. Even though nursing management requires the use of nursing process documentation (assessment, planning and evaluation). However, an absence of standardised data collection methods to capture individuals at high risk of complications was noted. A division between nursing and medical guidelines was also recognised.

Other problems identified during the interviews included staff reluctance to engage in change processes, low numbers of nursing staff leading to high nursing workload, communication problems with medical officers, lack of equipment or equipment not properly maintained, such as patient beds, and lack of information technology resources including computers and internet access. Electronic databases for accessing empirical evidence were only available in the hospital library.

Nurse survey

In Malaysia, nurses have a diversity of skill mix due to a shortage of health care staff. There were 83 registered nurses, five ward managers, three acute pain service nurses, and 75 nurses working in this ICU at the time of data collection (Table 3). Two of these nurses reported post-basic critical care qualifications. A total of 81 nurses were invited to participate in the study with a response rate of 92.6%.

Professional Practice Environment

Evaluation of staff's perceived level of positive regard for their practice environment was conducted using the RPPE scale. The highest mean scores within the eight components were for internal work motivation (M 3.24; SD 0.3), relationship with physician (M 3.22; SD 0.53), and cultural sensitivity (M 3.04; SD 0.24). Only three components had mean scores of three or higher and five components had mean scores less than three. The two lowest mean scores were for handling disagreement and teamwork with mean scores of 2.77 (SD 0.16) and 2.45 (SD 0.47), respectively (Table 4).

Sustainability

Sustainability Index scores ranged from 13.4 to 100 percent with a total mean score of 75.21 (SD 21.71) (Table 5). Approximately 84 percent of the nurses surveyed scored more than 55 percent, indicating for optimism for the change process.

Knowledge score

Nurses' knowledge scores ranged from 74 to 140 with total mean score of 124.84 (SD 14.66). The majority (n=66; 88%) of nurses scored more than 80 percent with 5.3 percent of nurses scoring 60% or less. Table 6 shows the mean score for each knowledge item.

Patient characteristics

Twenty-one cases of ICU complications were identified in 18 of the 91 patients (19.8%) admitted during December 2009 (Table 7). Of these, three patients developed two complications, PU and/or VAP (two patients) and/or CRBSI (one patient). All patients were of Malay ethnicity. Approximately 89% patients were medical admissions to the ICU and 15 (83.3%) of 18 patients were male. Of the patients with complications, 16 (88.8%) were recorded as having a co-

morbidity prior to admission. Three (16.7%) of those who developed an ICU complication were discharged alive from hospital, with the majority dying either in the ICU or on the ward.

DISCUSSION

The mixed method approach used in this study allowed a multifaceted view of the barriers and facilitators to clinical practice improvement in the ICU. These findings provide insight into system, patient and provider factors impacting on clinical practice in the ICU and are important for quality improvement initiatives. The findings from the environmental scan indicated that this ICU had a high case load due to the high ICU bed demand, as demonstrated by 70 to 90 admissions per month for 16 ICU beds. Many patients who needed an ICU bed were nursed in general wards due to unavailability of ICU beds. The mean score for disease severity of illness in patients that developed VAP, CRBSI or PU was higher compared to the average mean score from the Malaysian ICU Audit from 2003 to 2008. In the current study, the mean score for SAP II was 46.3 (SD 18.1) and for SOFA, 8.1 (SD 3.9). According to Le Gall (1993), the SAP II has been shown to be an extremely effective method for estimating the probability of mortality for ICU patients. The SOFA score was predictive of survival when applied on day of presentation to the ICU (Neumann et al., 2008). A study on early predictors of mortality in trauma patients found that ICU mortality was 7.9 percent with a fairly high degree of illness as indicated by a SOFA admission score of five to seven (Brattstrom, Granath, Rossi, & Oldner, 2010).

Approximately 78.8 percent of the 18 patients developed at least one of the three complications and died. Interpreting these data is challenging and further benchmarking and monitoring is required to identify system, patient and provider factors predictive of adverse

outcome. Worldwide increases in demands for health resources and staffing signal the urgency of addressing these factors to ensure the health and safety of consumers.

The findings have demonstrated that although nurses have a good knowledge of prevention strategies, the prevalence of VAP, CRBSI and PU suggest barriers to implementation. A study conducted in three ICUs across three regions in Malaysia on the practice of oral care for ventilated patients (which included this study ICU) has revealed similar results (Soh, Soh, Japar, Abdul Raman, & Davidson, 2010). In their study, there were discrepancies between self-reporting and observed practice (Soh et al., 2010). In contrast, Biancofiore (2007) found that the majority of nurses surveyed reported they had a lack of knowledge of VAP prevention strategies, yet were observed undertaking these tasks. Pravikoff et al. (2005) surveyed 760 nurses in the United States of America and they found that the majority of nurses did not understand or value research, and they were generally unprepared for a practice built on evidence. Furthermore, most nurses believed that they were not adequately prepared to appraise research and interpret relevance for clinical decision making. Participating nurses indicated a lack of access to the electronic information databases or the internet in the workplace. Smith and Donze (2010) have reported that the most important physical resource to learn and practice EBP is computer access to textbooks and online journals. Although not specifically investigated in this study, nurses may also have limited data retrieval skills and may not be adequately prepared to retrieve information from electronic sources (2005). Inadequate resources and the limited number of nurses with a baccalaureate education suggests that this may be a barrier to implementing evidence-based practice in this setting.

Evaluation of likelihood of sustainability showed positive attitudes toward the change process. The survey feedback indicated that nurses had positive attitudes toward the change

process proposed to decrease rates of ICU complications. The mean score on the Sustainability Index was 75.21 (SD 21.71). These findings indicate that the chance of sustainability of the proposed change process was very high with 93.3 percent of participants having scored higher than 45 percent. This indicates that nurses in this unit enthusiastic about new practices if they were incorporated in their routine practice. Soh et al. (2010) similarly found that nurses in this ICU would implement oral care procedures for patients if the practice was integrated into routine work.

The majority of nurses reported a high level of positive regard for their professional practice environments with a mean score of >3 for internal work motivation, staff relationship with physician, and cultural sensitivity. However, handling disagreement or conflict, leadership and autonomy in clinical practice, control over practice, teamwork and communication about patients scored < 3. This result was comparable to Charalambous et al (2010)'s study in 13 different units acute 3 Finnish acute care hospitals. Although their study was not specifically conducted in the ICU, the mean responses for all components in the RPPE were similar.

The low mean score for teamwork in this study may be related to the hierarchical administrative structure of the ICU and the limited opportunities to discuss and debate patient care issues. Furthermore, all patients referred to this hospital were transferred from the Emergency Department to ICU. Therefore, for the subscale 'teamwork', 75 percent of the nurses agreed they have constructive relationships with other groups in the hospital. This finding indicated that the teamwork with other units / department in the hospital is good.

Nurses reported that they had a lack of control over their practice and had difficulty handling conflict. A perception of lack of autonomy in clinical practice may be related to an

historical emphasis on dependent nursing practice and a hierarchical organisation of the delivery of health care (Reeves, Nelson, & Zwarenstein, 2008).

A healthy work environment is important for nurses to enable them to meet organizational objectives and achieve personal satisfaction in their work. Ulrich et al. (2007) indicated that in order to establish healthy work environments, leadership is critical at every level of nursing because it will create a vision for nursing in their organizations and provide resources and inspiration to transform the vision into reality. They also added that effective frontline managers are crucial for the success of every organization because they understand both the organization's vision and its social structure, so it will enable them to serve as interpreters across organizational levels and interdisciplinary groups. This study has not only provided important baseline information to inform future quality improvement initiatives but provided important insight into the barriers and facilitators to driving clinical change. Appraising an organisation's readiness and identification of drivers is crucial in implementing acceptable and appropriate interventions. The use of a mixed-method approach enabled assumptions to be validated and elucidated factors that are crucial in implementing interventions to improve patient outcomes.

Limitations

A number of limitations within this study are acknowledged. Firstly, purposive sampling and the conduct of this study at a single ICU precludes generalising results to other settings. Secondly, there is a risk participants presented themselves or their organisation more favourably than is the case. Despite these limitations which are common in most health services research, the used of validated measures and the mixed method approach allowed the capacity to validate observations and to interpret study findings.

CONCLUSIONS

Preventing complications in the ICU is a critical issue challenging health care providers to assess and reflect on their capacity to deal with this problem. A complex interplay of system, provider, and patient issues contribute to factors impacting on health outcomes. Therefore, in order to implement clinical practice improvement interventions, it is crucial to consider each of these factors. Although there are comprehensive descriptions of these factors in the Western world, there is limited information pertaining to organisational culture that is available to assist planning in Malaysian ICU settings. The assessment of organizational readiness has found that although nurses in this unit are strongly committed to improving patient outcomes, they are inadequately prepared for implementing evidence-based practice. They are working in a highly pressured environment, have limited access to high-quality information resources, and are accustomed to working in a hierarchical structure where autonomy and independent practice is not fostered. Addressing these factors is crucial in implementing interventions to improve patient outcomes.

References

- American Thoracic Society. (2005). Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. *American Journal of Respiratory and Critical Care Medicine*, 171(4), 388-416.
- Andrew, S., & Halcomb, E. (2009). *Mixed methods research for nursing and the health sciences*: Wiley Online Library.
- Barsanti, M. C., & Woeltje, K. F. (2009). Infection prevention in the intensive care unit. *Infectious Disease Clinics of North America*, 23(3), 703-725.
- Berenholtz, S. M., Pronovost, P. J., Lipsett, P. A., Hobson, D., Earsing, K., Farley, J. E., et al. (2004). Eliminating catheter-related bloodstream infections in the intensive care unit. *Critical Care Medicine*, 32(10), 2014-2020.
- Biancofiore, G., Barsotti, E., Catalani, V., Landi, A., Bindi, L., Urbani, L., et al. (2007). Nurses' knowledge and application of evidence-based guidelines for preventing ventilator-associated pneumonia. *Minerva Anestesiologica*, 73(3), 129-134.
- Brattstrom, O., Granath, F., Rossi, P., & Oldner, A. (2010). Early predictors of morbidity and mortality in trauma patients treated in the intensive care unit. *Acta Anaesthesiologica Scandinavica*, 54(8), 1007-1017.
- Butvila, W., Reilly, M., & Sturman, G. (2008). Disinfection with chlorhexidine mouthwash, "Safer Systems Saving Lives" and regular mouth care can reduce ventilator associated pneumonia. *Building Quality in Health Care*, 2(2), 11-15.
- Carling, P. C., Parry, M. F., Bruno-Murtha, L. A., & Dick, B. (2010). Improving environmental hygiene in 27 intensive care units to decrease multidrug-resistant bacterial transmission. *Critical Care Medicine*, 38(4), 1054-1059.
- Cason, C. L., Tyner, T., Saunders, S., & Broome, L. (2007). Nurses' implementation of guidelines for ventilator-associated pneumonia from the Centers for Disease Control and Prevention. *American Journal of Critical Care*, 16(1), 28-36.
- Centers for Disease Control and Prevention. (2002a). Examples of clinical definitions for catheter-related infections. Retrieved 6 Aug, 2009, from <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5110a2.htm>
- Centers for Disease Control and Prevention. (2002b). Guidelines for the prevention of intravascular catheter-related infections. *Morbidity and Mortality Weekly Report*, 51(10), i-32.
- Centers for Disease Control and Prevention. (2009, March 2009). Ventilator-Associated Pneumonia (VAP) event. Retrieved Aug 29, 2009, from <http://www.cdc.gov/nhsn/PDFs/pscManual/6pscVAPcurrent.pdf>
- Chan, E. Y., Ruest, A., Meade, M. O., & Cook, D. J. (2007). Oral decontamination for prevention of pneumonia in mechanically ventilated adults: Systematic review and meta-analysis. *British Medical Journal* 334(7599), 889-899.

- Charalambous, A., Katajisto, J., Välimäki, M., Leino-Kilpi, H., & Suhonen, R. (2010). Individualised care and the professional practice environment: Nurses' perceptions. *International Nursing Review*, 57(4), 500-507.
- Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. In *Handbook of Mixed Methods in Social and Behavioral Research* (pp. 209-240) California: Sage Publications Inc.
- de Laat, E. H., Pickkers, P., Schoonhoven, L., Verbeek, A. L., Feuth, T., & van Achterberg, T. (2007). Guideline implementation results in a decrease of pressure ulcer incidence in critically ill patients. *Critical Care Medicine*, 35(3), 815-820.
- Eman, S. M. S., Theo, D., & Ruud, J. G. H. (2009). Pressure ulcer prevention in intensive care patients: Guidelines and practice. *Journal of Evaluation in Clinical Practice*, 15(2), 370-374.
- Erasmus, V., Thea, J., Brug, H., Richardus, Jan H., Behrendt, Myra D., Vos, Margreet C., et al. (2010). Systematic review of studies on compliance with hand hygiene guidelines in hospital care. *Infection Control and Hospital Epidemiology*, 31(3), 283-294.
- Erickson, J. I., Duffy, M. E., Ditomassi, M., & Jones, D. (2009). Psychometric evaluation of the Revised Professional Practice Environment (RPPE) scale. *Journal of Nursing Administration*, 39(5), 236-243.
- Evans-Lacko, S., Jarrett, M., McCrone, P., & Thornicroft, G. (2010). Facilitators and barriers to implementing clinical care pathways. *BMC Health Services Research*, 10(1), 182.
- Ferreira, F. L., Bota, D. P., Bross, A., Melot, C., & Vincent, J.-L. (2001). Serial evaluation of the SOFA score to predict outcome in critically ill patients. *Journal of the American Medical Association*, 286(14), 1754-1758.
- Fueglistaler, P., Amsler, F., Schüepp, M., Fueglistaler-Montali, I., Attenberger, C., Pargger, H., et al. (2010). Prognostic value of sequential organ failure assessment and simplified acute physiology II score compared with trauma scores in the outcome of multiple-trauma patients. *The American Journal of Surgery*, 200(2), 204-214.
- Gastmeier, P., & Geffers, C. (2007). Prevention of ventilator-associated pneumonia: analysis of studies published since 2004. *Journal of Hospital Infection*, 67(1), 1-8.
- Graves, N. (2010). Economics and preventing hospital-acquired infection. *Emerging Infectious Diseases*, 10(4), 561-566.
- Graves, N., Weinhold, D., Tong, E., Birrell, F. A., Doidge, S. R., Ramritu, P., et al. (2010). The effect of healthcare-acquired infection on length of hospital stay and cost. *Infection Control and Hospital Epidemiology*, 28(3), 280-292.
- Greene, J. C., & Caracelli, V. J. (1997). Defining and describing the paradigm issue in mixed-method evaluation. *New Directions for Evaluation*, 1997(74), 5-17.
- Grimshaw, J., Eccles, M., Thomas, R., MacLennan, G., Ramsay, C., Fraser, C., et al. (2006). Toward evidence-based quality improvement: Evidence (and its limitations) of the effectiveness of guideline dissemination and implementation strategies 1966–1998. *Journal of General Internal Medicine*, 21(S2), S14-20.

- Grol, R. (1997). Personal paper: Beliefs and evidence in changing clinical practice. *British Medical Journal*, 315(7105), 418-421.
- Grol, R., & Grimshaw, J. (2003). From best evidence to best practice: Effective implementation of change in patients' care. *The Lancet*, 362(9391), 1225-1230.
- Hsieh, H.-F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277-1288.
- Hutchins, K., Karras, G., Erwin, J., & Sullivan, K. L. (2009). Ventilator-associated pneumonia and oral care: A successful quality improvement project. *American Journal of Infection Control*, 37(7), 590-597.
- Institute for Innovation and Improvement. (2006). NHS Sustainability Model. Retrieved 20 October, 2010, from http://www.institute.nhs.uk/sustainability_model/introduction/find_out_more_about_the_model.html
- Laupland, K. B., Kirkpatrick, A. W., Church, D. L., & Ross, T. (2004). Intensive-care-unit-acquired bloodstream infections in a regional critically ill population. *Journal of Hospital Infection*, 58(2), 137-145.
- Le Gall, J. R., Lemeshow, S., & Saulnier, F. (1993). A new simplified acute physiology score (SAPS II) based on a European/North American multicenter study. *Journal of the American Medical Association*, 270(24), 2957-2963.
- Lugtenberg, M., Burgers, J. S., & Westert, G. P. (2009). Effects of evidence-based clinical practice guidelines on quality of care: a systematic review. *Quality and Safety in Health Care*, 18(5), 385-392.
- Maher, L., Gustafson, D., & Evan, A. (2003). *NHS Sustainability Model*. United Kingdom: Institute of Innovation and Improvement.
- Malaysian Registry of Intensive Care. (2009). *6th Report of Malaysian Registry of intensive care 2008* (No. MOH/s/CRC/02.09(AR)): Ministry of Health Malaysia.
- McHugh, S. M., Hill, A. D. K., & Humphreys, H. (2010). Preventing healthcare-associated infection through education: Have surgeons been overlooked? *The Surgeon*, 8(2), 96-100.
- Mermel, L. A., Allon, M., Bouza, E., Craven, Donald E., Flynn, P., O'Grady, Naomi P., et al. (2009). Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 update by the Infectious Diseases Society of America. *Clinical Infectious Diseases*, 49(1), 1-45.
- Ministry of Health Malaysia. (2008). Anaesthesia and intensive care service operation policy from http://www.moh.gov.my/static/Anaesthesia_Policy.pdf
- Needham, D. M., Scales, D. C., Laupacis, A., & Pronovost, P. J. (2005). A systematic review of the Charlson Comorbidity Index using Canadian administrative databases: A perspective on risk adjustment in critical care research. *Journal of Critical Care*, 20(1), 12-19.
- Neumann, F., Lobitz, O., Fenk, R., Bruns, I., Köstering, M., Steiner, S., et al. (2008). The sepsis-related organ failure assessment (SOFA) score is predictive for survival of patients

- admitted to the intensive care unit following allogeneic blood stem cell transplantation. *Annals of Hematology*, 87(4), 299-304.
- Pravikoff, D. S., Tanner, A. B., & Pierce, S. T. (2005). Readiness of US nurses for evidence-based practice: many don't understand or value research and have had little or no training to help them find evidence on which to base their practice. *American Journal of Nursing*, 105(9), 40.
- Pronovost, P., & Sexton, B. (2005). Assessing safety culture: Guidelines and recommendations. *Quality and Safety in Health Care*, 14(4), 231-233.
- Ramritu, P., Halton, K., Cook, D., Whitby, M., & Graves, N. (2008). Catheter-related bloodstream infections in intensive care units: A systematic review with meta-analysis. *Journal of Advanced Nursing*, 62(1), 3-21.
- Reddy, M., Gill, S. S., & Rochon, P. A. (2006). Preventing pressure ulcers: A systematic review. *The Journal of the American Medical Association*, 296(8), 974-984.
- Reeves, S., Nelson, S., & Zwarenstein, M. (2008). The doctor–nurse game in the age of interprofessional care: A view from Canada. *Nursing Inquiry*, 15(1), 1-2.
- Riordan, J., & Voegeli, D. (2009). Prevention and treatment of pressure ulcers. *British Journal of Nursing*, 18(20), S20-27.
- Smith, J. R., & Donze, A. (2010). Assessing environmental readiness: First steps in developing an evidence-based practice implementation culture. *Journal of Perinatal and Neonatal Nursing*, 24(1), 61-71
- Soh, K. L., Soh, K. G., Japar, S., Abdul Raman, R., & Davidson, P. M. (2010). A cross-sectional study on nurses' oral care practice for mechanically ventilated patients in Malaysia. *Journal of Clinical Nursing*, *In Press*.
- Solomkin, Joseph S., Mazuski, John E., Bradley, John S., Rodvold, Keith A., Goldstein, E. J C., Baron, Ellen J., et al. (2010). Diagnosis and management of complicated intraabdominal infection in adults and children: Guidelines by the surgical infection society and the infectious diseases society of America. *Clinical Infectious Diseases*, 50(2), 133-164.
- Soo Hoo, G. W., Wen, Y. E., Nguyen, T. V., & Goetz, M. B. (2005). Impact of clinical guidelines in the management of severe hospital-acquired pneumonia. *Chest*, 128(4), 2778-2787.
- Ulrich, B. T., Woods, D., Hart, K. A., Lavandero, R., Leggett, J., & Taylor, D. (2007). Critical care nurses' work environments value of excellence in Beacon units and magnet organizations. *Critical Care Nurse*, 27(3), 68-77.
- Vincent, J. L., Moreno, R., Takala, J., Willatts, S., De Mendonça, A., Bruining, H., et al. (1996). The SOFA (sepsis-related organ failure assessment) score to describe organ dysfunction/failure. *Intensive Care Medicine*, 22(7), 707-710.
- Walz, J. M., Memtsoudis, S. G., & Heard, S. O. (2010). Analytic reviews: Prevention of central venous catheter bloodstream infections. *Journal of Intensive Care Medicine*, 25(3), 131-138.

- Warren, D. K., Quadir, W. W., Hollenbeak, C. S., Elward, A. M., Cox, M. J., & Fraser, V. J. (2006). Attributable cost of catheter-associated bloodstream infections among intensive care patients in a nonteaching hospital. *Critical Care Medicine*, 34(8), 2084.
- Warren, D. K., Shukla, S. J., Olsen, M. A., Kollef, M. H., Hollenbeak, C. S., Cox, M. J., et al. (2003). Outcome and attributable cost of ventilator-associated pneumonia among intensive care unit patients in a suburban medical center. *Critical Care Medicine*, 31(5), 1312-1317.
- Waterlow, J. (2005). Pressure ulcer risk assessment scale. Retrieved Sept 12, 2009, from <http://www.judy-waterlow.co.uk/downloads/Waterlow%20Score%20Card-front.pdf>
- West, V. S. (2009). Catheter-related bloodstream infection project Retrieved 8 April, 2010, from http://www.infectioncontrol.org.nz/catheter-related/Guidance%20document%20-%20FINAL%20%20_Dec%202009_.pdf
- Wip, C., & Napolitano, L. (2009). Bundles to prevent ventilator-associated pneumonia: how valuable are they? *Current Opinion in Infectious Diseases*, 22(2), 159-166.
- Wond, T., & Macaulay, M. (2010). Evaluating local implementation: An evidence-based approach. *Policy and Society*, 29(2), 161-169.
- Zilberberg, M. D., Shorr, A. F., & Kollef, M. H. (2009). Implementing quality improvements in the intensive care unit: Ventilator bundle as an example. *Critical Care Medicine*, 37(1), 305-309.
- Zingg, W. M. D., Imhof, A. M. D., Maggiorini, M. M. D., Stocker, R. M. D., Keller, E. M. D., & Ruef, C. M. D. (2009). Impact of a prevention strategy targeting hand hygiene and catheter care on the incidence of catheter-related bloodstream infections. *Critical Care Medicine*, 37(7), 2167-2173.

TABLE 1: INTENSIVE CARE UNIT (ICU) PATIENT CHARACTERISTICS REPORTED BY NATIONAL ICU AUDIT FROM 2003 TO 2008

Patients information	Year (Mean)					
	2003	2004	2005	2006	2007	2008
SAP II	42.1	37.1	42.7	*	39.8	37.6
SOFA	*	*	*	*	5.7	6.3
ICU length of stay	*	4.1	3.9	3.5	4.3	4.2
Hospital length of stay	*	16.6	14.4	16.1	15.2	16.7
Incidence of pressure ulcer	*	*	*	*	0	0
VAP (VAP/1000 ventilator days)	26.2	29.7	6.8	*	6.2	8.2
Crude in-ICU mortality rate (%)	*	25.1	32.7	27.0	23.7	16.5
Crude in-hospital mortality rate (%)	*	31.4	42.0	38.1	33.0	24.8

* Data not available

(Malaysian Registry of Intensive Care, 2009)

TABLE 2: BARRIERS, FACILITATORS, AND ACTIONS IDENTIFIED THROUGH KEY INFORMANT CONSULTATION AND INTERVIEWS

Barriers	Facilitators	Actions
No routine data monitoring processes		Implementation of routine validated measures eg Waterlow Pressure Ulcer Risk Assessment.
	Executive leadership and support	Engagement of project advisory team. Regular consultation and update.
High bed demand and limited resources		Incorporate strategies in nursing practice. Use data to document need to lobby for additional resources.
Introduction of additional workload through increased attention on surveillance	Executive leadership and support	Engage and empower clinicians in monitoring their practice. Work with executive leadership for endorsement of project strategies. Provide regular feedback to demonstrate the utility of data collection.
Staff reluctance to engage in the change process	Executive leadership and support	Provide regular feedback for staff. Provide resources such as evidence based practice journals. Reinforcement of best practice Provide information related to career advancement.
	Research advisory committee	Screening instrument to facilitate communication between staff.
Inadequate feedback for staff	Executive leadership and support	Provide current information on unit status such as infection control prevention achievement. Ensure all information is accessible to the staff.
Need for leadership endorsement	Executive leadership and support	Encourage reflective practice. Support nurses in leadership development.
Lack of efficiency in utilising nursing process	Executive leadership and support	Maintain documentation if there is proper facilitation given, however, if not, abolish documentation that do not benefit patients.
Hierarchical organisational structure		Engage in planning project. Support nurses in assessing and communicating clinical findings.

TABLE 3: NURSE PARTICIPANT CHARACTERISTICS

Characteristics	n	%	Mean (SD)
Gender (n=75)			
Male	1	1.4	
Female	74	98.6	
Age (n=67) years			40.8 (SD 21.3)
Length of service as a nurse (n=75) years			9.2 (SD 6.2)
Length of service in ICU (n=75) years			5.9 (SD 5.0)
Occupation (n=75)			
Ward manager	2	2.7	
Registered Nurse	73	97.3	
Shift workers (n=74)			
Shift	71	95.9	
Office Hour	3	4.1	
First Nursing Qualification (n=75)			
3 years certificate programme	6	8.0	
3 years diploma programme	69	92.0	
Highest nursing qualification (n=75)			
3 years certificate programme	1	1.3	
3 years diploma programme	46	61.4	
Post-basic critical care	27	36.0	
Bachelor degree	1	1.3	

TABLE 4: REVISED PROFESSIONAL PRACTICE ENVIRONMENT (RPPE) SCORES

Component	Agree %	Disagree %	Mean	SD
1. Handling disagreement and conflict			2.77	0.16
When staff disagree, they ignore the issue, pretending it will “go away”*	42.7	57.3		
Staff withdraw from conflict	45.3	54.7		
Disagreements between staff members are ignored or avoided*	69.3	30.7		
All contribute from their experience, expertise to effect high-quality solution	98.7	1.3		
All staff member work hard to arrive at the best possible solution	98.7	1.3		
All points of view considered in finding best solution to problem	81.1	18.9		
Most conflicts occur with members of my own discipline	87.8	12.2		
Staff involved do not settle the dispute until all are satisfied with decision	47.3	52.7		
Staff involved in a disagreement or conflict settle the dispute by consensus	94.6	5.4		
2. Leadership and autonomy in clinical practice			2.93	0.43
Department head supports staff even if conflict is with a physician	69.3	30.7		
Leadership is supportive of my department/unit staff	82.7	17.3		
Department head is a good manager and leader	90.5	9.5		
My discipline controls its own practice	98.7	1.3		
I have freedom to make important patient care and work decisions	82.4	17.6		
3. Internal work motivation			3.24	0.30
I have challenging work that motivates me to do the best job I can	100	0		
Working in this unit gives me opportunity to gain new knowledge and skills	100	0		
I feel a great sense of personal satisfaction when I do my work well	98.7	1.3		
I feel a high degree of personal responsibility for the work I do	100	0		
Working in this environment increases my sense of professional growth	92.0	8.0		
I’m motivated to do well because I’m empowered by my work environment	98.7	1.3		
My opinion of myself goes up when I work in this unit	90.7	9.3		
I feel bad and unhappy when I discover I performed less well than I should	84.0	16.0		
4. Control over practice			2.82	0.35
There are enough staff to provide quality patient care	74.7	25.3		
We have enough staff to get the work done	52.0	48.0		
I have enough time and chance to discuss patient care problems with other staff	86.7	13.3		
I have adequate support services to allow me to spend time with my patients	84.0	16.0		
There are opportunities to work on a highly specialized patient care unit	98.7	1.3		
5. Teamwork			2.45	0.47
Inadequate working relationships with other hospital groups limit effectiveness of work on this unit.*	66.7	33.3		
My department does not get cooperation it needs from other hospital units*	57.3	42.7		
Other hospital units/departments seem to have low opinion of my department*	34.7	65.3		
My department has constructive relationships with other groups in this hospital	74.7	25.3		
6. Staff relationship with physicians			3.22	0.53
Physicians and staff have good working relationships	93.3	6.7		
There is a lot of teamwork between unit/department staff and doctors	93.3	6.7		
7. Cultural sensitivity			3.04	0.24
Staff members are sensitive to diverse patients populations for whom they care	100	0		
Staff respect the diversity of their health care team	93.3	6.7		
Staff have access to necessary resources to provide culturally competent care	98.7	1.3		
8. Communication about patient			2.95	0.20
I receive information quickly when a patient’s status changes	89.3	10.7		
Information regarding patient care is relayed without delays	96.0	4.0		
Information on the status of patients is available when I need it	90.7	9.3		

* Disagree indicates more positive professional practice environment

TABLE 5: SUSTAINABILITY SCORES

Stage	Mean	SD
Process	24.17	7.75
1. Benefits beyond helping patients	7.49	2.53
2. Credibility of the benefits	7.13	2.46
3. Adaptability of improved process	5.47	2.10
4. Effectiveness of the system to monitor progress	4.08	2.68
Staff	39.23	12.05
5. Staff involvement and training to sustain the process	7.11	3.33
6. Staff attitudes toward sustaining the change	7.15	4.40
7. Senior leadership engagement	12.82	4.58
8. Clinical leadership engagement	12.15	4.60
Organisation	11.81	4.41
9. Fit with the organisation's strategic aims and culture	3.94	2.49
10. Infrastructure for sustainability	7.87	2.97
Total mean score 75.21 SD 21.71		

TABLE 6: KNOWLEDGE SCORES

	Knowledge	Mean	SD
1.	Hand washing is important to prevent cross infection	9.57	1.23
2.	Alcoholic antiseptic solution is recommended compared to soap for hand washing	8.16	1.94
3.	Regular positioning of patients can help to prevent VAP and pressure ulcers	8.21	1.91
4.	Elevation of the head of bed more than 30 degree is recommended for all ventilated patients	9.13	1.30
5.	Chlorhexidine is recommended in prevention of VAP and CRBSI	8.60	1.59
6.	Enteral nutrition should be started immediately for all ventilated patients with no contraindication.	9.33	1.18
7.	Maximal barrier precautions are recommended to prevent infections in ICU.	9.09	1.20
8.	Early mobilization reduces ICU complications	8.80	1.05
9.	Subglottic suctioning can prevent microaspiration in ventilated patients.	8.19	1.84
10.	Blood or tracheal secretions culture and sensitivity is recommended if patient shows signs and symptoms of infection	9.25	0.89
11.	Exposure to evidence based practice can help nurses to prevent VAP, CRBSI and pressure ulcer	9.31	1.24
12.	Hygiene care help to reduces infection for ICU patients	9.57	1.22
13.	Assessment of pressure area is indicated for all ICU patients	9.24	1.06
14.	Each patient shows specific signs and symptoms if he/she develops VAP and CRBSI	8.91	1.68
Total Mean score 124.84 SD 14.66			

TABLE 7: PATIENT CHARACTERISTICS (N=18)

Characteristics	n	%	Mean (SD)
Case (n=18)			
Medical	16	88.8	
Surgical	1	5.6	
Head Injury	1	5.6	
Sex			
Male	15	83.3	
Female	3	16.7	
Age (n=18)			57.3 (SD 15.8)
Glasgow Coma Scale (GCS)			7.38 (SD 4.96)
Simplified Acute Physiology (SAP II)			46.3 (SD 18.1)
Sequential Organ Failure Assessment (SOFA)			8.1 (SD 3.9)
Risk of Hospital mortality			44.8 (SD 23.5)
Length of ICU stay			12.2 (SD 7.1)
Length of ward stay			7.2 (SD 9.6)
Condition on transfer from ICU (n=18)			
Dead	7	38.9	
Alive	11	61.1	
Condition on transfer from ward (n=11)			
Dead	7	63.6	
Alive	3	27.3	
Still in the ward	1	9.1	
Type of complication (n=21cases)			
VAP	4	19.0	
CRBSI	1	4.8	
PU	16	76.2	
Charlson Comorbidity Score			3.24 (SD 1.97)