

Level of Knowledge and Extent of Practice of Intensive Care Unit Nurses on Healthcare-Associated Infections' Bundle of Care: Basis for Competency Program

Reniel Amos Sanchez

Mary Johnston Hospital; Philippine Christian University–Mary Johnston College of Nursing; Mary Johnston College of Nursing Scholarship Foundation, Inc.; Philippine Women's University
renielrn@gmail.com

Date Submitted:

August 16, 2026

Date Accepted:

September 11, 2026

Date Published:

October 08, 2026

DOI:

10.5281/zenodo.23244303

ABSTRACT

Healthcare-associated infections (HAIs) remain a major patient-safety concern in critical care, where invasive devices increase infection risk and consistent bundle implementation depends heavily on nursing knowledge and practice. This study determined the level of knowledge and extent of practice of intensive care unit (ICU) nurses on HAI bundles for ventilator-associated pneumonia (VAP), catheter-associated urinary tract infection (CAUTI), surgical site infection (SSI), and central line-associated bloodstream infection (CLABSI) in a selected private tertiary hospital in Manila and used the findings as basis for a competency program. A descriptive quantitative correlational design was employed among 30 ICU nurses selected through purposive sampling from medical, surgical, pediatric, and neonatal ICUs. An adapted and modified Institute for Healthcare

Improvement questionnaire, validated by experts, measured participant profile, knowledge, and practice. Frequency, percentage, McDonald's percent score, weighted mean, Pearson correlation, and chi-square were used. Overall knowledge was moderate (73%); SSI scored highest (79%) and CLABSI lowest (64%). Practice was high overall (grand mean = 4.50), with CAUTI (4.73) and VAP (4.71) at the fullest extent and CLABSI (4.41) and SSI (4.15) at the full extent. Age and hospital experience were significantly related to both knowledge and practice, whereas gender, clinical area, and training attendance were not. Knowledge-practice correlations were significant for VAP, SSI, and CLABSI, but not for CAUTI. The findings support institutionalizing a structured HAI Bundle of Care Competency Program and quarterly compliance audits to strengthen evidence-based nursing practice and patient safety.

Keywords: *healthcare-associated infections, bundle of care, intensive care unit nurses, infection prevention, nursing competency, clinical practice*

INTRODUCTION

Healthcare-associated infections (HAIs) are adverse events acquired during healthcare delivery and are especially consequential in intensive care units, where invasive devices, critical illness, and complex procedures increase the likelihood of infection. The source thesis emphasized that HAIs can prolong hospitalization, increase disability and mortality, and impose substantial costs on patients and health systems. Device-associated infections of particular concern in the ICU include VAP, CAUTI, SSI, and CLABSI. Evidence-based bundles were developed to organize a small set of practices that should be delivered together and reliably to reduce preventable complications (Institute for Healthcare Improvement [IHI], 2012a, 2012b, 2012c; Klompas, 2013).

The bundle-of-care approach requires more than the availability of protocols. ICU nurses are central to bedside delivery, monitoring, documentation, and communication of bundle components. Reliable

implementation therefore depends on both conceptual knowledge and consistent practice. The Philippine nursing competency framework likewise recognizes safe and quality care, resource management, health education, communication, collaboration, and quality improvement as core areas of professional practice (Professional Regulation Commission–Board of Nursing [PRC-BON], 2009). In critical-care settings, repeated education and hands-on experience are particularly relevant because highly technical practices may deteriorate when they are not regularly reinforced (Jansson, 2014; McHugh, 2011).

In the selected private tertiary hospital in Tondo, Manila, the HAI Bundle of Care had been introduced to ICU nurses and incorporated into infection-prevention practice. Nevertheless, the thesis identified a need to assess whether nurses possessed adequate knowledge of the evidence underlying the bundles and whether the corresponding interventions were consistently performed. The study was situated in the Medical, Surgical, Pediatric, and Neonatal Intensive Care Units, where patients frequently require devices associated with VAP, CAUTI, SSI, and CLABSI risk.

The study therefore determined ICU nurses' level of knowledge and extent of practice on the four HAI bundles, examined whether selected profile characteristics were associated with knowledge and practice, and assessed the relationship between knowledge and practice. The findings were intended to provide an empirical basis for a structured competency program that could be institutionalized by the hospital. This focus responds to the practical gap between having bundle protocols in place and ensuring that ICU nurses possess the knowledge, skills, and sustained practice needed for reliable implementation.

Literature Review

Healthcare-associated infections and the bundle-of-care approach

HAIs are infections that develop in association with healthcare and were not present or incubating at admission. The thesis identified device-associated infections as a major concern in intensive care because mechanical ventilation, urinary catheters, central venous lines, and surgical procedures can create direct pathways for infection. Standardized surveillance definitions help institutions identify and monitor these conditions, while prevention strategies emphasize timely removal of unnecessary devices, appropriate aseptic technique, and reliable adherence to evidence-based practices (Horan et al., 2008; IHI, 2012a, 2012b).

A care bundle packages a small number of evidence-supported interventions that should be performed together rather than as isolated tasks. The approach is intended to improve reliability and patient outcomes through consistent execution, documentation, and monitoring. Studies cited in the thesis showed that high bundle compliance was associated with reductions in ventilator-associated pneumonia and catheter-related bloodstream infections, underscoring the value of an all-or-none implementation strategy and ongoing surveillance (Pronovost et al., 2006; Resar et al., 2005). The hospital-level implication is that competency development, feedback, and audit systems should accompany the bundle itself rather than treating the bundle as a static checklist.

Device-specific HAI bundles in intensive care

The VAP bundle described in the thesis included elevation of the head of the bed, daily sedative interruption and assessment of readiness to extubate, peptic-ulcer disease prophylaxis, deep-vein thrombosis prophylaxis, and daily oral care with chlorhexidine. These components address aspiration risk, duration of mechanical ventilation, thromboembolic complications, and oropharyngeal colonization. The literature cited in the thesis emphasized that education, compliance monitoring, and competency review are needed because VAP prevention depends on the reliable performance of several interdependent activities (Eddin, 2016; Klompas, 2013; Sessler et al., 2002).

The CAUTI bundle focused on avoiding unnecessary urinary catheters, aseptic insertion, appropriate catheter maintenance, and daily review of catheter necessity with prompt removal. Duration of catheterization is a major infection risk, making daily necessity review and maintenance of a closed drainage system central to

prevention. The source literature also stressed hand hygiene and aseptic urine sampling as basic safety practices (Gilbert, 2006; Gould, 2010; IHI, 2012a).

The SSI bundle addressed appropriate prophylactic antibiotics, appropriate hair removal, postoperative glucose control, and maintenance of normothermia. The CLABSI bundle emphasized hand hygiene, maximal barrier precautions, chlorhexidine skin antisepsis, optimal catheter-site selection, and daily review of line necessity. These bundles require both sound theoretical understanding and competent performance of technical procedures. The thesis noted that resource availability, staff training, and documentation practices may affect consistent application, particularly for procedures involving specialized equipment and sterile barriers (Breithaupt, 2010; Diaz, 2010; IHI, 2012b, 2012c; Philippine Hospital Infection Control Society [PHICS], 2013; Reichman, 2009; Sax et al., 2007).

ICU nursing competence, knowledge, and practice

Critical-care nursing requires continuous assessment, technical proficiency, collaborative practice, and the ability to respond to rapidly changing patient conditions. Competence therefore extends beyond knowing a protocol; it includes performing essential procedures correctly, communicating with the healthcare team, and documenting care. The thesis drew attention to the need for continuing education and structured skills development because ICU nurses work in settings where evidence and technology change over time (PRC-BON, 2009; Royal College of Nursing, 2005).

Clinical experience is an important contributor to nursing expertise, but experience alone does not guarantee that current evidence is understood or applied correctly. McHugh (2011) emphasized the influence of both nurse education and hospital context on clinical expertise, while the thesis used Benner's skill-acquisition perspective to explain how nurses progress through repeated exposure to clinical situations (Benner, 1984). This perspective supports combining didactic knowledge with observed skill performance and return demonstration rather than relying solely on lecture attendance.

Educational programs can translate knowledge into safer clinical practice when they combine evidence review, simulation or demonstration, competency assessment, and feedback. The thesis cited evidence that bundle-focused education can improve nurses' knowledge and adherence to critical-care guidelines (Jansson, 2014). It also emphasized that institutional implementation is strengthened when staff have access to resources, training, monitoring, and supportive leadership. This rationale directly informed the proposed competency program, which was designed to reinforce knowledge, hands-on skills, documentation, and multidisciplinary collaboration.

Theoretical and conceptual grounding

The thesis used the Dreyfus Model of Skill Acquisition as expounded by Benner to frame the development of nursing competence from novice toward expert practice. In the context of HAI prevention, the framework supports the view that knowledge, repeated clinical exposure, reflection, and supervised performance contribute to progressively more competent decision-making. The proposed competency program therefore incorporated both knowledge testing and skill demonstration, consistent with the study's emphasis on strengthening evidence-based practice through structured learning (Benner, 1984).

The research paradigm was also organized using a systems perspective. Inputs comprised nurses' profile characteristics, level of knowledge, extent of practice, and the skill-acquisition framework. The process involved instrument validation, survey assessment, and statistical analysis, while the output was the proposed HAI Bundle of Care Competency Program. A feedback mechanism represented evaluation and subsequent improvement. This input-process-output-feedback structure preserved the conceptual logic of the original thesis and linked the empirical assessment directly to the competency intervention.

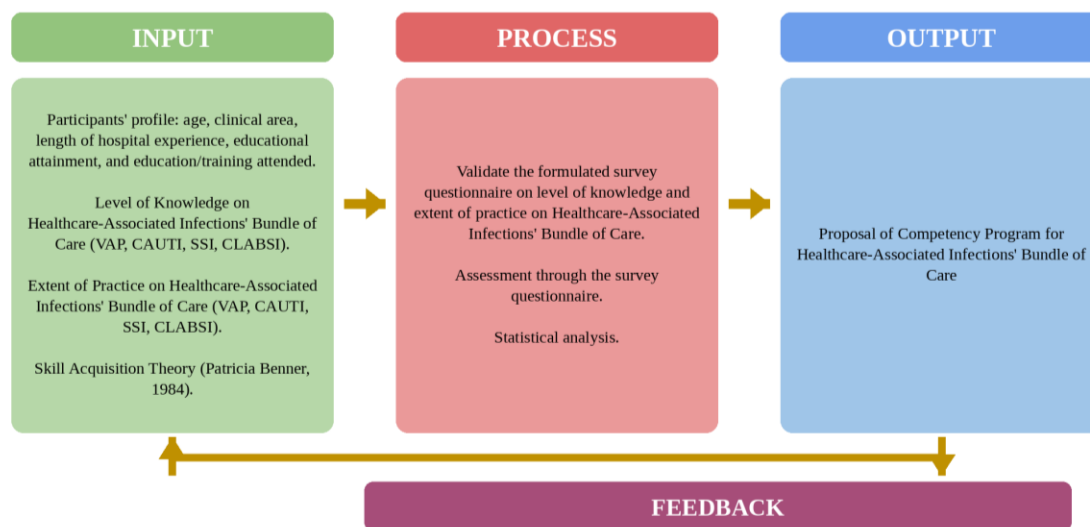


Figure 1. Research Paradigm of the Study

METHODS

Research Design

The study employed a descriptive quantitative correlational research design. It described ICU nurses' level of knowledge and extent of practice on HAI bundles and examined relationships among participant profile characteristics, knowledge, and practice. The design was used without manipulating study variables, consistent with the purpose of documenting existing knowledge and practice in the selected hospital.

Research Locale

The study was conducted in a selected private tertiary hospital in Tondo, Manila. The hospital maintained four Department of Health-accredited intensive care units: Medical ICU, Surgical ICU, Pediatric ICU, and Neonatal ICU. The HAI Bundle of Care had been introduced in the institution and was an existing infection-prevention practice among ICU nurses.

Participants and Sampling Technique

The participants were 30 ICU nurses who had undergone Bundle of Care education or training and were performing bundle interventions for patients with medical devices such as endotracheal tubes, indwelling urinary catheters, central-line catheters, and surgical devices. Non-probability purposive sampling was used to select nurses from the four ICUs who met these study conditions.

Research Instrument

The researcher adopted and modified a structured questionnaire based on Institute for Healthcare Improvement materials. Part I gathered participant profile information. Part II consisted of 40 true-or-false items, with 10 items for each of the VAP, CAUTI, SSI, and CLABSI bundles. Part III measured extent of practice using a five-point scale from never (1) to always (5). The instrument was reviewed and validated by experts from nursing administration, infectious disease/infection control, academe, and statistics; their recommendations were incorporated before administration. For knowledge, a transmuted score of 80% was used as the cut-off for a high level, while practice ratings followed the study's five-point interpretation ranges.

Data Gathering Procedure

A formal request endorsed by the thesis adviser was submitted to the hospital's Medical and Nursing Directors. After approval, the researcher presented the consent form to eligible participants and personally distributed the questionnaires. Clarifications were provided when needed, and each accomplished questionnaire was sealed in an envelope by the consenting participant before collection.

Data Analysis

Frequency and percentage were used to summarize participant characteristics. McDonald's Percent Score was used for the knowledge assessment, and weighted mean was used for extent of practice. Pearson's product-moment correlation and chi-square tests were used to examine relationships among participant profile variables, knowledge, and practice. Hypotheses were tested at the 0.05 level of significance.

Ethical Consideration

The study observed ethics and confidentiality throughout data collection. Institutional permission was obtained before recruitment, and participants received an approved consent form before answering the questionnaire. The researcher maintained confidentiality in handling responses, and completed instruments were sealed by participants to reduce unauthorized access to individual answers.

RESULTS AND DISCUSSION

Participant characteristics

The 30 participants were all Bachelor of Science in Nursing graduates. Most were 20–30 years old (70%), female (67%), and had one to five years of hospital experience (67%). Medical ICU nurses constituted the largest clinical-area group (36.67%), followed by Surgical ICU (26.67%), Pediatric ICU (20.00%), and Neonatal ICU (16.67%). Regarding prior education, 90% had completed an Infection Control Basic Course, 53% reported nursing orientation that included bundle content, and 30% had undertaken comprehensive Bundle of Care training. The profile shows a predominantly early-career ICU nursing workforce with broad exposure to infection-control education but more limited participation in comprehensive bundle training.

Table 1. *Profile of Participants*

Profile characteristic	f	%
Age: 20–30 years	21	70.0
Age: 31–40 years	6	20.0
Age: 41–50 years	2	7.0
Age: 51–60 years	1	3.0
Male	10	33.0
Female	20	67.0
Medical ICU	11	36.67
Surgical ICU	8	26.67
Neonatal ICU	5	16.67
Pediatric ICU	6	20.00
Hospital experience: 1–5 years	20	67.0
Hospital experience: 6–10 years	8	27.0
Hospital experience: 11–15 years	2	6.0
BSN	30	100.0
Nursing orientation	16	53.0
Infection Control Basic Course	27	90.0
Comprehensive Bundle of Care training	9	30.0

Level of knowledge and extent of practice

Overall knowledge of the four HAI bundles was moderate, with a grand mean knowledge score of 73%. SSI obtained the highest knowledge score (79%), followed by VAP (78%) and CAUTI (71%), while CLABSI was the only domain classified as low (64%). The 73% grand mean was below the thesis cut-off of 80%, demonstrating a meaningful knowledge gap despite prior exposure to infection-control instruction. This finding supports the thesis rationale that education should be periodically reinforced and linked to competency assessment rather than inferred from prior course attendance alone (Jansson, 2014).

Practice ratings were substantially higher than knowledge scores. CAUTI (4.73) and VAP (4.71) were rated at the fullest extent, whereas CLABSI (4.41) and SSI (4.15) were rated at the full extent. The grand mean was 4.50. The coexistence of moderate knowledge with strong self-reported practice indicates that routine performance of bundle activities did not eliminate conceptual gaps. The lower CLABSI knowledge score is especially important because central-line care requires multiple coordinated steps—hand hygiene, maximal barriers, antisepsis, site selection, and daily necessity review—whose reliable execution depends on both procedural resources and understanding of the rationale for each component (IHI, 2012b; Sax et al., 2007).

Table 2. *Summary of Knowledge and Practice Across HAI Bundle Domains*

Bundle	Knowledge score	Knowledge interpretation	Practice means	Practice interpretation
VAP	78%	Moderate	4.71	Fullest Extent
CAUTI	71%	Moderate	4.73	Fullest Extent
SSI	79%	Moderate	4.15	Full Extent
CLABSI	64%	Low	4.41	Full Extent
Overall	73%	Moderate	4.50	High overall

Relationships of participant profile with knowledge and practice

Age and years of hospital experience were significantly related to knowledge. Age showed a low correlation ($r = .20$; computed $t = 2.96$), while years of experience also showed a low correlation ($r = .33$; computed $t = 2.253$). Training attendance, despite a moderate correlation coefficient ($r = .41$), did not reach significance using the study's computed test statistic. Gender and clinical area were also not significantly related to knowledge. The pattern is consistent with the thesis emphasis on accumulated clinical exposure as a contributor to competence, while also showing that attendance at prior training, by itself, did not distinguish knowledge scores in this sample (McHugh, 2011).

A similar pattern was reported for extent of practice. Age ($r = .020$; computed $t = 2.18$) and years of experience ($r = .253$; computed $t = 2.10$) were classified as significant in the study, whereas training attendance, gender, and clinical area were not. Because all participants were BSN graduates, educational attainment did not vary within the sample. These results support the need for a standardized competency system available to nurses across units and demographic groups rather than assuming that prior orientation or clinical assignment guarantees equivalent knowledge and practice.

Table 3. *Relationships of Participant Profile with Knowledge and Practice*

Outcome	Profile variable	Reported statistic	Interpretation
Knowledge	Age	$r = .20$; $t = 2.96$	Significant
Knowledge	Years of experience	$r = .33$; $t = 2.253$	Significant
Knowledge	Training attended	$r = .41$; $t = 1.06$	Not significant
Knowledge	Gender	$\chi^2 = .04$	Not significant
Knowledge	Clinical area	$\chi^2 = 1.10$	Not significant
Practice	Age	$r = .020$; $t = 2.18$	Significant
Practice	Years of experience	$r = .253$; $t = 2.10$	Significant
Practice	Training attended	$r = -.30$; $t = 2.00$	Not significant
Practice	Gender	$\chi^2 = .90$	Not significant
Practice	Clinical area	$\chi^2 = 4.71$	Not significant

Relationship between knowledge and practice

Domain-level correlations showed that knowledge and practice were related for most bundle areas, but not uniformly. VAP demonstrated a moderately high significant correlation ($r = .623$), SSI a moderately high significant correlation ($r = .67$), and CLABSI a moderate significant correlation ($r = .425$). CAUTI showed a low correlation ($r = .37$) that was not significant under the thesis decision rule. These findings refine the broader conclusion that knowledge and practice are interdependent: the relationship was evident in three of the four bundle domains, while CAUTI practice appeared less dependent on measured knowledge. This domain-specific pattern reinforces the value of combining written knowledge assessment with observed clinical performance rather than treating either measure as a complete proxy for competency.

Table 4. *Correlation Between Knowledge and Extent of Practice*

Bundle	r	Degree of correlation	Interpretation
VAP	.623	Moderately high	Significant
CAUTI	.370	Low	Not significant
SSI	.670	Moderately high	Significant
CLABSI	.425	Moderate	Significant

Proposed HAI Bundle of Care Competency Program

The study proposed a structured Healthcare-Associated Infections' Bundle of Care Competency Program for current and prospective ICU nurses. The program was designed as a two-day intervention combining lecture, case discussion, demonstration, teamwork activities, a written examination, and simultaneous return demonstration. Content covered the definition and burden of HAIs and the evidence-based components of VAP, CAUTI, SSI, and CLABSI bundles. A 90% passing standard was specified for competency certification, with unsuccessful participants directed to repeat the program. The thesis further proposed implementation twice yearly and integration into the hospital's work plan and budget.

The program directly responds to the observed profile of moderate knowledge and high but uneven practice. It prioritizes skill areas identified in the source results and aligns knowledge testing with actual demonstrations of hand hygiene, personal protective equipment, antisepsis, appropriate hair removal, glucose monitoring, bed elevation, sedation assessment, oral care, aseptic catheter technique, closed urinary drainage, and bundle documentation. This approach reflects the thesis premise that ICU competency requires both evidence comprehension and consistent performance, supported by periodic audit and feedback (IHI, 2012a, 2012b, 2012c; Royal College of Nursing, 2005).

Table 5. *Core Elements of the Proposed Competency Program*

Component	Focus	Implementation
Knowledge update	HAI definitions, burden, and VAP/CAUTI/SSI/CLABSI components and rationale	Lecture, case scenario, group discussion, written test
Skills enhancement	Bundle-specific nursing procedures and documentation	Demonstration, video, interactive discussion
Competency validation	Return demonstration of the four bundles	Simultaneous return demonstration; 90% passing standard
Implementation and monitoring	Current and prospective ICU nurses; proposed twice yearly	Institutional work plan and budget; quarterly bundle audit

CONCLUSION

The study demonstrated a clear competency-development need among ICU nurses in the selected tertiary hospital. Although the nurses reported strong implementation of HAI bundle practices, their overall knowledge remained moderate, with the greatest deficit in CLABSI. Age and hospital experience were associated with both knowledge and practice, whereas gender, clinical area, and prior training attendance were not. Knowledge and

practice were significantly related in the VAP, SSI, and CLABSI domains but not in CAUTI, indicating that the knowledge-practice relationship was domain-specific rather than uniform. Taken together, the findings show that routine exposure to bundle procedures and prior infection-control education were insufficient grounds for assuming comprehensive competency. A structured program that integrates evidence review, skill demonstration, assessment, and feedback provides a direct response to the measured gaps and offers a practical mechanism for strengthening infection-prevention practice and patient safety in intensive care.

Recommendation

The hospital should institutionalize the proposed Healthcare-Associated Infections' Bundle of Care Competency Program for current and incoming ICU nurses and incorporate it into the annual work plan, budget, and competency goals. Priority should be given to CLABSI knowledge and to bundle components in which practice was less consistently rated. Quarterly audits of bundle compliance should be conducted and the findings fed back to ICU staff and the Infection Prevention and Control Committee to guide corrective actions and refresher education. Competency validation should include both written knowledge testing and observed return demonstration, with remediation for nurses who do not meet the prescribed standard. Future studies may replicate the research in public or specialized hospitals, include larger samples, and extend the assessment to ward-based nurses to determine whether the observed knowledge-practice patterns are consistent across healthcare settings.

References

- Benner, P. (1984). *From novice to expert: Excellence and power in clinical nursing practice*. Addison-Wesley.
- Breithaupt, T. (2010). Postoperative glycemic control in cardiac surgery patients. *Baylor University Medical Center Proceedings*, 23(1), 79–82.
- Diaz, M. (2010). Thermoregulation: Physiological and clinical considerations during sedation and general anesthesia. *Anesthesia Progress*, 57(1), 25–33.
- Eddin, L. (2016). Oral care competency and practices among critical care nurses for mechanically ventilated patients. *Journal of the Saudi Heart Association*. <https://doi.org/10.1016/j.jsha.2016.04.007>
- Gilbert, R. (2006). Obtaining a catheter specimen of urine. *Nursing Times*, 102(19), 22–23.
- Gould, C. (2010). *Catheter-associated urinary tract infection toolkit: Collaborative prevention*. Centers for Disease Control and Prevention. https://www.cdc.gov/hai/pdfs/toolkits/cautitoolkit_3_10.pdf
- Horan, T. C., Andrus, M., & Dudeck, M. A. (2008). CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting. *American Journal of Infection Control*, 36(5), 309–332.
- Institute for Healthcare Improvement. (2012a). *Prevent catheter-associated urinary tract infection: How-to guide* (2nd ed.).
- Institute for Healthcare Improvement. (2012b). *Prevent central line-associated bloodstream infection: How-to guide* (2nd ed.).
- Institute for Healthcare Improvement. (2012c). *Prevent surgical site infection: How-to guide* (2nd ed.).
- Jansson, M. (2014). *The effectiveness of education on critical care nurses' knowledge and skills in adhering to guidelines to prevent ventilator-associated pneumonia* [Academic dissertation].
- Klompas, M. (2013). Complications of mechanical ventilation—The CDC's new surveillance paradigm. *New England Journal of Medicine*, 368, 1472–1475.
- McHugh, M. D. (2011). Understanding clinical expertise: Nurse education, experience, and the hospital context. *Research in Nursing & Health*, 33(4), 276–287.
- Philippine Hospital Infection Control Society. (2013). *Bundle of care for ventilator-associated pneumonia, surgical site infection, and central line infection control competency course manual*.
- Professional Regulation Commission–Board of Nursing. (2009). *National competency standards for Filipino nurses*.
- Pronovost, P., Needham, D., Berenholtz, S., Sinopoli, D., Chu, H., Cosgrove, S., Sexton, B., Hyzy, R., Welsh, R., Roth, G., Bander, J., Kepros, J., & Goeschel, C. (2006). An intervention to decrease catheter-related bloodstream infections in the ICU. *New England Journal of Medicine*, 355(26), 2725–2732. <https://doi.org/10.1056/NEJMoa061115>
- Reichman, D. E. (2009). Reducing surgical site infections: A review. *Obstetrics and Gynecology*, 2(4), 212–221.

- Resar, R., Pronovost, P., Haraden, C., Simmonds, T., Rainey, T., & Nolan, T. (2005). Using a bundle approach to improve ventilator care processes and reduce ventilator-associated pneumonia. *Joint Commission Journal on Quality and Patient Safety*, 31(5), 243–248. [https://doi.org/10.1016/S1553-7250\(05\)31031-2](https://doi.org/10.1016/S1553-7250(05)31031-2)
- Royal College of Nursing. (2005). *Knowledge and skills framework*.
https://www2.rcn.org.uk/data/assets/pdf_file/0007/78667/002775.pdf
- Sax, H., Allegranzi, B., Uçkay, I., Larson, E., Boyce, J., & Pittet, D. (2007). My five moments for hand hygiene: A user-centred design approach to understand, train, monitor and report hand hygiene. *Journal of Hospital Infection*, 67(1), 9–21. <https://doi.org/10.1016/j.jhin.2007.06.004>
- Sessler, C. N., Gosnell, M. S., Grap, M. J., Brophy, G. M., O’Neal, P. V., Keane, K. A., Tesoro, E. P., & Elswick, R. K. (2002). The Richmond Agitation-Sedation Scale: Validity and reliability in adult intensive care unit patients. *American Journal of Respiratory and Critical Care Medicine*, 166(10), 1338–1344. <https://doi.org/10.1164/rccm.2107138>