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Authoritative, evidence-based summaries for the critical care clinician

SPECIAL FEATURE

Integrating Nurse Practitioners into the Critical Care Team

By Leslie A. Hoffman, RN, PhD and Jane Guttendorf, RN, DNP, CRNP

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Dr. Guttendorf reports no financial relationships relevant to this field of study.

INTRODUCTION

Nurse practitioners (NP) have been involved in the care of critically ill patients since the late 1980s.[1] Today, multiple universities and colleges offer NP preparation with specialization in a variety of areas. Acute Care Nurse Practitioners (ACNP), prepared to manage care in acute and critical care settings, were the fifth most common specialty in the United States in 2009, representing about 5% of the estimated 135,000 practicing NPs.[2] ACNPs practice as members of hospitalist teams and specialty teams such as those in critical care, trauma, organ transplantation, and emergency departments. Surveys indicate that almost half (40%) practice in critical care.[2] More than half of adult ICUs in academic teaching institutions in the United States currently employ NPs.[1]

Nurses prepared in advanced practice roles include certified nurse practitioners (CNP), clinical nurse specialists (CNS), certified registered nurse anesthetists (CRNA), and certified nurse midwives (CNM). In 2008, a nationwide effort was undertaken to define their scope of practice and set requirements for education, accreditation, licensure, and certification to ensure greater consistency in education and practice.[3] This effort resulted in the *Consensus Model for Advanced Practice Registered Nurse Regulation*.[4] Under this model, advanced practice nurses must be educated, certified, and licensed to practice in one of four roles (CNP, CNS, CRNA, CNM), and education must be targeted to one of six populations: family/individual across the life span, adult-gerontology, pediatrics, neonatal, women's health/gender-related health, and

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psychiatric/mental health. The goal was to focus preparation on patient care needs rather than the practice site.[3,4] This change resulted in restructuring education for adult ACNPs to include gerontology and changes in the certification examination. The American Nurses Credentialing Center, the primary credentialing body for NPs, currently offers Adult-Gerontology ACNP certification and will retire the current ACNP examination in December 2014.[5]

The goal for implementing the Consensus Model is 2015. In 2012, 14 states had enacted or had pending legislation related to these changes.[3] Once the model is fully enacted, NPs seeking licensure will need to have educational preparation and certification congruent with licensure and will seek employment in an area consistent with their licensure, certification, educational specialty, and population focus. This requirement differs from current practice, which does not mandate that NPs practice only in an area consistent with their specialty preparation. What happens to currently practicing NPs depends on state regulations. If a state enacts a grandfathering clause, NPs who are currently practicing will be able to continue practicing in the state where they are licensed. However, they may need to meet specific additional criteria if attempting to seek licensure in another state or do not have preparation consistent with their specialty area.

THE ACNP IN CRITICAL CARE

Growth in ACNPs practicing in critical care settings has been attributed to several factors. In academic settings, physicians-in-training historically provided a substantial portion of direct patient care. This changed with restrictions placed on resident physician duty hours by the Accreditation Council on Graduate Medical Education. The volume of patients admitted to critical care units has continued to increase and 24/7 coverage by board-certified intensivists has been advocated by organizations such as the Leapfrog Group, further stretching available resources.[6] To meet these challenges, several practice changes resulted, including increased hiring of NPs and physician assistants (PAs).[7-9]

Several studies have examined outcomes of care provided by NPs in acute/critical care settings and perspectives of those involved in these teams. With a consistent presence in the ICU, ACNPs quickly become well versed in managing patient care responsibilities. However, it is advisable to provide a detailed orientation and more time and supervision initially. As noted by Gershengorn and colleagues, ACNPs and PAs who practice in ICUs are typically employed in this setting because it is their chosen practice site and are, therefore, more likely to be engaged in learning about ways to perfect their practice, compared to rotating housestaff whose primary interests may be elsewhere.[1] As consistent ICU care providers, ACNPs may have a higher risk of burnout, compared to those who rotate on and off service, making it necessary to monitor for this consequence.[1] Several studies evaluating ACNP practice in various settings support that outcomes of care are equivalent to comparative physician groups in a variety of critical care settings, including subacute medical ICU, coronary care unit, cardiovascular thoracic ICU, medical ICU, and other venues, e.g., trauma and neuroscience teams, and rapid response teams.[10-16]

PRACTICE MODELS INCORPORATING THE ACNP

The addition of ACNPs to intensivist-led ICU teams has the potential to increase the number of ICU patients each intensivist can effectively manage by off-loading some of the routine care and practice to the ACNP. There are a variety of models in which ACNPs can be incorporated into the critical care service team as noted below.

• Smaller ICUs, particularly those in community hospital settings, may benefit by the addition of one or two ACNP positions. Intensivists typically have responsibilities that require attention outside the ICU. The ACNP can practice in the ICU in a collaborative relationship with the critical care team. With this model, minute-to-minute changes in patient condition can be assessed immediately and changes can be made to pharmacologic and treatment pathways. The ACNP assumes primary responsibility for safety and quality metrics applicable to the ICU population, assures compliance with practice guidelines, and works collaboratively with nursing and other ancillary teams to address patient throughput, minimize ICU length of stay, and maximize care and services, e.g., pharmacy services, physical therapy, mobility, nutrition support, discharge planning, follow-up with consultant services.

• In a tertiary care setting, one or more ACNPs can provide similar benefits if assigned to specialty ICU populations or teams such as trauma, coronary care, cardiothoracic surgery, transplant, neuroscience, or medical/surgical ICUs. Familiarity with patient problems, the team of service providers, and practice guidelines ensures that best practices are applied early and with consistency. The ACNP provides continuity when intensivists, fellows, and residents rotate on and off service — a particular benefit to "long-stay" patients whose diagnostic and management challenges and family support may not be known to the new team. The ACNP can also play a pivotal role in educating rotating team members about protocols for care of specialty populations.

• More extensive models are used in academic settings. At Vanderbilt, NP practice teams are formally integrated with medical house staff teams to provide 24/7 NP coverage with 39 NPs across five ICUs.[17] Memorial Sloan-Kettering Cancer Center uses an NP staffing model wherein a 20-bed medical-surgical ICU is staffed 24/7 by a team of 23 NPs and additional medical house staff. Thus, NPs may function collaboratively with resident physicians on a house staff/NP team or independently on an NP-only team.[18] The University of Pittsburgh Medical Center critical care model includes advanced practice providers (NPs and PAs), critical care fellows, resident physicians, and intensivists working collaboratively to meet needs across a number of surgical ICUs using different staffing models depending on the individual unit requirements.

SCOPE OF PRACTICE, CREDENTIALING, AND PRIVILEGING FOR PROCEDURES

The ACNP can perform the admission history and physical assessment; review medical records, labs, radiographic data, and pharmacologic interventions; develop a differential diagnosis; develop a plan of care; and present patients on formal rounds. In addition, the ACNP can manage the full range of problems encountered in the care of the acutely and chronically critically ill patient, including airway and ventilator management, fluid resuscitation, institution and titration of vasopressors, inotropes and antiarrhythmic therapies, and management of delirium, pain and sedation, and instituting continuous renal replacement therapies, and nutritional support. Other roles may involve initiation of antimicrobial therapies and management of common problems due to neurologic, cardiovascular, pulmonary, renal, or hepatic dysfunction.

Specialty procedures performed by ACNPs include, among others, endotracheal intubation and insertion of arterial lines, central venous catheters and pulmonary artery catheters, thoracostomy tubes and chest tubes, and removal of these. ACNPs may also be credentialed to perform lumbar puncture, bone marrow biopsy, paracentesis, joint aspiration, cardioversion, defibrillation, suturing, and wound care.[2] The ACNP will need to be credentialed and privileged by the institution through the same (or similar) procedure as medical staff to perform invasive procedures. The requested privileges should be consistent with the practitioner's education and licensure and should be in compliance with Joint Commission Standards.[19] Credentialing usually initially involves direct supervision by another provider credentialed to perform that procedure and documentation of a specified minimum number of successful procedures prior to granting full privileges. To maintain credentialing for specialty procedures, a procedure log documenting the number of procedures performed to meet established thresholds is required.[19,20]

REIMBURSEMENT AND BILLING

Since 1997, NPs and PAs have been able to obtain individual provider numbers and submit bills to Medicare Part B for evaluation and management services.[21] NPs must first meet specified training and certification requirements and maintain a collaborative practice arrangement with a physician, as well as meet state-specific regulations governing their scope of practice. The complexities of critical care billing for non-physician providers have been detailed in prior publications.[21] Various approaches have been used, including allowing ACNPs to submit billing for critical care time or for evaluation and management services or billing only through physician providers.

CONCLUSION

The ACNP can be a valuable asset to the critical care team in providing the spectrum of services needed by acutely and critically ill patients. The ACNP provides a constant presence in the ICU, which can promote greater continuity of care. Those who have incorporated NPs and PAs into physician practices tend to uniformly value this collaboration, and studies evaluating practice have shown similar outcomes. Given the escalating need for critical care services, aging of the population, and demands placed on intensivists to meet these challenges, it is likely that integration of ACNPs into critical care teams will continue and likely increase in the future. ■

REFERENCES

1. Gershengorn HB, et al. The use of nonphysician providers in adult intensive care units. *Am J Respir Crit Care Med* 2012;185:600-605.
2. Kleinpell R, Goolsby MJ. American Academy of Nurse Practitioners National Nurse Practitioner sample survey: Focus on acute care. *J Am Acad Nurse Pract* 2012;24:690-694.
3. Kleinpell RM, Hudspeth RS. Advanced practice nursing scope of practice for hospitals, acute care/critical care, and ambulatory care settings: A primer for clinicians, executives, and preceptors. *AACN Adv Crit Care* 2013;24:23-29.
4. APRN Consensus Work Group and National Council of State Boards of Nursing. Consensus Model for APRN Regulation: Licensure, Accreditation, Certification & Education, July 7, 2008. https://www.ncsbn.org/Consensus_Model_for_APRN_Regulation_July_2008.pdf. Accessed on January 21, 2014.
5. American Nurses Credentialing Center. http://www.nursecredentialing.org/. Accessed on January 21, 2014.
6. Milstein A, et al. Improving the safety of health care: The Leapfrog Initiative. *Eff Clin Pract* 2000;3:313-316.
7. Howie-Esquivel J, Fontaine DK. The evolving role of the acute care nurse practitioner in critical care. *Curr Opin Crit Care* 2006;12:609-613.
8. Lundberg S, et al. Attaining resident duty hours compliance: The acute care nurse practitioners program at Olive View-UCLA Medical Center. *Acad Med* 2006;81:1021-1025.
9. Pastores SM, et al. The Accreditation Council for Graduate Medical Education resident duty hour new standards: History, changes and impact on staffing of intensive care units. *Crit Care Med* 2011;39:2540-2549.
10. Kleinpell RM, et al. Nurse practitioners and physician assistants in the intensive care unit: An evidence-based review. *Crit Care Med* 2008;36:2888-2897.
11. Hoffman LA, et al. Outcomes of care managed by an acute care nurse practitioner/attending physician team in a subacute medical intensive care unit. *Am J Crit Care* 2005;14:121-132.
12. Gershengorn HB, et al. Impact of nonphysician staffing on outcomes in a medical ICU. *Chest* 2011;139:1347-1353.
13. Spisso J, et al. Improved quality of care and reduction of housestaff workload using trauma nurse practitioners. *J Trauma* 1990;30:660-665.
14. Gillard JN, et al. Utilization of PAs and NPs at a level I trauma center: Effects on outcomes. *JAAPA* 2011;24:34-43.
15. Russell D, et al. Effect of an outcomes-managed approach to care of neuroscience patients by acute care nurse practitioners. *Am J Crit Care* 2002;11:353-364.
16. Scherr K, et al. Evaluating a new rapid response team: NP-led versus intensivist-led comparisons. *AACN Adv Crit Care* 2012;23:32-42.
17. Kapu AN, et al. NPs in the ICU, the Vanderbilt initiative. *Nurse Pract* 2012;37:46-52.
18. D'Agostino R, et al. The NP staffing model in the ICU at Memorial Sloan-Kettering Cancer Center. In: Kleinpell RM, et al, eds. *Integrating Nurse Practitioners & Physician Assistants into the ICU*. Mount Prospect, IL: Society of Critical Care Medicine; 2012, pp. 18-25.
19. Ackerman M, et al. Credentialing and privileging for nurse practitioners and physician assistants. In: Kleinpell RM, et al, eds. *Integrating Nurse Practitioners & Physician Assistants into the ICU*. Mount Prospect, IL: Society of Critical Care Medicine; 2012, pp. 66-71.
20. Magdic KS, et al. Credentialing for nurse practitioners: An update. *AACN Clin Issues* 2005;16:16-22.
21. Boyle WA, et al. Billing, reimbursement, and productivity for nonphysician practitioners in the ICU. In: Kleinpell RM, et al, eds. *Integrating Nurse Practitioners & Physician Assistants into the ICU*. Mount Prospect, IL: Society of Critical Care Medicine; 2012, pp. 28-45.

ABSTRACT & COMMENTARY

Efficacy of Continuous EEG Monitoring in Critical Care Units

By Elayna Rubens, MD

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Dr. Rubens reports no financial relationships relevant to this field of study.

***This article originally appeared in the February issue of* Neurology Alert.**

SYNOPSIS: Utilization of continuous EEG monitoring in mechanically ventilated patients in the ICU was associated with a reduction in hospital mortality without sigificantly affecting hospital costs or length of stay.

SOURCE: Ney JP, et al. Continuous and routine EEG in intensive care. *Neurology* 2013;81:2002-2008.

As the technology for obtaining, storing, and reviewing digital EEG has expanded over the last 10 years, so has the utilization of continuous electrocencephalography monitoring (cEEG). In the ICU setting, cEEG has become an important tool in the diagnosis and management of non-convulsive seizures, status epilepticus, and other changes in cerebral function such as ischemia. With its increased utilization, controversy has emerged about the cost effectiveness of cEEG and its overall impact on patient outcome. In this study, Ney et al examined the effect of cEEG monitoring in critically ill patients on inpatient mortality, length of stay, and hospital charges.

This is a retrospective, cross-sectional study conducted using data from the Nationwide Inpatient Sample (NIS), the largest all-payer inpatient database containing clinical and demographic information from approximately 20% of all discharges from non-federal U.S. hospitals. All patients who underwent mechanical ventilation and EEG (either cEEG or routine EEG) between 2005-2009 were included in the study. In-hospital mortality was the primary outcome measure, while length of stay and hospitalization charges were secondary outcomes. The group undergoing cEEG was compared to the group that had routine EEG alone for all outcome measures. Multivariate regression analysis included comorbidities, demographics, and hospital variables. In addition, separate subgroup analysis was performed on groups of patients with epilepsy/seizure diagnosis, neurologic diagnosis, or EEG performed on the day of discharge.

A total of 40,945 inpatient discharges were included in the analysis. Of these, 5949 underwent cEEG monitoring and 34,996 underwent routine EEG only. The group undergoing cEEG was significantly younger, less likely to have Medicare, and more likely to have a neurologic or epilepsy diagnosis. Hospitals performing cEEG were more likely to be larger, academic centers. The use of cEEG increased dramatically from 2005 to 2009 (by 263%). Inpatient mortality in ventilated patients receiving cEEG was significantly reduced when compared to patients undergoing routine EEG only (25% vs 39%; odds ratio [OR], 0.54) even when adjusting for demographics, hospital characteristics, and comorbidities (OR, 0.63; $P < 0.001$). Total hospital charges and length of stay tended to be increased in the cEEG group compared to the routine EEG group, but were not significantly different. Subgroup analysis of patients with neurologic/epilepsy diagnosis revealed that these diagnoses were more common in the cEEG group and were positively associated with survival. Routine EEG performed on the day of discharge was highly associated with mortality, since EEG is used to confirm brain death in some hospitals. When any of these subgroups was used as a covariate in the analysis, or excluded from the multivariate regression calculations, there was no change in the association between cEEG and inpatient mortality.

The authors concluded that cEEG monitoring in ICU patients is associated with improved patient survival compared to routine EEG alone. They propose that the survival benefit stems from the ability to detect and, therefore, treat brain dysfunction more accurately and responsively with cEEG monitoring. In addition, the study found no significant increase in hospitalization cost or length of stay in those patients undergoing cEEG monitoring. Together, these results support the use of cEEG monitoring in the ICU setting as a clinically valuable and potentially cost-effective tool.

■ COMMENTARY

Previous research on cEEG monitoring in critically ill patients has focused on the diagnostic value of cEEG monitoring and its role in modifying ICU management and clinical decision-making. Such research has demonstrated that the diagnostic effectiveness of cEEG monitoring in critically ill patients exceeds that of routine EEG. It is now well established that utilizing cEEG monitoring in the ICU leads to change in management in a significant number of patients. The current study is an important contribution to the cEEG literature, as it takes the impact of cEEG a step further: patient outcome. By demonstrating an association of cEEG with improved survival in a large cohort of patients, the authors are able to provide further justification for cEEG monitoring and its implicit resource utilization among critically ill patients.

The study's design as a retrospective study allowed the researchers to obtain a large enough sample size to test outcome-based hypotheses. The limitations of the design, however, are that the results cannot be used to infer causation. There may be a number of alternative explanations (differences between comparison groups, improvement in ICU care concurrent with cEEG utilization, etc.) for the association of cEEG with improved survival, only some of which can be adequately adjusted for in the data analysis. Further prospective studies of cEEG in critically ill patients are needed to confirm the survival benefits and cost effectiveness of cEEG monitoring.

■ EDITOR'S COMMENTARY
DAVID J. PIERSON, MD

The authors' examination of data from the 2005-2009 Nationwide Inpatient Sample showed that mechanically ventilated patients who received cEEG monitoring had 36% lower in-hospital mortality compared to those who received routine EEGs only (25% vs 39%; OR, 0.54; 95% confidence interval [CI], 0.45-0.64; $P < 0.001$). After adjustments for patient demographics, hospital characteristics, comorbidities, and other factors by multivariate regression, the association persisted, with an OR of 0.63 (95% CI, 0.52-0.76; $P < 0.001$). Ney et al posit that the survival benefit may result from the ability to detect and treat brain dysfunction more accurately and responsively with cEEG monitoring. This is plausible, but the magnitude of the observed effect on survival is *enormous*: consider the effect sizes produced by other major breakthroughs in critical care during the last 20 years. I think the authors' statement that "our analysis has important implications for clinical care and health care policy" warrants clarification.

The subspecialty of neurocritical care is one of the newest in our field, its professional society and dedicated journal having been founded only in 2002 and 2004, respectively, and the first neurocritical care certifications having been issued in 2007. The period covered by the data in the present study was one of rapid increases in the numbers of neuro-ICUs, specialist physicians and nurses, guidelines for management of neurological critical illness, and other aspects of management — along with documentation of improved patient outcomes in several conditions. It was a time of dramatic advances in the care of patients with neurological injury, including as the authors point out a huge, steady increase in cEEG usage. A great deal was changing in addition to how patients were being monitored. This context presents a formidable challenge in any attempt to account for all potential confounders affecting an observed difference between retrospectively identified patient groups.

Thus, while the findings of this study are heartening, as with other retrospective, observational studies they can more confidently be used for hypothesis generation than for statements about causation. Ney et al acknowledge this, concluding that, "if confirmed in well-designed, prospective clinical studies, would indicate that the use of this emerging technology should be encouraged by health policymakers." ■

ABSTRACT & COMMENTARY

An Evidence-Based Extubation Bundle Improved Care Outcomes in Mechanically Ventilated Brain-Injured Patients

By Leslie A. Hoffman, RN, PhD

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SYNOPSIS: Implementation of an evidence-based extubation-readiness bundle was associated with a decrease in mechanical ventilation days and pneumonia in brain-injured patients.

SOURCE: Roquilly A, et al. Implementation of an evidence-based extubation readiness bundle in 499 brain-injured patients. A before-after evaluation of a quality improvement project. *Am J Respir Crit Care Med* 2013;188:958-966.

Brain injury is a frequent cause of prolonged mechanical ventilation. The authors hypothesized that use of a systematic management protocol, termed an extubation-readiness bundle, could reduce the duration of mechanical ventilation for brain-injured patients. Patients were required to have: 1) evidence of acute neurological injury, e.g., extradural hematoma, subarachnoid hemorrhage, brain contusion, brain edema, skull fracture, stroke, or abscess, 2) require mechanical ventilation for > 24 hours, and 3) Glasgow Coma Score of ≤ 12. Patients were excluded if there was a decision to limit care within 24 hours of ICU admission or if they died within 24 hours of admission. The study used a before-after design. The control phase included all patients (n = 299) admitted to the two study ICUs over a 3-year period. The intervention was then introduced over a 12-month period (no data collected). The intervention phase included all patients (n = 200) who met entry criteria during the following 22-month period. The bundle included four components: 1) lung protective ventilation (tidal volume 6-8 mL/kg of ideal body weight; PEEP > 3 cm H_20; respiratory rate set to achieve normocapnia or moderate hypocapnia), 2) early enteral nutrition (Day 1), 3) optimized antibiotic therapy (predefined criteria), and 4) a systematic approach to extubation. Sedation management was not included in the bundle because it was already standardized.

Patients enrolled in the bundle experienced fewer days of mechanical ventilation (12.6 ± 10.3) compared to control (14.9 ± 11.7 days; $P = 0.02$). At day 28 and day 90, the intervention group also experienced more ventilator-free days ($P = 0.01$), with no difference in mortality in the ICU ($P = 0.51$) or at day 90 ($P = 0.22$). The rate of hospital-acquired pneumonia declined from 57.5% in the control phase to 47.5% in the intervention phase ($P = 0.03$). There was a nonsignificant increase in reintubation for intervention vs control patients (13.8% vs 9%; $P = 0.11$). Unplanned extubation decreased from 9.4% (control) to 4.5% (intervention) ($P < 0.01$).

■ COMMENTARY

Commonly, patients with an acute brain injury are explicitly excluded from clinical trials. Therefore, guidance regarding weaning from mechanical ventilation is limited. This is concerning, as brain injury is a frequent cause of prolonged mechanical ventilation. The protocol tested in this study consisted of four components: lung protective ventilation, early enteral nutrition, protocolized antibiotic therapy, and a standardized extubation protocol. Lung protective ventilation was included based on two rationales: lung compliance of brain-injured patients is frequently not altered and hypercapnia can be easily prevented by increasing respiratory rate instead of increasing tidal volume. Early enteral nutrition was included because a prior study, conducted by the authors, suggested early enteral nutrition was a protective factor in regard to the risk of hospital-acquired pneumonia. International guidelines, adapted to local epidemiology, were used to guide antibiotic therapy. Criteria used to indicate extubation readiness included tolerance of inspiratory support < 10 cm H_2O or spontaneous breathing and FIO_2 ≤ 40% for ≥ 30 minutes. Tube removal occurred if the Glasgow Coma Score was ≥ 10 and the patient had a cough that was spontaneous or caused. Full awakening was not required. These criteria were selected based on findings from prior studies that suggested a low risk of extubation failure when the Glasgow Coma Score was between 8 and 10, provided patients can cough.

Using these criteria, 13.8% of patients required reintubation in the intervention phase, a percentage slightly higher than goal (≤ 10% in neurological patients). However, there were significantly fewer unplanned extubations. As with all before-after studies, the study design prevents attributing causality to positive outcomes. Notably, the authors included several statistical procedures designed to exclude the possibility that extraneous factors caused their results in their analytic strategy. These included a time series analysis to rule out changes due to improvements in patient care and two sensitivity analyses designed to balance covariates in the two phases and reduce bias. Future studies are needed to confirm findings. In the interim, study findings suggest ways to potentially speed weaning of this complex and challenging patient population. ■

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CME/CNE Questions

1. Types of Advanced Practice Registered Nurses include:

a. Certified Nurse Practitioners (CNP)
b. Clinical Nurse Specialists (CNS)
c. Certified Registered Nurse Anesthetists (CRNA)
d. Certified Nurse Midwives (CNM)
e. All of the above

2. In addition to education and accreditation, the *Consensus Model for Advanced Practice Registered Nurse Regulation* addresses what other aspects of practice/preparation?

a. Licensure in a specialty and population focus
b. Certification that is congruent with specialty and population focus
c. Credentialing and clinical privileges
d. Reimbursement and billing
e. Both a and b

3. In addition to performing assessment and management of acutely and critically ill patients, Acute Care Nurse Practitioners may:

a. meet certification requirements to bill for services.
b. prescribe pharmacologic and nonpharmacologic therapies.
c. develop differential diagnoses, and develop and implement a plan of care.
d. insert arterial lines and pulmonary artery catheters, if credentialed.
e. All of the above

4. In a recent study of cEEG in ICU patients, Ney et al reported all of the following *except*:

a. there was a significant increase in cEEG utilization over time.
b. cEEG monitoring was associated with a significantly longer length of stay when compared to routine EEG.
c. cEEG monitoring was associated with improved inpatient survival when compared to routine EEG.
d. cEEG monitoring was associated with younger patient age compared to routine EEG.

5. The four components of the extubation readiness bundle tested in brain injured patients included all of the following *except*:

a. lung protective ventilation.
b. early enteral nutrition.
c. antibiotic therapy based on institutional and international guidelines.
d. systematic approach to extubation.
e. protocolized sedation management.

6. In the study of a four-component extubation-readiness bundle in brain-injured patients, which of the following was *not* a statistically significant finding?

a. Fewer days of mechanical ventilation
b. More ventilator-free days as measured at days 28 and 90
c. Fewer instances of unplanned extubation
d. A decrease in reintubations
e. A decrease in hospital-acquired pneumonia

CME/CNE Objectives

Upon completion of this educational activity, participants should be able to:

- identify the particular clinical, legal, or scientific issues related to critical care;
- describe how those issues affect physicians, nurses, health care workers, hospitals, or the health care industry; and
- cite solutions to the problems associated with those issues.